Natura Impact Statement

Volume 4

Assessment of Implications for Special Areas of Conservation

codling wind park

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Abbreviations

Abbreviation	Term in Full
AA	Appropriate Assessment
CEMP	Construction Environmental Management Plan
CWP	Codling Wind Park
CWPL	Codling Wind Park Limited
DEB	Dynamic energy budget
EDR	Effective Deterrence Range
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EVMP	Ecological Vessel Management Plan
EU	European Union
FOS	Fred Olsen Seawind
INNS	Invasive non-native species
kV	Kilovolt
MMMP	Marine Mammal Mitigation Protocol
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Services
OECC	Offshore Export Cable Corridor
OTI	Onshore Transmission Infrastructure
OWF	Offshore Wind Farm
O&M	Operations and Maintenance
OMB	Operations and Maintenance Base
OSS	Offshore Substation Structure
PAM	Passive Acoustic Monitoring
SAC	Special Area of Conservation
SPA	Special Protection Area
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator
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.
Dublin Array Offshore Wind Farm (OWF) export cable crossing zone	A defined zone within the OECC within which the Dublin Array OWF export cables and the CWP Project export cables are anticipated to cross.
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.
high water mark (HWM)	The line of high water of ordinary or medium tides of the sea or tidal river or estuary.
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.
metocean	Meteorological and oceanographic data (for example metocean data or metocean conditions).
offshore development area	The total footprint of the offshore infrastructure and associated temporary works including the array site and the OECC.
offshore export cables	The cables which transport electricity generated by the WTGs from the offshore substations (OSSs) to the TJBs at the landfall.

Glossary	Meaning
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.
offshore substation structure (OSS)	A fixed structure located within the array site, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
offshore transmission infrastructure (OfTI)	The offshore transmission assets comprising the OSSs and offshore export cables. The EIAR considers both permanent and temporary works associated with the OfTI.
onshore export cables	The cables which transport electricity generated by the WTGs from the TJBs at the landfall to the onshore substation.
onshore development area	The entire footprint of the OTI and associated temporary works that will form the onshore boundary for the development consent application.
onshore transmission infrastructure (OTI)	The onshore transmission assets comprising the TJBs, onshore export cables and the onshore substation. The EIAR considers both permanent and temporary works associated with the OTI.
O&M phase	This is the period of time during which the CWP Project will be operated and maintained.
transition joint bay (TJB)	This is required as part of the OTI and is located at the landfall. It is an underground bay housing a joint which connects the offshore and onshore export cables.
wind turbine generator	All the components of a wind turbine, including the tower, nacelle and rotor.
zoI	Spatial extent of potential impacts resulting from the project.

1 INTRODUCTION

1. This volume of the NIS provides the scientific examination of the CWP Project on relevant European sites (Special Area of Conservation (SACs)), to identify and characterise any possible implications of the CWP Project on the integrity of European sites.

2. The NIS is laid out as follows:

- **Volume 1** contains the introduction to the CWP Project, document structure and a summary of the conclusions of the other volumes.
- **Volume 2** contains the introductory sections of the document, detailing the relevant legislation, assessment methodology and the project description.
- **Volume 3** provides the report to inform AA Screening.
- This document, **Volume 4** provides the scientific examination of the CWP Project on relevant European sites (Special Area of Conservation (SACs)), to identify and characterise any possible implications of the CWP Project on the integrity of European sites.
- **Volume 5 (Part 1 and Part 2)** provides the scientific examination of the CWP Project on relevant European sites (Special Protection Areas (SPAs)), to identify and characterise any possible implications of the CWP Project on the integrity of European sites.
- **Volume 6 (Part 1 and Part 2)** provides the scientific examination of the CWP Project and examines the in-combination impacts screened into the analysis of project-only assessment (Volume 4 and 5).
- **Volume 7** provides the appendices referred to throughout the respective individual Volumes.

3. This volume is structured to give a scientific consideration of potential impacts each 'screened in' European designated site, drawing on the conclusions presented in **Volume 3.** Each section in this volume initially provides a summary of the conclusions for the site, through reference to the Conservation Objectives and potential impact pathways, before then providing a detailed QI by QI impact assessment. **Section 2** presents this detailed examination and analysis in a site by site structure to allow the reader to understand the implications for each site.

2 EXAMINATION AND ANALYSIS OF POTENTIAL IMPACTS ON EUROPEAN SITES – PROJECT ALONE

2.1 South Dublin Bay SAC (IE000210)

4. South Dublin Bay SAC is an intertidal site with extensive areas of sand and mudflats. The sediments are predominantly sands but grade to sandy muds near the shore.

5. The South Dublin Bay SAC is 0 km from the offshore development area and is screened in for Mudflats and sandflats not covered by seawater at low tide; Annual vegetation of drift lines; *Salicornia* and other annuals colonising mud and sand; and Embryonic shifting dunes.

Table 2-1 Conservation Objectives, Attributes and Targets for South Dublin Bay SAC and summary of associated assessment (NPWS, 2013a, 2013b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Mudflats and sandflats not covered by seawater at low tide [1140]				
Conservation Objective*: To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in South Dublin Bay SAC, which is defined by the following list of attributes and targets:*				
Habitat area (720 ha). The permanent habitat area is stable or increasing, subject to natural processes.	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of Invasive non-native species INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.1**	Construction Environment Management Plan (CEMP) including biosecurity management measures to manage introduction of INNS.	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied. No reduction in habitat area.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Community extent. Maintain the extent of the *Zostera*-dominated community, subject to natural processes.	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) <u>See **Section 2.1.1**</u>	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Community structure: *Zostera* density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.1**			
Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation)	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of EMF / temperature changes (O&M) See **Section 2.1.1**			

Annual vegetation of drift lines [1210]

Conservation Objective*: To restore the favourable conservation condition of Annual vegetation of drift lines in South Dublin Bay SAC, which is defined by the following list of attributes and targets*[1]*:*

Habitat area. Area increasing, subject to natural processes, including erosion and succession.	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.3**	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

[1] From North Dublin Bay SAC: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000206.pdf

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	integrity, in the absence of mitigation) See **Section 2.1.3**		integrity, even in the absence of mitigation measures being applied.	
Physical structure: functionality and sediment supply. Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.3**	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.3**	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex spp*.)	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.3**	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation composition: negative indicator species. Negative indicator species (including non-natives) to represent less than 5% cover	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.3**	INNS mitigation measures will be implemented.	Following the implementation of INNS mitigation measures (see Paragraph 99) there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Salicornia and other annuals colonising mud and sand [1310]				
Conservation Objective*: To restore the favourable conservation condition of Salicornia and other annuals colonizing mud and sand in South Dublin Bay SAC, which is defined by the following list of attributes and targets*[2]*:*				
Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

[2] From North Dublin Bay: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000206.pdf

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Habitat distribution. No decline, or change in habitat distribution, subject to natural processes	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity,	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**		even in the absence of mitigation measures being applied.	
Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation)	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of EMF / temperature changes (O&M) See **Section 2.1.2**			
Physical structure: flooding regime. Maintain natural tidal regime	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation structure: zonation. Maintain the range of coastal habitats	Direct impacts on habitats	CEMP including biosecurity management measures	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced	No impediment to the Conservation Objective being met, and following

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
including transitional zones, subject to natural processes including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	to manage introduction of INNS	as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation structure: vegetation height. Maintain structural variation within sward	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**			
Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation)	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of EMF / temperature changes (O&M) See **Section 2.1.2**			
Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009)	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation structure: negative indicator species – *Spartina anglica.* No significant expansion of	Direct impacts on habitats	CEMP including biosecurity management measures	Following the implementation of INNS mitigation measures, pathway for introduction of INNS is reduced as far as reasonably practicable. No	No impediment to the Conservation Objective being met, and following mitigation there will not

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
common cordgrass (*Spartina anglica*), with an annual spread of less than 1%	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.1.2**	to manage introduction of INNS	mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	be an adverse effect on site integrity predicted from the project alone.

Embryonic shifting dunes [2110]

Conservation Objective*: To restore the favourable conservation condition of Embryonic shifting dunes in South Dublin Bay SAC, which is defined by the following list of attributes and targets*[3]*:*

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Habitat area. Area stable or increasing, subject to natural processes, including erosion and	Direct impacts on habitats	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of	No impediment to the Conservation Objective being met, and following mitigation there will not

[3] From North Dublin Bay: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000206.pdf

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
succession. For sub-sites mapped: North Bull – 2.64 ha; South Bull – 3.43 ha.	Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.4**		the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	be an adverse effect on site integrity predicted from the project alone.
Habitat distribution. No decline or change in habitat distribution, subject to natural processes.	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.4**	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Physical structure: functionality and sediment supply. Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	integrity, in the absence of mitigation) See **Section 2.1.4**		integrity, even in the absence of mitigation measures being applied.	
Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.4**	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation composition: plant health of foredune grasses. More than 95% of sand couch (*Elytrigia juncea*) and / or lyme-grass (*Leymus arenarius*) should be healthy (i.e., green plant parts above ground and flowering heads present)	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation)	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	See **Section 2.1.4**			
Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities with typical species: sand couch (*Elytrigia juncea*) and / or lyme-grass (*Leymus arenarius*)	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.4**	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.
Vegetation composition: negative indicator species. Negative indicator species (including non-native species) to represent less than 5% cover	Direct impacts on habitats Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.1.4**	INNS mitigation measures will be implemented	Following the implementation of INNS mitigation measures (refer to Paragraph 110), there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation there will not be an adverse effect on site integrity predicted from the project alone.

2.1.1 Mudflats and sandflats not covered by seawater at low tide [1140]

2.1.1.1 Direct impacts on habitats

6. The Conservation Objective attributes and targets which are considered relevant to this impact are:
   - Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
   - Community extent. Maintain the extent of the Zostera-dominated community, subject to natural processes.
   - Community structure: *Zostera* density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
   - Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.
7. A number of different CWP Project activities in the intertidal area of the South Dublin Bay SAC have the potential to cause direct impacts on the mudflats and sandflats not covered by seawater at low tide. This includes direct disturbance through cable lay activities, as well as compaction from vehicles and plant that may be present in the intertidal area. A cofferdam will also be installed in the mudflat and sandflat habitat near the upper shore limit. The cofferdam will be installed in such a way as to permit open cut trenching from the onshore area to the intertidal area, allowing a dry working area below the HWM. The installation and presence of the cofferdam may lead to reduced abundances of intertidal species in this area through the interruption of tidal influence. The cable will be buried where installed in the SAC with a minimum depth of cover of 1.4 m. No above surface rock protection will be installed in the SAC.
8. The Conservation Objectives for South Dublin Bay SAC (NPWS, 2013) states that, for intermittent or episodic activities for which the receiving environment would have some resilience and may be expected to recover within a reasonable timeframe relative to the six-year reporting cycle (as required under Article 17 of the Directive), such activities can be assessed in a context specific manner giving due consideration to the particular resilience of the receiving habitat.
9. The area of the intertidal habitat temporarily affected by construction activities is 0.157 km^2, which represents 2.18% of the 720 hectare area of the QI[4].
10. Intertidal surveys in 2006 and 2011 to support the designation of South Dublin Bay SAC identified the Annex I habitat Mudflats and sandflats not covered by seawater at low tide (1140) containing two community types; Fine sands with *Angulus tenuis* community complex and *Zostera*-dominated community, the latter of which lies to the south of the bay at Merrion gates, and outwith the proposed export cable corridor. An intertidal reef community occurs to the south of the SAC, dominated by algae species and the bivalve *Mytilus edulis*. The mudflats and sandflats were found to contain two communities: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex and Fine sand with *Spio martineses* community complex.
11. The site specific intertidal survey undertaken for the CWP Project found the majority of the sediment type across the lower, middle and upper shore was fine sand or very fine sand, with two sites consisting of coarser sediment in the mid and upper shore. Faunal diversity was low across the majority of stations sampled, with the majority of taxa and individuals found in the mid to upper shore. The lower shore habitat was homogeneous fine sand with casts of *Arenicola marina*, patches of *Ulva* sp. and brown filamentous algae. Patches of *Ulva* sp. were frequent at the stations close to landfall at the mid shore. Biotopes at landfall were classified as Littoral Sand (LS.LSa) apart from two small areas which

[4] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000210.pdf

were classified as Littoral Coarse Sediment (LS.LCS) and Littoral Mixed Sediment (LS.LMx). The mixed sediment was found at the top of the shore where more cobbles and boulders were present.

12. The tolerance of the littoral sand habitat to the direct impacts on habitats effect is assessed as medium-high and recoverability as high as it is characterised by areas of mobile sands, with opportunistic polychaetes and mobile amphipods that are indicative of, and adapted to, biotopes subject to natural and / or anthropogenic disturbance and recover quickly, <1 year (Tillin and Budd, 2016 Ashley, M., 2016). Given the recoverability of these species, their pioneer status and the wide availability of similar habitat nearby which will provide considerable opportunity for recolonisation of comparable fauna, it is considered that this habitat will recover within several months from any direct impacts including cable laying activities, compaction, or use of cofferdams.

13. In muddier habitats, resilience of the majority of infaunal burrowing polychaetes is high to physical disturbance; however, bivalves and tube dwelling polychaetes may suffer reduced abundances or physical damage. Such species are known to recover quickly with abundance predicted to return to pre-impacted levels in the short term (*c*. 1–2 years) from active immigration of adults and settlement of new individuals (Tillin et al., 2023).

14. The *Angulus tenuis* community complex is widespread within the SAC (NPWS, 2013). Angulus tenuis can be adversely affected by surface disturbance and reduced abundances are likely in heavily compacted areas, though overall resilience to disturbance is considered to be high (Tillin and Ashley 2018). The majority of species present in such intertidal sedimentary habitats are pioneer species and / or those used to periods of moderate or annual disturbance and can therefore recover or recolonise disturbed sediment within a short period of time (between 6 months and 2 years (Tillin and Ashley 2018)) via larval settlement as well as adult mobility.

15. Within the Mudflats and sandflats QI of the SAC, lies a *Zostera* sp. bed occurring in the south of the protected area near Merrion Gate; however, no construction activities take place in the vicinity of the *Zostera* sp. community and therefore there is no potential for direct impacts on this habitat.

16. Considering the small area affected, the relatively high resilience to physical disturbance of the habitat, the high recovery potential to changes in faunal abundances and the avoidance of any work in sensitive habitats (i.e., *Zostera* sp. area), it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss of the habitat area, alter the long term condition on of the fine sands with *Angulus tenuis* community complex, and as the CWP Project is located outside of the *Zostera* dominated community there will therefore be no reduction in extent or quality of the attribute or associated target. On this basis, direct impacts on habitat arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that will be no adverse effects on the site integrity of the South Dublin Bay SAC from direct impacts on habitats.

2.1.1.1.1 Increased suspended sediment concentration (SSC) and sediment deposition

17. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent. Maintain the extent of the *Zostera*-dominated community, subject to natural processes.
- Community structure: *Zostera* density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.

18. Activities associated with seabed preparation such as the deposit of dredged material, and cable installation activities in the OECC have the potential to lead to local increases in SSC.

19. Sediment resuspension from work in the intertidal will be minimal as the works are small scale, localised, will in the main be undertaken during 'dry' conditions, and the nature of the activities (e.g., localised physical disturbance for cable installation) do not give rise to high levels of SSC (UK Department for Business Innovation and Skills (BIS), 2008).

20. Subtidally, both dredging and cable installation are considered to result in the greatest increases in SSC, and have been modelled for the project. Model outputs are presented in (**Appendix 6.3 Modelling Report** of the EIAR) and summarised below:

Dredging and dredge disposal

21. Suspended sediment plumes created during dredge disposal operations are predicted to increase 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).

22. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the CWP Project can be summarised as follows:

23. 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

24. 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.

25. Based upon the representative scenario, the modelled 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.

26. 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.

27. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

28. Background levels of SSC are considered to be between 5–15 mg/l within the CWP Project. The nature of anticipated SSC increases are transient in nature with a duration that will be short term and temporary and, despite exceeding average concentrations for the locality, are consistent with levels observed during storm events.

29. As per the above, considering the predominant tidal direction, any increase in SSC created during subtidal works (e.g., dredging, dredge disposal, or subtidal cable installation) are not predicted to interact with the intertidal area in any meaningful volume as material is predicted to be transported southwards and eastwards. The levels of sediment arising from the construction activities are therefore predicted to be less than or similar to the natural background levels experienced on a daily or annual basis by the habitats present.

30. Regional data contained within the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) Programme shows increasing fine sediments and muds as you move towards the inshore sheltered areas within Dublin Bay. Coughlan et al. (2021) through a detailed hydrodynamic modelling exercise of the entire Irish Sea Basin concluded that in these sheltered areas of finer sediment low seabed mobility exists, principally due to the low tidal current speeds in these areas, which have created areas of net sediment accretion (Coughlan et al., 2021). The marine QIs of South Dublin Bay SAC can therefore be concluded to be habitats that have formed within this area of net accretion and are thus tolerant of increases in and deposition of suspended sediments.

31. The habitats present are characterised by opportunistic polychaetes, bivalves and mobile amphipods that are characteristic of habitats subject to regular (i.e., daily) increases in SSC and smothering that arise through natural tidal forces (Ashley, M., 2016). As such the communities have high tolerance and recoverability to levels of SSC and deposition greater than those predicted to arise as a result of the construction activities (Tyler Walters & Marshal, 2006; Ashley, M., 2016).

32. A small area of *Zostera* bed is also present within the SAC. Intertidal seagrass beds are considered to have medium tolerance and recoverability to increased SSC and sediment deposition of a level of 5 cm (d'Avack et al., 2022). This is above the predicted level of deposition resulting from CWP construction activities which will only persist for a short duration and therefore will not affect light attenuation for an extended period (Han et al., 2012) and therefore there is no potential for adverse effects on this habitat from the predicted levels of SSC and associated deposition that may arise from the CWP Project.

33. Given the above described high tolerance to this impact, and low levels of SSC and associated deposition predicted to arise from the works which will be well within natural background levels, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss of the habitat area, alter the long term condition on of the fine sands with *Angulus tenuis* community complex, and not lead to any reduction in extent or quality of the *Zostera* community. On this basis, increased SSC concentrations and sediment deposition arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the South Dublin Bay SAC from increased SSC and associated deposition.

2.1.1.1.2 *Remobilisation of contaminated sediments*

34. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent. Maintain the extent of the *Zostera*-dominated community, subject to natural processes.
- Community structure: *Zostera* density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.

35. Activities associated with seabed preparation such as deposit of dredged material and cable installation activities have the potential to remobilise sediments which may contain levels of chemical contaminants. Pollution by contaminated sediments can impact on the fitness or health of organisms or communities and thus alter community structure or habitats.

36. In the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with coarse sands and gravels. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). Testing for contaminants in North Dublin Bay has shown the levels of heavy metal contaminants to be below the Cefas Action Level 1 guidelines (McBreen & Wilson, 2003). This is consistent with the 'good' chemical status (2016–2021) of the Water Framework Directive water body, indicating low background incidence of contaminants within sediments in the wider area.

37. Remobilisation of contaminated sediments can occur when such sediments are disturbed and enter the water column and are transported and redeposited elsewhere. As such the zone of influence of this potential impact is considered analogous to that described above for Increased SSC and Sediment Deposition. As per the description of Increased SSC and associated deposition, any remobilisation of sediments is not predicted to travel far from the point of origin, and thus any habitats or species present are considered to be tolerant to any exposure they may be subject to due to the construction or operation of the CWP Project.

38. Considering the low levels of contamination within the sediments within the area, the relatively low predicted levels of sediment deposition, and predicted tolerance of individuals, the impact of remobilisation of contaminated sediments is not predicted to have any observable effect on this QI. Given this, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in any change of the habitat area, alter the long term condition on of the fine sands with *Angulus tenuis* community complex, and not lead to any reduction in extent or quality of the *Zostera* community. As such it can be concluded beyond reasonable scientific doubt that there will be no impediment to the Conservation Objectives for the feature being met and there will be no adverse effects on the site integrity of the South Dublin Bay SAC from the remobilisation of contaminated sediments.

2.1.1.2 Introduction of INNS

39. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent. Maintain the extent of the *Zostera*-dominated community, subject to natural processes.
- Community structure: Zostera density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.

40. The presence of vessels or plant in the marine or intertidal environment could act to introduce INNS to the South Dublin Bay SAC should such vessels or plant not be subject to biosecurity management measures. Marine INNS could also colonise offshore structures which would then provide such species with a platform for subsequent dispersal.

41. Intertidal mud and sand habitats may be exposed to invasive species which can alter the character of the habitat (primarily *Crepidula fornicata* at the sublittoral fringe, and the Pacific oyster *Magallana gigas,* or the cordgrass *Spartina anglica*), leading to re-classification of this biotope. Tolerance of this habitat to colonisation by INNS is assessed as medium and recoverability of this habitat to the introduction of INNS is considered very low respectively (Tyler-Walters, H. & Marshall, C., 2006).). Other INNS that are already recorded as present within Irish waters (e.g., as the slipper limpet *Crepidula fornicata*, the carpet sea squirt *Didemnum vexillum* and the Japanese skeleton shrimp *Caprella mutica*) are not known to colonise this habitat.

42. Considering the potential for habitat changes, which would alter the extent and distribution of the QI, it is considered that without adequate mitigation the Conservation Objective attributes and targets could be impeded or adversely affected, through for example loss of habitat area or changes to community composition. As such, it cannot be concluded that, in the absence of mitigation, there would be no adverse effect on site integrity from the introduction of INNS into the South Dublin Bay SAC.

2.1.1.2.1 Mitigation

43. All activities on the CWP Project will operate under an agreed CEMP including biosecurity management measures which will detail the measures to minimise the potential to introduce INNS into the environment, in accordance with best practice.

44. These measures will include adherence to International Management Organisation (IMO) Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (IMO, 2012), and where applicable, to comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) (IMO, 2021). Application of these standards will require the following actions:

- Ballast water exchange to be carried out at least 200 nm from the nearest land and in water at least 200 m in depth for applicable vessels; and
- Use of anti-fouling systems, which includes the use of coating systems, bio-fouling resistant materials and marine grown prevention systems.

45. In addition to the above, any plant, machinery, or other equipment (including personnel protective equipment (PPE)) used in the SAC will be clean, inspected visually, and if required treated to ensure that no material is introduced that could transport INNS from other intertidal areas in the vicinity, notably, the cordgrass *S. anglica*.

46. With this mitigation in place for all CWP Project activities, the potential for introduction or spread of any INNS is reduced to as low as reasonably practicable.

2.1.1.2.2 *Residual effect*

47. Following the implementation of mitigation, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in any change of the habitat area, alter the long term condition on of the fine sands with *Angulus tenuis* community complex, and not lead to any reduction in extent or quality of the *Zostera* community. As such it can be concluded beyond reasonable scientific doubt that no impediment to the Conservation Objectives for the feature being met will arise and there will be no adverse effects on the site integrity of the South Dublin Bay SAC from the introduction of INNS.

2.1.1.3 Presence of EMF / temperature changes

48. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent. Maintain the extent of the *Zostera*-dominated community, subject to natural processes.
- Community structure: *Zostera* density. Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community distribution. Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex.

49. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

50. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

51. Love et al. (2017) used submersible surveys of energized cables (35 kV) to compare the invertebrate colonising community and the fish assemblages present in southern California (U.S.). Whilst some research has shown measurable effects and responses to E- and / or B-fields on a small number of individual species (behavioural, physiological, developmental and genetic levels), these effects are only observed at significantly elevated field strengths (by orders of magnitude) compared to those associated with Marine Renewable Energy (Gill and Desender, 2020). The field strengths predicted to arise from the CWP Project are orders of magnitude lower than any where measurable effects have been observed in invertebrate species, and well within the levels experienced by all species as a result of the Earth's background B fields.

52. Marine benthic fauna are considered sensitive to acute increases in temperature (Tillin and Tyler-Walters, 2016). Marine organisms are however capable of acclimating to long term, stable increased temperature (Menon, 1972), such as would be produced by a generating cable (Tillin, 2016a; Tillin 2016b; Tillin and Rayment, 2001; De-Bastos and Hill, 2016). The minimum depth of cover for the offshore export cable is 1.4 m (except cable buried within the zone of greater burial depth adjacent to DL Harbour which will have a trench depth of 3.0 m) and is therefore expected to be consistent with these predictions for the majority of the route. At this depth of lowering, temperature increases can be expected to remain between 0 °C and 2 °C in most circumstances, with no discernible increase in any water temperature anticipated, particularly considering the dynamic nature of the water in the intertidal

area. It should also be noted that the majority of organisms in sediment do not exceed a burrowing depth of 0.2 m, with 95 to 99% remaining in the top 5 cm (Kingston, 2001), and as such are unlikely to be affected by the greatest levels of temperature change which are expected to be only found close to the cable.

53. Considering the low levels of EMF and predicted temperature changes associated with the installation of the OECC, and predicted tolerance and acclimatation of individuals, this impact is only considered to have the potential to cause very slight or imperceptible changes to key features of the baseline habitats. Given this, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss of the habitat area, alter the long term condition on of the fine sands with *Angulus tenuis* community complex, and as the CWP Project is located outside of the *Zostera* dominated community there will therefore be no reduction in extent or quality of the attribute or associated target. As such it can be concluded beyond reasonable scientific doubt that will be no impediment to the Conservation Objectives and there will be no adverse effects on the site integrity of the South Dublin Bay SAC from EMF and temperature changes associated with the installation of the OECC.

2.1.2 *Salicornia* and other annuals colonising mud and sand [1310]

54. A small area of pioneer saltmarsh occurs in the lee of an embryonic sand dune just north of Booterstown Station[5]. This early stage of saltmarsh development is here characterised by the presence of pioneer stands of glassworts (*Salicornia* spp.) occurring below an area of drift line vegetation.

2.1.2.1 Direct impacts on habitats

55. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime. Maintain natural tidal regime.
- Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height. Maintain structural variation within sward.
- Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

56. As the planned works will all be undertaken within the OECC, there is no potential for direct impacts on the habitat *Salicornia* and other annuals colonising mud and sand which is located near to Booterstown Station to the southwest of the OECC.

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[5] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000210.pdf

57. As such, there will be no impediment to the Conservation Objectives for the *Salicornia* and other annuals colonising mud and sand QI and therefore no adverse effects on site integrity resulting from direct impacts to habitats.

2.1.2.1.1 Increased SSC and sediment deposition

58. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime. Maintain natural tidal regime.
- Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height. Maintain structural variation within sward.
- Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

59. As noted in the context of the mudflats and sandflats not covered by seawater at low tide QI, activities associated with seabed preparation, such as the deposit of dredged material and cable installation activities, have the potential to lead to local increases in SSC.

60. Sediment resuspension from work in the intertidal will be minimal as the works are small scale, localised, will in the main be undertaken during 'dry' conditions, and the nature of the activities (e.g., localised physical disturbance for cable installation) do not give rise to high levels of SSC (UK Department for Business Innovation and Skills (BIS), 2008).

61. Subtidally, both dredging and cable installation are considered to result in the greatest increases in SSC, and have been modelled for the project. Model outputs are presented in (**Appendix 6.3 Modelling Report** of the EIAR) and summarised below:

Dredging and dredge disposal

62. Suspended sediment plumes created during dredge disposal operations are predicted to increase 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).

63. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the CWP Project can be summarised as follows:

64. 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

65. 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.

66. Based upon the representative scenario, the modelled 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.

67. 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.

68. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

69. Background levels of SSC are considered to be between 5–15 mg/l within the CWP Project. The nature of anticipated SSC increases are transient in nature with a duration that will be short term and temporary and, despite exceeding average concentrations for the locality, are consistent with levels observed during storm events.

70. Therefore, considering the predominant tidal directions, increases in SSC created during subtidal works (e.g., dredging, dredge disposal, or subtidal cable installation), are not predicted to interact with the intertidal area in any meaningful volume. The levels of sediment arising from the construction activities are therefore predicted to be less than or similar to the natural background levels experienced on a daily or annual basis by the habitats present.

71. Regional data contained within the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) Programme shows increasing fine sediments and muds as you move towards the inshore sheltered areas within Dublin Bay. Coughlan et al. (2021) through a detailed hydrodynamic modelling exercise of the entire Irish Sea Basin concluded that in these sheltered areas of finer sediment low seabed mobility exists, principally due to the low tidal current speeds in these areas, which have created areas of net sediment accretion (Coughlan et al., 2021). The marine QIs of

South Dublin Bay SAC can therefore be concluded to be habitats that have formed within this area of net accretion and are thus tolerant of increases in and deposition of suspended sediments.

72. *Salicornia* and other annuals colonising mud and sand exist in areas of net accretion and are thus tolerant to this effect, although prolonged periods of increases in SSC (exceeding one month) can lead to reduced growth (Tyler Walters, 2001). Though the construction period itself will exceed this duration, individual events that may give rise to increases in SSC in the intertidal area will be episodic and short in duration (days) and the increased levels of SSC predicted are transient and, at the distances from the works that this habitat is found, likely to be well within levels experienced as part of the natural conditions experienced **Appendix 6.3** of the EIAR.

73. Given the low levels of increased SSC that may occur over a short duration as a result of CWP Project activities, high natural tolerance and distance from the works to the habitat, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss or change in the habitat area or distribution, or alter the physical or vegetation structure of the QI. On this basis, increased SSC and sediment deposition arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the South Dublin Bay SAC from increased SSC and associated deposition.

2.1.2.1.2 Remobilisation of contaminated sediments

74. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime. Maintain natural tidal regime.
- Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height. Maintain structural variation within sward.
- Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

75. Activities associated with seabed preparation such as deposit of dredged material and cable installation activities have the potential to remobilise sediments which may contain levels of chemical contaminants. Pollution by contaminated sediments can impact on the fitness or health of organisms or communities and thus alter community structure or habitats.

76. In the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with coarse sands and gravels. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). Testing for contaminants in North Dublin Bay has shown the levels of heavy metal contaminants

to be below the Cefas Action Level 1 guidelines (McBreen & Wilson, 2003). This is consistent with the 'good' chemical status (2016–2021) of the Water Framework Directive water body, indicating low background incidence of contaminants within sediments in the wider area.

77. Remobilisation of contaminated sediments can occur when such sediments are disturbed and enter the water column and are transported and redeposited elsewhere. As such the zone of influence of this potential impact is considered analogous to that described above for Increased SSC and Sediment Deposition. As per the description of Increased SSC and associated deposition, any remobilisation of sediments is not predicted to travel far from the point of origin, and thus any habitats or species present are considered to be tolerant to any exposure they may be subject to due to the construction or operation of the CWP Project.

78. Considering the low levels of contamination within the sediments within the offshore development area, the relatively low predicted levels of sediment deposition, and predicted tolerance of individuals, the impact of remobilisation of contaminated sediments is not predicted to have any observable effect on this QI. Given this, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss or change in the habitat area or distribution, or alter the physical or vegetation structure of the QI. On this basis, remobilisation of contaminated sediments arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the South Dublin Bay SAC from increased SSC and associated deposition.

2.1.2.2 Introduction of INNS

79. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime. Maintain natural tidal regime.
- Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height. Maintain structural variation within sward.
- Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

80. The presence of vessels or plant in the marine or intertidal environment could act to introduce INNS to the South Dublin Bay SAC should such vessels or plant not be subject to biosecurity management measures. Marine INNS could also colonise offshore structures which would then provide such species with a platform for subsequent dispersal. Intertidal habitats may be exposed to invasive species which can alter the character of the habitat (e.g., the cordgrass *Spartina anglica*), leading to re-classification of this biotope. Other INNS that are already recorded as present within Irish waters (e.g., as the slipper limpet *Crepidula fornicata*, the carpet sea squirt *Didemnum vexillum* and the Japanese skeleton shrimp *Caprella mutica*) are not known to colonise this habitat.

81. Considering the potential for habitat changes, which would alter the extent and distribution of the QI, it is considered that without adequate mitigation the Conservation Objective attributes and targets could be impeded or adversely affected, through for example loss of habitat area or changes to community composition. As such, it cannot be concluded that there would be no adverse effect on site integrity from the introduction of INNS into the South Dublin Bay SAC.

2.1.2.2.1 Mitigation

82. All activities on the CWP Project will operate under an agreed CEMP including biosecurity management measures which will detail the measures to minimise the potential to introduce INNS into the environment, in accordance with best practice.

83. These measures will include adherence to International Management Organisation (IMO) Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (IMO, 2012), and where applicable, to comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) (IMO, 2021). Application of these standards will require the following actions:

- Ballast water exchange to be carried out at least 200 nm from the nearest land and in water at least 200 m in depth for applicable vessels; and
- Use of anti-fouling systems, which includes the use of coating systems, bio-fouling resistant materials and marine grown prevention systems.

84. In addition to the above, any plant, machinery, or other equipment (including personnel protective equipment (PPE)) used in the SAC will be clean, inspected visually, and if required treated to ensure that no material is introduced that could transport INNS from other intertidal areas in the vicinity, notably, the cordgrass *S. anglica*.

85. With this mitigation in place for all CWP Project activities, the potential for introduction or spread of any INNS is reduced to as low as reasonably practicable.

2.1.2.2.2 Residual effect

86. Following the implementation of mitigation, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss or change in the habitat area or distribution, or alter the physical or vegetation structure of the QI. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the South Dublin Bay SAC from increased SSC and associated deposition.

2.1.2.3 Presence of EMF / temperature changes (O&M)

87. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime. Maintain natural tidal regime.

- Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height. Maintain structural variation within sward.
- Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

88. As the planned works will all be undertaken within the OECC, there is no potential for EMF or temperature changes to be present within the habitat *Salicornia* and other annuals colonising mud and sand which is located near to Booterstown Station to the southwest of the OECC (*c*. 1.77 km from the OECC). EMF and temperature changes are only expected to be detectable within very close proximity of the cable (i.e., within *c*. 1–2 m). It is therefore concluded that the construction, operation and decommissioning of the CWP Project will not result in the long term loss or change in the habitat area or distribution, or alter the physical or vegetation structure of the QI. On this basis, EMF and temperature changes arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the South Dublin Bay SAC from the presence of EMF or temperature changes.

2.1.3 Annual vegetation of drift lines [1210]

89. Annual vegetation of drift lines occurs on sandy or shingle substrate at the upper part of the strand, around the high tide mark (NPWS, 2019).

2.1.3.1 Direct impacts on habitats

90. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area increasing, subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.

91. Construction works associated within the OTI and landfall will occur within a small area of the northern boundary of the SAC, which will result in the temporary disturbance of habitat within the SAC above the HWM. A specialist supratidal habitat survey was undertaken by AQUAFACT within the area of SAC which overlaps with the onshore development area boundary above the HWM, and confirmed that none of the QI habitats, including annual vegetation of drift lines, occur within the area which will be disturbed (**Appendix 21.3 Ecological Survey of Supratidal habitats at Poolbeg** of the EIAR).

92. In addition, construction works associated with the OfTI works will not result in direct impacts on the habitat.

93. No pathway between direct habitat loss associated with the CWP Project and this QI exists. No impediment to the Conservation Objectives for the site being met will arise as a result of this effect. There will be no adverse effects upon site integrity associated with the construction works carried out within the onshore development area.

2.1.3.2 Introduction of INNS

94. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities with typical species: sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex* spp.)
- Vegetation composition: negative indicator species. Negative indicator species (including non-natives) to represent less than 5% cover.

95. Three high impact INNS, listed on the Third Schedule of the European Communities (EC) (Birds and Natural Habitats) Regulations 2011 were recorded within the onshore development area during field surveys, namely, Japanese knotweed (*Reynoutria japonica*), bohemian knotweed (*Fallopia x bohemica*) and sea buckthorn (*Hippophae rhamnoides*), In addition, three medium impact INNS, were also recorded, which included butterfly bush (*Buddleja*), winter heliotrope (*Petasites fragrans*) and old man's beard (*Clematis vitalba*). The latter three species are not listed on the Third Schedule of the EC (Birds and Natural Habitats) Regulations 2011.

96. The proposed construction works associated with the OTI and landfall works have the potential to result in the disturbance of INNS which have been identified within the onshore development area. The disturbance of INNS during the construction phase, particularly the high impact species, can result in the introduction of INNS into the SAC site boundary, and establishing within terrestrial habitats such as the QI Annual vegetation of drift lines [1210]. Evidence of the infestation of Japanese knotweed has been recorded within coastal and saline habitats (Richards et al., 2008 & Walls 2010).

97. The establishment of INNS within the Annex I habitat could result in the shading out and competitively excluding of the typical, native plant species, such as sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*), prickly saltwort (*Salsola kali*) and oraches (*Atriplex spp.),* which form part of the QI habitat. The Conservation Objectives document[6] indicate that for the attribute Vegetation Composition, an increase in non-natives within the QI habitat, above 5% cover of the vegetation composition, would constitute an adverse effect on the integrity of the site. Considering the large extent of INNS identified within the onshore development area which would be disturbed by the construction works and acknowledging the invasive nature of INNS, it is assumed that the 5% cover may be exceeded overtime, in the absences of mitigation measures. There is therefore potential for the introduction / spread of INNS within the QI habitat to result in adverse effects on the integrity of the site.

98. The INNS common cordgrass (*Spartina anglicus*) was not recorded within the onshore development area. Common cordgrass is known to occur within North Dublin Bay SAC (NPWS, 2013); however, no construction work will occur in the vicinity of North Dublin Bay SAC. There is therefore no potential for the CWP Project to result in the introduction of common cordgrass into South Dublin Bay SAC.

2.1.3.2.1 Mitigation

99. An Onshore Invasive Species Management Plan (ISMP) has been prepared and is included in **Appendix** 1 of this report. The ISMP outlines control measures which will be put in place in order to control and treat the INNS within the onshore development area.

100. The treatment of the two knotweed species will include chemical treatment prior to the commencement of construction works for a period of time. Following the chemical treatment, all infestation areas will be excavated and removed off site to licensed waste facility. The treatment of sea buckthorn will include a combined manual and direct herbicide application method. Similarly, the herbicide will be applied in advance of the construction phase. Control measures will also be implemented for the eradication of winter heliotrope, butterfly bush and old man's beard within the onshore development

[6] NPWS (2013) Conservation Objectives: North Dublin Bay SAC 000206. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaerltacht.

area. The control measures will include mechanical excavation and deep burial. Further details on the management measures of the INNS are included within the ISMP.

101. The implementation of the above mitigation measures, as outlined within the ISMP, will be carried out by suitably qualified personnel, and will result in the complete control and removal of INNS within the ZoI of the construction works prior to the construction works commencing. There will therefore be no risk of the spread or introduction of INNS within the QI habitat as a result of the CWP Project.

2.1.3.2.2 Residual impacts

102. Following the implementation of the proposed INNS mitigation measures, the construction, operation and decommissioning of the CWP Project will not impede the overall objective of the attribute; 'Vegetation composition' and will not result in the increase of non native species within the QI habitat. As such it can be concluded beyond reasonable scientific doubt that no impediments to the Conservation Objectives for the feature being met will arise and there will be no adverse effects on the site integrity of the South Dublin Bay SAC from the introduction of INNS.

2.1.4 Embryonic shifting dunes [2110]

103. Embryonic shifting dunes are low sand mounds (generally less than a metre high) occurring between the high tide mark and 2120 Shifting dunes (white dunes) (NPWS, 2013).

2.1.4.1 Direct impacts on habitats

104. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. Area stable or increasing subject to natural processes, including erosion and succession.
- Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.

105. Construction works associated with the OTI and landfall will occur within a small area of the northern boundary of the SAC, which will result in the temporary disturbance of habitat within the SAC above the HWM. A specialist supratidal habitat survey was undertaken by AQUAFACT within the area of SAC which overlaps with the onshore development boundary above the HWM and confirmed that none of the QI habitats occur within the area which will be disturbed (refer to **Appendix 21.3 Ecological Survey of Supratidal Habitats at Poolbeg** of the EIAR).

106. No pathway between direct habitat loss associated with the CWP Project and this QI exists. No impediment to the Conservation Objectives for the site being met will arise as a result of this effect. It can be concluded beyond reasonable scientific doubt that there will be no adverse impacts upon site integrity associated with the construction works carried out within the onshore development area.

2.1.4.2 Introduction of INNS

107. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities with typical species: sea couch (*Elytrigia juncea*) and / or lyme-grass (*Leymus arenarius*).
- Vegetation composition: negative indicator species. Negative indicator species (including non-natives) to represent less than 5% cover.

108. As mentioned, three high impact and three medium impact INNS were recorded within the onshore development area during field surveys. The proposed construction works associated with the OTI works have the potential to result in the disturbance of INNS identified within the onshore development area. The disturbance of INNS during the construction phase, particularly the high impact species, can result in the introduction of the INNS into the SAC site boundary, establishing within terrestrial habitats such as the QI Embryonic shifting dunes [2110]. The establishment of INNS within the QI habitat could result in the shading and competitively excluding of the typical native plant species, such as sand couch (*Elytrigia juncea)* and lyme-grass (*Leymus arenarius*), which form part of the QI habitat. The Conservation Objectives for the attribute Vegetation composition, indicate that an increase in INNS, in particular sea buckthorn, within the QI habitat above 5% cover of the vegetation composition, would constitute an adverse effect on the integrity of the site.

109. Considering the large extent of INNS identified within the onshore development area which would be disturbed by the construction works and acknowledging the invasive nature of INNS, it is assumed that the 5% cover may be exceeded overtime, in the absences of mitigation measures. There is therefore potential for the introduction / spread of INNS within the QI habitat to result in adverse effects on the integrity of the site.

2.1.4.2.1 Mitigation

110. An ISMP has been prepared and is included in **Appendix 1** of this report. The ISMP outlines control measures which will be put in place in order to control and treat the INNS within the onshore development area. The treatment of the two knotweed species will include chemical treatment prior to the commencement of construction works for a period of time. Following the chemical treatment, all infestation areas will be excavated and removed off site to licensed waste facility. The treatment of sea buckthorn will include a combined manual and direct herbicide application method. Similarly, the herbicide will be applied in advance of the construction phase. Control measures will also be implemented for the eradication of winter heliotrope, butterfly bush and old man's beard which were also recorded within the onshore development area. The control measures will include mechanical excavation and deep burial. Further details on the management measures of the INNS are included within the ISMP.

111. The implementation of the above mitigation measures, as outlined within the ISMP, will be carried out by suitably qualified personnel, and will result in the complete control and removal of INNS within the ZoI of the construction works prior to the construction works commencing. There will therefore be no risk of the spread or introduction of INNS within the QI habitat as a result of the CWP Project.

2.1.4.2.2 Residual impacts

112. Following the implementation of the proposed INNS mitigation measures, the construction, operation and decommissioning of the CWP Project will not impede the overall objective of the attribute; 'Vegetation composition' and will not result in the increase of non native species within the QI habitat. As such it can be concluded beyond reasonable scientific doubt that no impediments to the Conservation Objectives for the feature being met will arise ad there will be no adverse effects on the site integrity of the South Dublin Bay SAC from the introduction of INNS.

2.2 Rockabill to Dalkey Island SAC (IE003000)

113. This site includes a range of dynamic inshore and coastal waters in the western Irish Sea. These include sandy and muddy seabed, reefs, sandbanks and islands. This site extends southwards, in a strip approximately 7 km wide and 40 km in length, from Rockabill, running adjacent to Howth Head, and crosses Dublin Bay to Frazer Bank in south Co. Dublin. The site encompasses Dalkey, Muglins and Rockabill islands.

114. The Rockabill to Dalkey Island SAC is 0 km from the offshore development area and is screened in for reefs and harbour porpoise.

Table 2-2 Conservation Objectives, Attributes and Targets for Rockabill to Dalkey Island SAC and summary of associated assessment (NPWS, 2013c)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Reefs [1170] Conservation Objective*: To maintain the favourable conservation condition of Reefs in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets:*				
Habitat area. The permanent area is stable or increasing, subject to natural processes.	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.2.1**	CEMP including biosecurity management measures to manage introduction of Invasive non-native species (INNS)	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation, no adverse effect on site integrity predicted from the project alone.
Habitat distribution.	Direct impacts on habitats	CEMP including biosecurity	Following the implementation of INNS	No impediment to the Conservation

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Distribution is stable or increasing, subject to natural processes.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.2.1**	management measures to manage introduction of Invasive non-native species (INNS)	mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	Objective being met, and following mitigation, no adverse effect on site integrity predicted from the project alone.
Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex	Direct impacts on habitats Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) Presence of EMF / temperature changes (O&M) See **Section 2.2.1**	CEMP including biosecurity management measures to manage introduction of Invasive non-native species (INNS)	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and following mitigation no adverse effect on site integrity predicted from the project alone.

2.2.1 Reefs [1170]

115. Rockabill to Dalkey Island SAC contains intertidal and subtidal reef habitats that occur on the islands within the SAC and on the south coast of Howth and off the coast between Lambay Island and Rush Village. The substrate types include flat and sloping bedrock, vertical rock walls and cobbles and boulders. The intertidal reef habitats support fucoid algae communities and the subtidal reef habitats support kelp and red algal species and epifaunal communities with barnacles and anemones such as *Alcyonium digitatum*.

2.2.1.1 Direct impacts on habitats

116. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent area is stable or increasing, subject to natural processes.
- Habitat distribution. Distribution is stable or increasing, subject to natural processes.
- Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.

117. The reefs in the Rockabil to Dalkey SAC are located to the north and west of the OECC (Howth Head and Dalkey Islands respectively). There is no overlap with this feature, and as such there is no potential for direct impacts on habitat area, distribution or community structure. As such it can be concluded beyond reasonable scientific doubt that there will be no impediment to the Conservation Objectives being met, and no adverse effects on the site integrity of the Rockabill to Dalkey Island SAC from direct impacts on habitats.

2.2.1.1.1 Increased SSC and sediment deposition

118. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent area is stable or increasing, subject to natural processes.
- Habitat distribution. Distribution is stable or increasing, subject to natural processes.
- Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.

119. Activities associated with seabed preparation such as the deposit of dredged material and cable installation activities in the OECC, including the increased depth of burial required near to Dun Laoghaire harbour, have the potential to lead to local increases in SSC.

120. The activities of dredging and cable installation are considered to result in the greatest increases in SSC, and have been modelled for the project. Model outputs are presented in (**Appendix 6.3** of the EIAR) and summarised below:

Dredging and dredge disposal

121. Suspended sediment plumes created during dredge disposal operations are predicted to increase 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).

122. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the CWP Project can be summarised as follows:

123. 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

124. 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.

125. Based upon the representative scenario, the modelled 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.

126. 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.

127. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

128. Background levels of SSC are considered to be between 5–15 mg/l within the CWP Project. The nature of anticipated SSC increases are transient in nature with a duration that will be short term and temporary and, despite exceeding average concentrations for the locality, are consistent with levels observed during storm events.

129. The closest area of reef habitat within Rockabill to Dalkey Island SAC are located to the north and west of the offshore development area and are *c*. 6 km from the OECC at their nearest point. Based upon the modelling of sediment transport arising from the CWP Project activities, there is no potential for increases in SSC to affect the protected habitats within the Rockabill to Dalkey SAC.

130. Nevertheless, should negligible levels of increased SSC and associated deposition interact with the reef habitats present, it is considered that rocky reef habitats, such as those around the islands and

on the south coast of Howth, have a high a tolerance and recoverability to increased SSC and sediment deposition rates up to 5 cm, and the high energy environment in which this habitat occurs means that any sediment deposition is likely to be removed quickly (Stamp, T.E. et al., 2023).

131. Given the short duration of impact and low levels of increased SSC and sediment deposition that may reach these habitats, any effects of this impact would be localised and short term in nature, with recovery expected immediately following remobilisation and removal of any sediments through tidal and wave action, and there will be no effect on habitat area, distribution, or community structure. On this basis, increased SSC and sediment deposition arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the Rockabill to Dalkey Island SAC from increased SSC and associated deposition.

2.2.1.2 Introduction of INNS

132. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent area is stable or increasing, subject to natural processes.
- Habitat distribution. Distribution is stable or increasing, subject to natural processes.
- Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.

133. The presence of vessels or plant in the marine or intertidal environment could act to introduce INNS to the Rockabill to Dalkey Island SAC should such vessels or plant not be subject to biosecurity management measures. Marine INNS could also colonise offshore structures which would then provide such species with a platform for subsequent dispersal.

134. Many of the habitats present across the subtidal extents of the offshore development area are subject to high levels of scour and water and natural sediment movement which will limit the establishment of all but the most scour-resistant invasive non-indigenous species and as such tolerance is assessed as high while recoverability is assessed as low, due to the lack of natural predators. Two potential colonising INNS may be able to colonise such habitats, the slipper limpet *Crepidula fornicata* which may settle on stones in substrates and hard surfaces such as bivalve shells, and the colonial ascidian *Didemnum vexillum* (Valentine et al., 2007).

135. Considering the potential for changes in the community structure of the QI, it is considered that without adequate mitigation the Conservation Objective attributes and targets could be impeded or adversely affected. As such, it cannot be concluded that there would be no adverse effect on site integrity from the introduction of INNS into the Rockabill to Dalkey Island SAC.

2.2.1.2.1 Mitigation

136. All activities on the CWP Project will operate under an agreed CEMP including biosecurity management measures which will detail the measures to minimise the potential to introduce INNS into the environment, in accordance with best practice.

137. These measures will include adherence to International Management Organisation (IMO) Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (IMO, 2012), and where applicable, to comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) (IMO, 2021). Application of these standards will require the following actions:

- Ballast water exchange to be carried out at least 200 nm from the nearest land and in water at least 200 m in depth for applicable vessels; and

- Use of anti-fouling systems, which includes the use of coating systems, bio-fouling resistant materials and marine grown prevention systems.

138. With this mitigation in place for all CWP Project activities, the potential for introduction or spread of any INNS is reduced to as low as reasonably practicable.

2.2.1.2.2 Residual effect

139. Following the implementation of mitigation, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in any change of the on habitat area, distribution, or community structure. As such it can be concluded beyond reasonable scientific doubt that no adverse effects on the Conservation Objectives for the feature will arise and therefore there will be no adverse effects on the site integrity of the SAC from the introduction of INNS.

2.2.1.3 Remobilisation of contaminated sediments

140. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent area is stable or increasing, subject to natural processes.
- Habitat distribution. Distribution is stable or increasing, subject to natural processes.
- Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.

141. As above, based upon the modelling of sediment transport arising from the CWP Project activities, there is no potential for remobilised sediment to affect the protected habitats within the Rockabill to Dalkey SAC. Sediment transport is predicted to travel in a predominantly easterly direction, with no increases in SSC moving in a northward direction.

142. Furthermore, the baseline site specific survey contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Contaminated sediments are only associated with finer sediments as they do not bind effectively with coarse sands and gravels. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007).

143. Considering the low levels of contamination within the sediments within the offshore development area, and the lack of predicted interaction with remobilised sediments, the impact of remobilisation of contaminated sediments is not predicted to have any observable effect on this QI. Given this, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in any change of the on habitat area, distribution, or community structure of this QI. On this basis, remobilisation of contaminated sediment arising as a result of the CWP Project will not impede the conservation objective for the South Dublin Bay SAC. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the SAC from this impact.

2.2.1.4 Presence of EMF / temperature changes (O&M)

144. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Habitat area. The permanent area is stable or increasing, subject to natural processes.
- Habitat distribution. Distribution is stable or increasing, subject to natural processes.

- Community structure. Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.

145. The reefs in the Rockabill to Dalkey SAC are outside of the OECC, and as such there is no potential for impacts from EMF or temperature changes to arise. As such, there is no potential for adverse effects on site integrity to arise from EMF or temperature changes.

146. The reefs in the Rockabil to Dalkey SAC are located to the north and west of the OECC (Howth Head and Dalkey Islands respectively). There is no overlap with this feature, and as such there is no potential for direct impacts on habitat area, distribution or community structure. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the Rockabil to Dalkey SAC from direct impacts on habitats.

2.2.2 Harbour porpoise [1351]

Table 2-3 Summary assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the Rockabill to Dalkey Island SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise with these measures in place is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an Adverse Effect on Site Integrity (AESI) associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. With these measures in place, collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See **Impact 3: Changes in prey availability**	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

147. The Rockabill to Dalkey Island SAC is designated for the Annex II species harbour porpoise (*Phocoena phocoena).* The occurrence of harbour porpoises within the Rockabill and Dalkey Island SAC has been estimated using visual observation and passive acoustic methods (NPWS, 2013b). Density and abundance estimates of harbour porpoise within the Rockabill to Dalkey Island SAC based on the two most recent survey efforts are described below.

148. In the summer of 2016 (Jun–Sep), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance of harbour porpoise (O'Brien and Berrow, 2016). In total, four survey days were conducted, all with Beaufort sea state ≤2, totalling 506 km of trackline surveyed and 152 sightings totalling 246 individual porpoise. The density estimates for each survey ranged between 1.37 porpoises/km^2 to a maximum of 1.87 porpoises/km^2, with an overall pooled density of 1.55 ±0.17 porpoises/km^2 (CV: 0.10). These density estimates within the SAC were very similar to those obtained in 2013 (1.44 ±0.09 porpoise/km^2, CV: 0.06) (Berrow and O'Brien, 2013).

149. In the summer of 2021 (Sep–Aug), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance of harbour porpoise (Berrow et al., 2021a). In total, six survey days were conducted, all with Beaufort sea state ≤2, totalling 728 km of trackline surveyed and 137 sightings totalling 181 individual porpoise. The density estimates for each survey ranged between 0.50 porpoises/km^2 to a maximum of 0.98 porpoises/km^2, with an overall pooled density of 0.83 ±0.14 porpoises/km^2. This results in an estimated abundance within the SAC of ~227 porpoise.

150. It should be noted that harbour porpoise is a wide-ranging species, and no detailed information is currently available on individual or group movements by harbour porpoise in or out of the site, nor is it known whether individuals or groups of the species demonstrate any fidelity to the site (i.e., residency; NPWS (2013b)). Berrow et al. (2021a) reported a 46% decline in density estimates within the SAC in 2021 compared to the survey in 2016. They comment that it is '*more likely a change in the local distribution of porpoises, adjacent to the SAC […]. Small changes in local distribution, driven by the distribution of their preferred prey can have profound effects on density estimates within a relatively small SAC compared to individual's home range'*.

2.2.2.1 Conservation Objectives and Targets

151. The Conservation Objective is to maintain the favourable conservation condition of harbour porpoise in the Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.

- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.2.2.1.1 Impact 1: Increased underwater noise

152. Target 2 of the Conservation Objectives states that '*proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site'*, and '*proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'*.

Assessment of the project alone

153. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise.

154. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (Wind Turbine Generators (WTGs) and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

155. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

156. The CWP array site is located approximately 14.2 km away from the Rockabill to Dalkey Island SAC, with only a small section of the OECC overlapping with the SAC. The underwater noise assessment within the EIAR (**Chapter 11 Marine Mammals**) concludes that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset. As such, there are no significant effects on marine mammals at a management unit (MU) or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

157. As the OECC of the CWP Project overlaps with the Rockabill to Dalkey Island SAC, there is the potential for in situ overlap between PTS-onset ranges and the Rockabill to Dalkey Island SAC for unmitigated UXO clearance activities occurring within the OECC. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km, resulting in up to 101.7 km^2 impacted area within the SAC (37.3% SAC area and 84 porpoise[7]). Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m, resulting in up to 3.08 km^2 impacted area within the SAC (1.13% SAC area and 3 porpoise[8]). The majority of acoustic energy produced by a high-order detonation is below a few hundred Hz, decreasing on average by about SEL 10 dB per decade above 100 Hz, and there is a pronounced drop-off in energy levels above ~5–10 kHz (Salomons et al., 2021, von Benda-Beckmann et al., 2015). Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise in situ.

158. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

159. For piling at the onshore substation, PTS impact ranges will not overlap with the Rockabill to Dalkey Island SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

160. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Rockabill and Dalkey Island SAC in situ.

161. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the

[7] Using a density of 0.83 porpoise/km^2 in the SAC from Berrow et al. (2021).
[8] Using a density of 0.83 porpoise/km^2 in the SAC from Berrow et al. (2021).

number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

162. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Rockabill to Dalkey Island SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

163. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Rockabill to Dalkey Island SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

164. In the absence of mitigation there is a risk, albeit low, that the Conservation Objectives for the site may be impeded or for an adverse effect on site integrity and / or FCS of the species to occur as a result of underwater noise. The CWP Project has committed to implementing UXO-specific and piling-specific Marine Mammal Mitigation Protocols (MMMPs) to reduce the risk of auditory injury (PTS) for marine mammals to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) to detect marine mammals (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)) as well as additional mitigation measures that could be put in place if required (e.g., Acoustic Deterrent Devices (ADDs), at source mitigation).

Conclusion

165. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS both in situ and ex situ are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, having regard to Target 2 of the Conservation Objectives, the CWP Project will not introduce noise levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site, and noise from the CWP Project will not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site. Having regard to these factors, it can be concluded that there will be no potential for adverse effect on site integrity to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

166. The underwater noise assessment within the EIAR (**Chapter 11 Marine Mammals**) concludes that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Whilst a small section of the OECC overlaps with the Rockabill to Dalkey Island SAC, disturbance will only cause short-term and / or intermittent and temporary behavioural effects in a limited spatial extent around the source. With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals), there will be very low potential for disturbance to harbour porpoise within, and outwith the Rockabill to Dalkey Island SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

167. The underwater noise modelling (see **Chapter 11 Marine Mammals** of the EIA) which supports the impact assessment details impacts from both high- and low-order UXO clearance.

168. For high-order clearance of a 525 kg UXO in the OECC:

- Using a 26 km effective deterrence range (EDR) results in up to 187.7 km^2 (68.8%) of the Rockabill to Dalkey Island SAC experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 171.14 km^2 (62.7%) of the Rockabill to Dalkey Island SAC experiencing disturbance.

169. For high-order clearance of a 525 kg UXO at the northwest corner of the array:

- Using a 26 km EDR results in up to 81.9 km^2 (30.0%) of the Rockabill to Dalkey Island SAC experiencing disturbance, and 0.95% of the Celtic and Irish Sea MU experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 54.41 km^2 (19.9%) of the Rockabill to Dalkey Island SAC experiencing disturbance and 0.75% of the Celtic and Irish Sea MU experiencing disturbance.

170. For low-order UXO clearance in the OECC:

- Using a 5 km EDR results in up to 46.7 km^2 (17.1%) of the Rockabill to Dalkey Island SAC experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 10.2 km^2 (3.7%) of the Rockabill to Dalkey Island SAC experiencing disturbance.

171. For low-order UXO clearance at the northwest corner of the array:

- Using a 5 km EDR results in up to 0% of the Rockabill to Dalkey Island SAC experiencing disturbance and 0.04% of the Celtic and Irish Sea MU experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 0 km^2 (0%) of the Rockabill to Dalkey Island SAC experiencing disturbance and <0.01% of the Celtic and Irish Sea MU experiencing disturbance.

172. It is noted in the JNCC (2020) guidance that, although UXO detonation is considered a loud underwater noise source, '*...a one-off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement...'.* Whilst detonations will usually be undertaken as part of a campaign and therefore may result in multiple detonations over several days (JNCC, 2020), each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site. Further, disturbance from UXO clearance will not result in a significant negative impact on individuals and / or the community of harbour porpoise within the site.

Piling at the onshore substation

173. For piling at the onshore substation, disturbance impact ranges will not overlap with the Rockabill to Dalkey Island SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

174. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Rockabill to Dalkey Island SAC and little potential for disturbance outwith the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

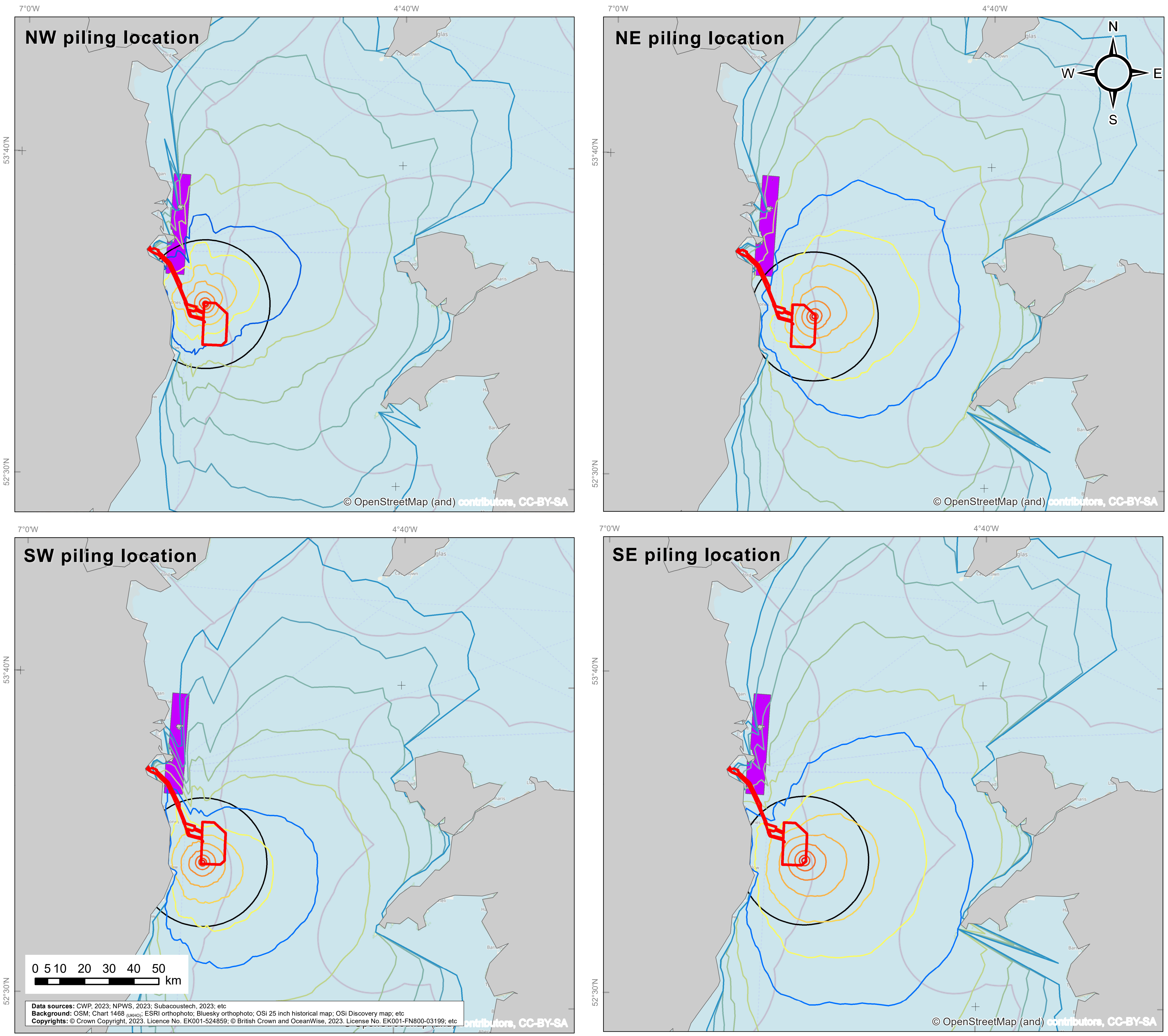
175. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

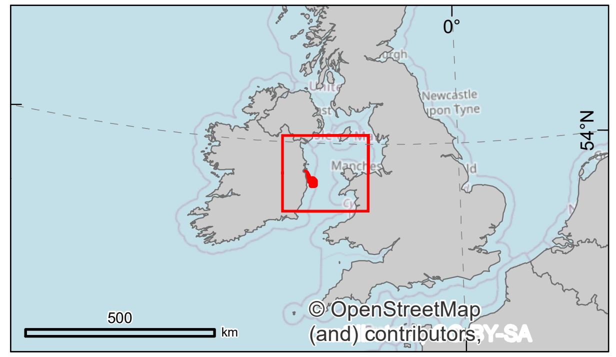
176. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

177. Using the harbour porpoise dose-response function a portion of the disturbance contours overlap with the Rockabill to Dalkey Island SAC boundary (see **Figure 2-1** and **Table 2-5**). Based on the dose-response assumptions, there is effective disturbance to 13% of the SAC area from piling at the NW location, where 62 harbour porpoise within the SAC are predicted to show a disturbance response (**Table 2-6**). When using the Lucke et al. (2009) 145 dB SEL_{ss} threshold, disturbance impact ranges from piling at the NW location overlap with 22% of the area of the Rockabill to Dalkey Island SAC,

disturbing 49 harbour porpoise within the SAC. Using the 26 km EDR approach, disturbance impact ranges for piling at the NW location overlap with 30% of the SAC area, disturbing 68 harbour porpoise within the SAC.





Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^{2}s threshold
- 26 km EDR
- SEL_{ss} dB re µPa^{2}s (5dB contours)
- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- Rockabill to Dalkey Island SAC

Data sources: CWP, 2023; NPWS, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc

codling wind park

Project: Codling Wind Park

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Figure 2.01:
Disturbance thresholds for piling at all modelling locations and the Rockabill to Dalkey Island SAC designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1598

Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - ROCKABILL.to.DALKEY.ISL.SAC - (NIS.Vol.04.Ch.02.FIG.01)

Size: A3
Scale: 1:1,500,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/03/07	JC	RRS/EA	EA

Table 2-4 Predicted overlap between disturbance contours from piling of WTGs at CWP and the Rockabilll to Dalkey Island SAC

Disturbance Threshold	Model location	Total overlap (% SAC area)	Effective area disturbed (% SAC)	# porpoise disturbed in SAC[9]
Dose-response	NE	260.9 km^2 (96% SAC)	59.4 km^2 (9.9% SAC)	49
	NW (see **Table 2-5** for detail)	257.2 km^2 (94% SAC)	74.6 km^2 (13.0% SAC)	62
	SE	264.8 km^2 (97% SAC)	19.9 km^2 (4.4% SAC)	16
	SW	200.5 km^2 (73% SAC)	25.8 km^2 (8.6% SAC)	21
145 dB SEL_{ss}	NE	0 km^2	NA	0
	NW	59.4 km^2 (22% SAC)		49
	SE	0 km^2		0
	SW	7.7 km^2 (3% SAC)		6
26 km EDR	NE	7.3 km^2 (3% SAC)	NA	6
	NW	81.9 km^2 (30% SAC)		68
	SE	0 km^2		0
	SW	0 km^2		0

[9] Using a density of 0.83 porpoise/km++2++ in the SAC from Berrow et al. (2021).

Table 2-5 Dose-response function overlap with the Rockabill to Dalkey Island SAC for piling at the NW location

Contour (unweighted dB SEL_{ss})	Area of SAC within contour (km^2)	% response within contour	Effective area of SAC disturbed (km^2)	# porpoise predicted to respond
150<155	7.3	68	5.0	4.1
145<150	52.1	51	26.5	22.0
140<145	74.1	33	24.6	20.4
135<140	85.1	19	15.9	13.2
130<135	26.7	9	2.3	1.9
125<130	9.4	3	0.3	0.3
120<125	1.8	1	0.0	0.0
TOTAL	**257.2**	**-**	**74.6**	**62**

178. In English, Welsh and Northern Irish harbour porpoise SACs, disturbance to 20% of the SAC area on a single day is considered significant (JNCC, 2020). The European Commission (EC) Directorate-General for Environment has set binding limits for underwater noise pollution (11 March 2024[10]). This states that for impulsive noise (such as piling): *'For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment / habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20% or lower (≤ 20%)'*. It is important to note that there is no advised threshold value for LOBE ('*a sound level above which an adverse biological effect on an indicator species is expected to occur, i.e., an effect that may affect the comfort, survival, and vital functions of individual animals*'), nor is there guidance on what constitutes '*assessment / habitat area utilised by a species'.* In the absence of specific guidance from NPWS on the application of the aforementioned EC limits for impulsive noise, the suitability of the approaches to estimating disturbance described in paragraph 316 for determining the LOBE is unknown. Similarly, given the wide-ranging and highly mobile nature of harbour porpoise, it is not clear if an individual SAC constitutes an appropriate assessment / habitat area. Nonetheless, a precautionary approach is to assume that disturbance, estimated by the methods described above, to 20% of the SAC area on a single piling day could constitute significant disturbance and a breach of the EC limits. **Table 2-4** shows that piling at the NW location, up results in disturbance in up to 30% of the Rockabill to Dalkey Island SAC. To determine if this constitutes a significant negative impact to the porpoise community under the Conservation Objective Target 2, further assessment detail is provided here.

Population modelling – iPCoD approach

179. A 'community' can be conceptualized as a group of individuals sharing common geographic, social, or cultural characteristics. The harbour porpoise community at the Rockabill to Dalkey Island SAC best fits the first of these characteristics, sharing a common geography. There is no evidence that individual animals or any social groups are resident within the SAC, or even return seasonally or annually, nor that it is a closed population. Surveys within the Rockabill to Dalkey Island SAC estimated an abundance of 227 harbour porpoise within the SAC (Berrow et al., 2021a). When undertaking population modelling, the setting of a biologically relevant reference population against which to assess potential impacts is an important consideration, which can have a large influence on the results. For example, in a population modelling exercise for the impacts of impulsive noise on the Southern North Sea SAC Brown et al. (2023) concluded that the most appropriate reference population was the entire North Sea management unit, noting that assuming a closed 'SAC population' was unrealistically conservative. Nonetheless, if it were to be assumed that the estimated abundance of 227 harbour porpoise within the Rockabill to Dalkey Island SAC represents a community with closed population dynamics, and that 68 porpoise in the SAC were disturbed per piling day (as predicted using a 26 km EDR at the NW piling location) over 78 piling days then iPCoD modelling can be used to determine if this results in an effect on the SAC community. Population modelling showed that this level of disturbance is estimated to result in a minor initial reduction in the population size but is not sufficient to result in a change to the long-term trajectory of the population, with the impacted population continuing on a stable trajectory at 99.1% of the size of the unimpacted population[11] (**Table 2-6** and **Plate 2-1)**. This approach is hugely conservative since: (i) there is no evidence that the SAC contains a closed population of individuals that would remain in the SAC to be exposed to disturbance over all 78 piling days; and, (ii) modelling has shown that this level of disturbance is predicted for only 1 out of the 4 modelling locations within the CWP Project area. Nevertheless, despite this huge conservatism, there is still predicted to be no significant negative impact on individuals and / or the community of harbour porpoise within the site and thus the favourable conservation condition of harbour porpoise in

[10] https://environment.ec.europa.eu/publications/notice-under-marine-strategy-framework-directive_en.

[11] As the iPCoD model does not currently allow for a density-dependent response, there is no way for the impacted population to increase in size after the piling disturbance ceases, which is what is expected to occur in reality.

the Rockabill to Dalkey Island SAC will be maintained despite the disturbance from piling at the CWP Project.

Table 2-6 Predicted mean Rockabill and Dalkey Island population size for the unimpacted (baseline) and impacted harbour porpoise iPCoD simulations (78 days piling in 2027), impacting 68 harbour porpoise per day[12]

	Unimpacted population mean size	Impacted population mean size	Impacted population as a proportion of the unimpacted population
Start 2027 (before piling commences)	226	226	100.0
End 2027 (after piling ends)	225	224	99.6
End 2033 (6 years after piling ends)	225	223	99.1
End 2039 (12 years after piling ends)	226	224	99.1
End 2045 (18 years after piling ends)	227	225	99.1

[12] Simulations were run comparing projections of the unimpacted (baseline) population (i.e., under current conditions, assuming current estimates of demographic parameters persist into the future) with a series of paired ‘impact’ scenarios with identical demographic parameters, incorporating a range of estimates for disturbance.

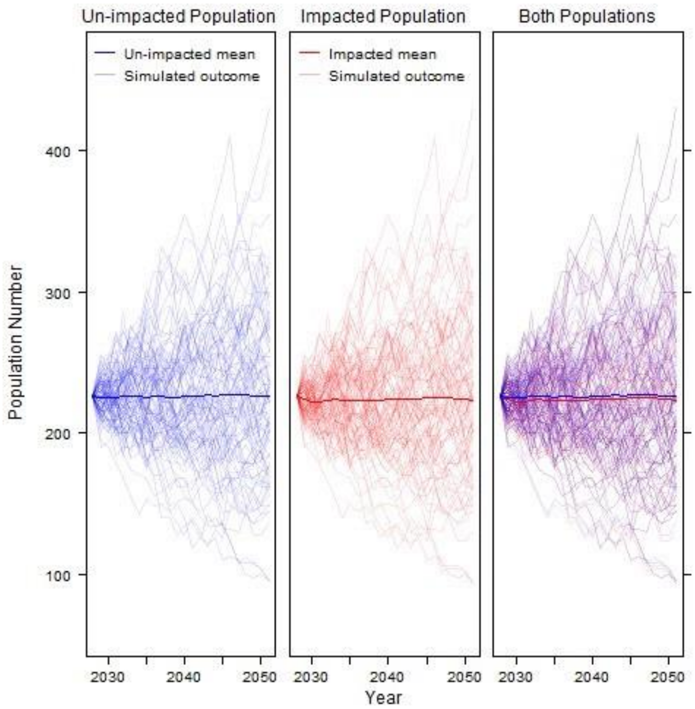


Plate 2-1 Predicted Rockabill and Dalkey Island population trajectories for the unimpacted (baseline) and impacted harbour porpoise iPCoD simulations (78 days piling in 2027), impacting 68 harbour porpoise per day

Dynamic energy budget model approach

180. The dynamic energy budget (DEB) model (**Appendix 2** of this report) was also run to investigate how piling disturbance might alter the vital rates, (calf mortality rate, adult mortality rate and birth rate) of female harbour porpoises during different life history stages. The DEB model assumes an impacted area with a 30 km radius (resulting in an impacted area of 2,826 km^2 in which animals do not forage). Based on the available evidence, the most realistic scenario is that porpoise cease foraging for <3 hours, and that less than 10% of the individuals within the 30 km impact radius respond (see DEB **Appendix 2** for further details).

181. Using the most realistic effect of disturbance (where disturbance resulted in 4 hours of non-foraging time and where 10% of the individuals present in the impacted area were affected), the model predicted no significant change in any vital rate from the undisturbed simulation. Therefore, using the most realistic limits, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals at the site.

Ex situ disturbance from piling of WTGs

182. For piling of WTGs, the approach presented below is in line with **Chapter 11 Marine Mammals** of the EIA which presented the numbers of animals likely to be disturbed by piling using the harbour porpoise dose-response function. The harbour porpoise dose-response function predicted 2,667 porpoise to be disturbed on a single piling day, equating to 4.27% of the Celtic and Irish Sea MU when a monopile foundation is installed at the SE location (using the Evans and Waggitt (2023) density surface).

183. To provide context, population modelling (against Celtic and Irish Seas MU reference population of 62,517) of disturbance to 2,667 harbour porpoise per piling day, over 78 piling days, showed that the

level of disturbance is not sufficient to result in any changes at the population level, since the impacted population is predicted to continue at a stable trajectory, the same as the unimpacted population (**Table 2-7** and **Plate 2-2** Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Table 2-7 Predicted mean Celtic and Irish Sea MU population size for the unimpacted (baseline) and impacted harbour porpoise iPCoD simulations (78 days piling in 2027), impacting 2,667 harbour porpoise per day

	Unimpacted population mean size	Unimpacted population mean size	Impacted population as a proportion of the unimpacted population
Start 2027 (before piling commences)	62,516	62,516	100.0%
End 2027 (after piling ends)	62,482	62,460	100.0%
End 2033 (6 years after piling ends)	62,381	62,334	99.9%
End 2039 (12 years after piling ends)	62,307	62,260	99.9%
End 2045 (18 years after piling ends)	62,281	62,234	99.9%

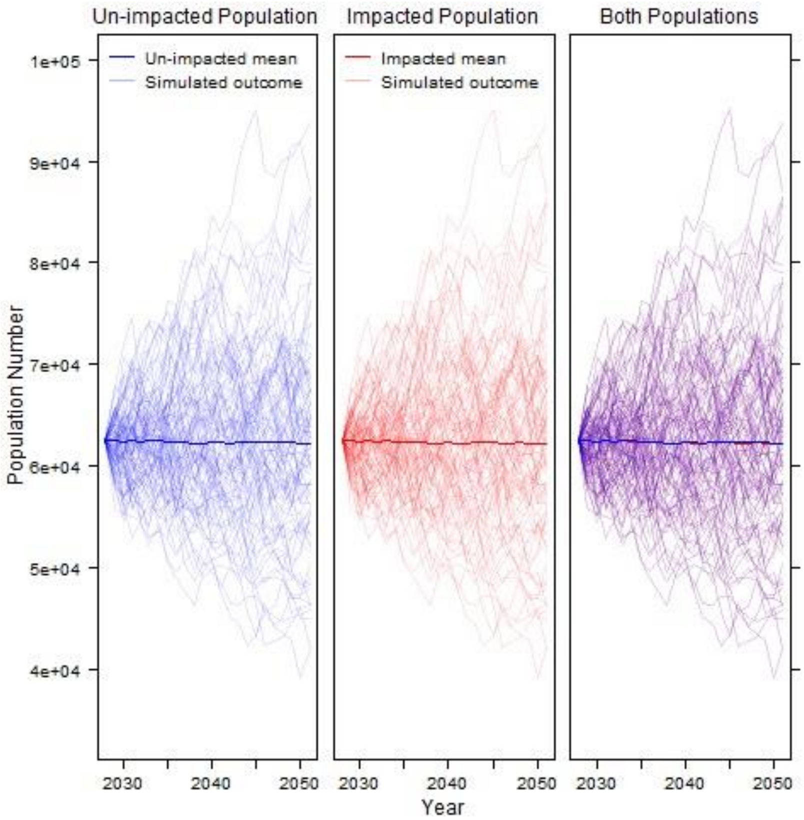


Plate 2-2 Predicted Celtic and Irish Sea MU population trajectories for the unimpacted (baseline) and impacted harbour porpoise iPCoD simulations (78 days piling in 2027), impacting 2,667 harbour porpoise per day

Disturbance from vessels

184. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** of the EIAR). Therefore, the introduction of additional vessels during construction of the CWP Project is not a novel impact for marine mammals present in the Rockabill to Dalkey Island SAC.

185. Irrespective of this, harbour porpoise may still be disturbed by the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Disturbance impact ranges will not overlap with the Rockabill to Dalkey Island SAC from activities within the array site; however, as the OECC overlaps with the SAC boundary, vessel activities occurring within the OECC could cause disturbance to harbour porpoise within the SAC. Assuming that porpoise within 2 km are disturbed by construction vessel activity, this results in disturbance in 4.6% of the SAC area from construction vessels. Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels

were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017). Assuming that porpoise within 200 m are disturbed by construction vessel activity, this results in disturbance in 0.05% of the SAC area from construction vessels. The area around the CWP Project already experiences high levels of vessel traffic (on average in the summer, 54 unique vessels in the study area per day, including recreational vessels, cargo ships, fishing vessels, tankers, passenger vessels and others). Therefore, the introduction of additional vessels associated with the CWP Project is not a novel impact for marine mammals present in the area. The indicative peak number of vessels on site at any one-time during construction is 38. It is highly likely that a large proportion of vessels associated with the CWP Project will be stationary or slow moving throughout construction activities for significant periods of time. In addition, the actual increase in vessel traffic moving around the site and to / from port to the site will occur over short periods of the offshore construction activity.

186. The project has committed to the adoption of an Ecological Vessel Management Plan (EVMP) to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

Conclusion

187. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

188. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

189. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

190. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

191. No additional mitigation is required.

Residual impacts

192. There is expected to be no change to the Favourable Conservation Status (FCS) and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Rockabill to Dalkey Island SAC from increased underwater noise from the CWP Project alone.

2.2.2.1.2 Impact 2: Collision risk

193. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

194. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

195. In the absence of mitigation there is a very low risk that the Conservation Objectives for the site may be impeded or for an adverse effect on site integrity and / or FCS of the species to occur as a result of vessel collision risk. Notwithstanding this the CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 ‘Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters’, the already low risk of vessel collisions will be further reduced. As such, although there will be some vessel activity within the Rockabill to Dalkey Island SAC due to the overlap between the OECC and SAC boundary, it is anticipated that the risk of vessel collision is negligible. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

196. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

197. No additional mitigation is required.

Residual impacts

198. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI on the harbour porpoise community associated with the Rockabill to Dalkey Island SAC from vessel collisions from the CWP Project alone.

2.2.2.1.3 Impact 3: Changes in prey availability

199. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

200. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Rockabill to Dalkey Island SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

201. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for impediment to the Conservation Objectives for the harbour porpoise community being achieved from changes in prey availability from the CWP Project alone, and no AESI for the Rockabill to Dalkey Island SAC.

Proposed mitigation

202. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Rockabill to Dalkey SAC as a result of changes in prey availability.

Residual impacts

203. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, or impediment to the Conservation Objectives for the harbour porpoise community associated with the Rockabill to Dalkey Island SAC as a result of changes to prey availability from the CWP Project alone.

2.2.2.1.4 Impact 4: Changes in available habitat

204. Target 1 of the Conservation Objectives states that 'species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities

or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

205. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Rockabill to Dalkey Island SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein. The majority of activities and infrastructure associated with the CWP Project will not occur within the SAC boundaries. Although there is some overlap between the OECC and Rockabill to Dalkey Island SAC, the infrastructure associated with the OECC will be installed / buried within the seabed. Impacts associated with underwater noise may temporarily deter animals from some areas within the SAC; however, any artificial barriers created by noise that might disrupt site use will be short-lived, and animals are expected to resume use of the site following the cessation of activities (e.g., piling will occur intermittently over the maximum period of 78 days). The presence of vessels can also cause changes in available habitat through displacement of marine mammals due to disturbance. As the OECC overlaps with the SAC boundary, vessel activities occurring within the OECC could cause temporary displacement of harbour porpoise from a small part of the SAC. However, it should be noted that vessel activity associated with the CWP Project will be limited to the OECC, as well as transit routes to and from ports, in areas characterised by relatively high levels of baseline traffic. Additionally, disturbance from vessel presence and noise is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in long-term changes to available habitat or permanent exclusion of harbour porpoise from their range within the SAC. As such, the disturbance due to underwater noise will be below levels that may adversely affect the harbour porpoise community at the site, and there will be no meaningful change or loss of habitat.

206. Considering the above, there is expected to be no potential for impediment to the Conservation Objectives of the harbour porpoise community being achieved as a result of changes in available habitat from the CWP Project alone.

Proposed mitigation

207. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Rockabill to Dalkey SAC as a result of changes in available habitat.

Residual impacts

208. There is expected to be no change to the FCS and no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Rockabill to Dalkey Island SAC from changes in available habitat from the CWP Project alone.

2.3 North Dublin Bay SAC (IE000206)

209. The North Dublin Bay SAC is 1.3 km from the offshore development area and is screened in for Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.

Table 2-8 Conservation Objectives, Attributes and Targets for North Dublin Bay SAC and summary of associated assessment (NPWS, 2013b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Mudflats and sandflats not covered by seawater at low tide [1140] Conservation Objective: *To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in North Dublin Bay SAC, which is defined by the following list of attributes and targets:*				
Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) <u>See **Section 2.3.1**</u>	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied.	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Community extent. Maintain the extent of the *Mytilus edulis*-dominated community, subject to natural processes	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Community structure: *Mytilus edulis* density. Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Community distribution. Conserve the following community types in a natural condition: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex; Fine sand with *Spio martinensis* community complex	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	integrity, in the absence of mitigation) See **Section 2.3.1**		on site integrity, even in the absence of mitigation measures being applied	

Salicornia and other annuals colonising mud and sand [1310]

Conservation Objective*: To restore the favourable conservation condition of Salicornia and other annuals colonizing mud and sand in North Dublin Bay SAC, which is defined by the following list of attributes and targets:*

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Habitat distribution. No decline, or change in habitat distribution, subject to natural processes	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Physical structure: flooding regime. Maintain natural tidal regime	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation)	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	See **Section 2.3.1**		absence of mitigation measures being applied	
Vegetation structure: vegetation height. Maintain structural variation within sward	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009)	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]				
Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island – 81.84 ha	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Habitat distribution. No decline or change in habitat distribution, subject to natural processes.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Physical structure: sediment supply. Maintain natural circulation of sediments and organic matter, without any physical obstructions	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: flooding regime.	Increased SSC and Sediment Deposition	CEMP including biosecurity management	Following the implementation of INNS	No impediment to the Conservation Objective being

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Maintain natural tidal regime	Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	measures to manage introduction of INNS	mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: vegetation height. Maintain structural variation within sward	Increased SSC and Sediment Deposition	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse	No impediment to the Conservation Objective being met, and with mitigation no

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	adverse effect on site integrity predicted from the project alone.
Vegetation structure: vegetation cover. Maintain more than 90% area outside creeks vegetated	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation composition: typical species and sub-communities. maintain range of sub-communities with typical	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
species listed in SMP (McCorry and Ryle, 2009)	Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Mediterranean salt meadows (*Juncetalia maritimi*) [1410]

Conservation Objective*: To maintain the favourable conservation condition of Mediterranean salt meadows (Juncetalia maritimi) in North Dublin Bay SAC, which is defined by the following list of attributes and targets:*

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Habitat distribution. No decline or change in habitat distribution, subject to natural processes.	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: sediment supply.	Increased SSC and Sediment Deposition	CEMP including biosecurity management	Following the implementation of INNS	No impediment to the Conservation Objective being

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Maintain / restore natural circulation of sediments and organic matter, without any physical obstructions	Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	measures to manage introduction of INNS	mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Physical structure: flooding regime. Maintain natural tidal regime	Increased SSC and Sediment Deposition	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse	No impediment to the Conservation Objective being met, and with mitigation no

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	adverse effect on site integrity predicted from the project alone.
Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation structure: vegetation height. Maintain structural variation in the sward	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation composition: typical species and sub-communities. Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009)	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	
Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.
Vegetation composition: negative indicator species. Negative indicator species (including non-native species) to represent less than 5% cover	Increased SSC and Sediment Deposition Remobilisation of contaminated sediments Introduction of INNS (identified as the only effect potentially capable of giving rise to	CEMP including biosecurity management measures to manage introduction of INNS	Following the implementation of INNS mitigation measures, there is no potential for adverse effects on the integrity of the site. No mitigation required for other Impacts as these impacts were not assessed as having the potential to	No impediment to the Conservation Objective being met, and with mitigation no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	adverse effects on site integrity, in the absence of mitigation) See **Section 2.3.1**		give rise to adverse effects on site integrity, even in the absence of mitigation measures being applied	

2.3.1 Mudflats and sandflats not covered by seawater at low tide [1140], *Salicornia* and other annuals colonising mud and sand [1310], Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] and Mediterranean salt meadows (*Juncetalia maritimi*) [1410]

2.3.1.1 Increased SSC and sediment deposition

210. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Mudflats and sandflats not covered by seawater at low tide [1140]:
  - Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
  - Community extent. Maintain the extent of the *Mytilus edulis*-dominated community, subject to natural processes.
  - Community structure: *Mytilus edulis* density. Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes.
  - Community distribution. Conserve the following community types in a natural condition: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex; Fine sand with Spio martinensis community complex.
- *Salicornia* and other annuals colonising mud and sand [1310]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
  - Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island – 81.84 ha.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% area outside creeks vegetated.

  - Vegetation composition: typical species and sub-communities. maintain range of sub-communities with typical species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain / restore natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation in the sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
  - Vegetation composition: negative indicator species. Negative indicator species (including non-native species) to represent less than 5% cover.

211. The mudflat and sandflat features are, at their closest point, 0.5 km from the offshore development area. Saltmarsh habitats (*Salicornia* and other annuals colonising mud and sand [1310]) and salt meadow habitats are located 1.7 km from the offshore development area at their closest point.

212. Activities associated with seabed preparation such as the deposit of dredged material and cable installation activities, including the increased depth of burial required near to Dun Laoghaire harbour, have the potential to lead to local increases in SSC.

213. The activities of dredging and cable installation are considered to result in the greatest increases in SSC, and have been modelled for the project. Model outputs are presented in (**Appendix 6.3** of the EIAR) and summarised below.

2.3.1.1.1 Dredging and dredge disposal

214. Suspended sediment plumes created during dredge disposal operations are predicted to increase 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).

215. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the CWP Project can be summarised as follows:

216. 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.

2.3.1.1.2 Trenching

217. 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.

218. Based upon the representative scenario, the modelled 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.

219. 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.

220. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

221. Background levels of SSC are considered to be between 5–15 mg/l within the CWP Project. The nature of anticipated SSC increases are transient in nature with a duration that will be short term and temporary and, despite exceeding average concentrations for the locality, are consistent with levels observed during storm events.

222. Based upon the modelling of sediment transport arising from the CWP Project activities there is no potential for increases in SSC to affect the protected habitats within the North Dublin Bay SAC. Sediment transport is predicted to travel in a predominantly easterly direction, with no increases in SSC moving in a northward direction.

223. Nevertheless, considering the close proximity to the SAC of the CWP Project, an evaluation of potential effects from increases in SSC and associated deposition is presented here should negligible levels of increased SSC be considered to interact with the SAC and its QIs.

224. Regional data contained within the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) Programme shows increasing fine sediments and muds as you move towards the inshore sheltered areas within Dublin Bay. Coughlan et al. (2021) through a detailed hydrodynamic modelling exercise of the entire Irish Sea Basin concluded that in these sheltered areas

of finer sediment low seabed mobility exists, principally due to the low tidal current speeds in these areas, which have created areas of net sediment accretion (Coughlan et al., 2021).

225. The marine QIs of North Dublin Bay SAC are habitats that have formed within this area of net accretion and are thus tolerant of variation in and deposition of suspended sediments. Furthermore, as described above any sediment that may reach the QIs of this SAC will be negligible in volume and concentration and well within background levels.

226. Mudflats and sandflats not covered by seawater at low tide experience regular remobilisation and settlement of sediments over a tidal cycle and are highly tolerant of increases in levels of SSC and associated deposition (Tyler Walters & Marshal, 2006).

227. Salt meadow habitats and Salicornia and other annuals colonising mud and sand exist in areas of net accretion and are thus tolerant to this effect, although prolonged periods of increases in SSC (exceeding one month which would be considerably greater than that experienced in this case) can lead to reduced growth of Salicornia (Tyler Walters, 2001), though salt meadows can tolerate very heavy annual accretion levels (Tyler-Walters, 2004).

228. Considering the distance to the QIs, the lack of predicted sediment transport in the direction of the SAC, and high tolerance to the impacts of the QIs, it is considered that no adverse effects on the integrity of North Dublin Bay SAC will arise as a result of this impact.

229. Given the negligible levels of increased SSC that may occur (noting the modelling does not predict any interaction at all) over a short duration as a result of CWP Project activities, high natural tolerance and distance from the works to the habitat, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the change in the habitat area or extent, alter the community structure or distribution, or alter the physical or vegetation structure or community of the QI. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the North Dublin Bay SAC from increased SSC and associated deposition.

2.3.1.2 Remobilisation of contaminated sediments

230. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Mudflats and sandflats not covered by seawater at low tide [1140]:
    - Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
    - Community extent. Maintain the extent of the *Mytilus edulis*-dominated community, subject to natural processes.
    - Community structure: *Mytilus edulis* density. Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes.
    - Community distribution. Conserve the following community types in a natural condition: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex; Fine sand with *Spio martinensis* community complex.
- Salicornia and other annuals colonising mud and sand [1310]:
    - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
    - Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
    - Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
    - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
    - Physical structure: flooding regime. Maintain natural tidal regime.

  - Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island – 81.84 ha.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. maintain range of sub-communities with typical species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain / restore natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation in the sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
  - Vegetation composition: negative indicator species. Negative indicator species (including non-native species) to represent less than 5% cover.

231. As per the assessment of increased SSC and sediment deposition above, the modelling of sediment transport arising from the CWP Project activities indicates there is no potential for remobilised

sediment to affect the protected habitats within the North Dublin Bay SAC. Sediment transport is predicted to travel in a predominantly easterly direction, with no increases in SSC moving in a northward direction. Should there be any interaction, it is considered that only negligible amounts of resuspended sediments will interact with the QIs of the North Dublin Bay SAC.

232. Furthermore, the baseline site specific survey contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). Testing for contaminants in North Dublin Bay has shown the levels of heavy metal contaminants to be below the Cefas Action Level 1 guidelines (McBreen & Wilson, 2003). This is consistent with the 'good' chemical status (2016–2021) of the Water Framework Directive water body, indicating low background incidence of contaminants within sediments in the wider area.

233. As such, considering the lack of predicted connectivity with remobilised sediments, and the low levels of contamination present in the wider area, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the change in the habitat area or extent, alter the community structure or distribution, or alter the physical or vegetation structure or community of the QI. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the North Dublin Bay SAC from remobilisation of contaminated sediments.

2.3.1.3 Introduction of INNS

234. The Conservation Objective attributes and targets which are considered relevant to this impact are:

- Mudflats and sandflats not covered by seawater at low tide [1140]:
  - Habitat area. The permanent habitat area is stable or increasing, subject to natural processes.
  - Community extent. Maintain the extent of the *Mytilus edulis*-dominated community, subject to natural processes.
  - Community structure: *Mytilus edulis* density. Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes.
  - Community distribution. Conserve the following community types in a natural condition: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex; Fine sand with *Spio martinensis* community complex.
- Salicornia and other annuals colonising mud and sand [1310]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
  - Habitat distribution. No decline, or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.

- Vegetation composition: typical species and sub-communities. Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).
- Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: North Bull Island – 81.84 ha.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation within sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain range of sub-communities with typical species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]:
  - Habitat area. Area stable or increasing, subject to natural processes, including erosion and succession.
  - Habitat distribution. No decline or change in habitat distribution, subject to natural processes.
  - Physical structure: sediment supply. Maintain / restore natural circulation of sediments and organic matter, without any physical obstructions.
  - Physical structure: creeks and pans. Maintain creek and pan structure, subject to natural processes, including erosion and succession.
  - Physical structure: flooding regime. Maintain natural tidal regime.
  - Vegetation structure: zonation. Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
  - Vegetation structure: vegetation height. Maintain structural variation in the sward.
  - Vegetation structure: vegetation cover. Maintain more than 90% of area outside creeks vegetated.
  - Vegetation composition: typical species and sub-communities. Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009).
  - Vegetation structure: negative indicator species – *Spartina anglica*. No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.
  - Vegetation composition: negative indicator species. Negative indicator species (including non-native species) to represent less than 5% cover.

235. The presence of vessels or plant in the marine or intertidal environment could act to introduce INNS to the North Dublin Bay SAC (indirectly through secondary transport or distribution), should such vessels or plant not be subject to biosecurity management measures. Marine INNS could also colonise offshore structures or adjacent areas of the coastline which would then provide such species with a platform for subsequent dispersal. Intertidal habitats may be exposed to invasive species which can alter the character of the habitat (e.g., the cordgrass *Spartina anglica*), leading to re-classification of this biotope. Other INNS that are already recorded as present within Irish waters (e.g., as the slipper

limpet *Crepidula fornicata*, the carpet sea squirt *Didemnum vexillum* and the Japanese skeleton shrimp *Caprella mutica*) are not known to colonise these habitats.

236. Considering the potential for habitat changes, which would alter the extent, distribution and community composition of the QI, it is considered that without adequate mitigation the Conservation Objective attributes and targets could be impeded or adversely affected, through for example loss of habitat area or changes to community composition. As such, it cannot be concluded that there would be no adverse effect on site integrity from the introduction of INNS.

2.3.1.3.1 Mitigation

237. All activities on the CWP Project will operate under an agreed CEMP including biosecurity management measures which will detail the measures to minimise the potential to introduce INNS into the environment. With this mitigation in place for all CWP Project activities, the potential for introduction or spread of any INNS is reduced to as low as reasonably practicable.

2.3.1.3.2 Residual effect

238. Following the implementation of mitigation, it is concluded that the construction, operation and decommissioning of the CWP Project will not result in the change in the habitat area or extent, alter the community structure or distribution, or alter the physical or vegetation structure or community of the QI. As such it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the site integrity of the North Dublin Bay SAC from the introduction of INNS.

2.4 Codling Fault Zone SAC (003015)

2.4.1 Harbour porpoise

Table 2-9 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the Codling Fault Zone SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.			
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise)	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
harbour porpoise population at the site.	MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend.		population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	affect harbour porpoise population at the site.			
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

239. The Codling Fault Zone SAC is located 24 km east of Howth Head, Co. Dublin at a water depth between 80 to 100 m and covers an area of 29.8 km^2. The SAC was designated for submarine structures made by leaking gases [1180].

240. In March 2024, harbour porpoise [1351] were added as a Qualifying Interest to the Codling Fault Zone SAC. While the Site Synopsis was amended in March 2024 to list harbour porpoise, it provides no information on the presence of porpoise within the site, or the importance of the site for harbour porpoise. While harbour porpoise have been added as a qualifying feature to the SAC, it is questionable how an SAC that is 29.8 km^2, containing 8 harbour porpoise[13] at any one time constitutes a site of importance for this species.

2.4.1.1 Conservation Objectives and Targets

241. No Conservation Objectives have been set for harbour porpoise at this site yet. Therefore, it is assumed that the Conservation Objectives at the nearby Rockabill to Dalkey Island SAC apply here.

242. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.4.1.1.1 Impact 1: Increased underwater noise

243. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise

[13] Assuming a density of 0.2803 porpoise/km++2++ from SCANS IV (Gilles et al., 2023).

within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

244. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

245. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

246. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

247. The CWP array site is located approximately 18.9 km away from the Codling Fault Zone SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Codling Fault Zone SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

248. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. This results in no overlap with the Codling Fault Zone SAC for either high- or low-order UXO clearance and no impacts to the SAC in situ.

249. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity

for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

250. For piling at the onshore substation, PTS impact ranges will not overlap with the Codling Fault Zone SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

251. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Codling Fault Zone SAC in situ.

252. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

253. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Codling Fault Zone SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

254. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Codling Fault Zone SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

255. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that will be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of

MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

256. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS both in situ and ex situ are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for Adverse effect on site integrity (AESI) to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

257. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations*'. There will be no overlap between disturbance impact ranges and the Codling Fault Zone SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

258. The underwater noise modelling (see **Chapter 11 Marine Mammals** of the EIA) which supports the impact assessment details impacts from both high- and low-order UXO clearance.

259. For high-order clearance of a 525 kg UXO at the northeast corner of the array:

- Using a 26 km EDR results in up to 20.5 km^2 (68.3%) of the Codling Fault Zone SAC experiencing disturbance, and 0.95% of the Celtic and Irish Sea MU experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 0 km^2 (0%) of the Codling Fault Zone SAC experiencing disturbance and 0.75% of the Celtic and Irish Sea MU experiencing disturbance.

260. For low-order UXO clearance at the northeast corner of the array:

- Using a 5 km EDR results in up to 0% of the Codling Fault Zone SAC experiencing disturbance and 0.04% of the Celtic and Irish Sea MU experiencing disturbance.
- Using TTS as a proxy for disturbance results in up to 0 km^2 (0%) of the Codling Fault Zone SAC experiencing disturbance and <0.01% of the Celtic and Irish Sea MU experiencing disturbance.

261. It is noted in the JNCC (2020) guidance that, although UXO detonation is considered a loud underwater noise source, '*...a one-off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement...'.* Whilst detonations will usually be undertaken as part of a campaign and therefore may result in multiple detonations over several days (JNCC, 2020), each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such

short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

262. For piling at the onshore substation, disturbance impact ranges will not overlap with the Codling Fault Zone SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

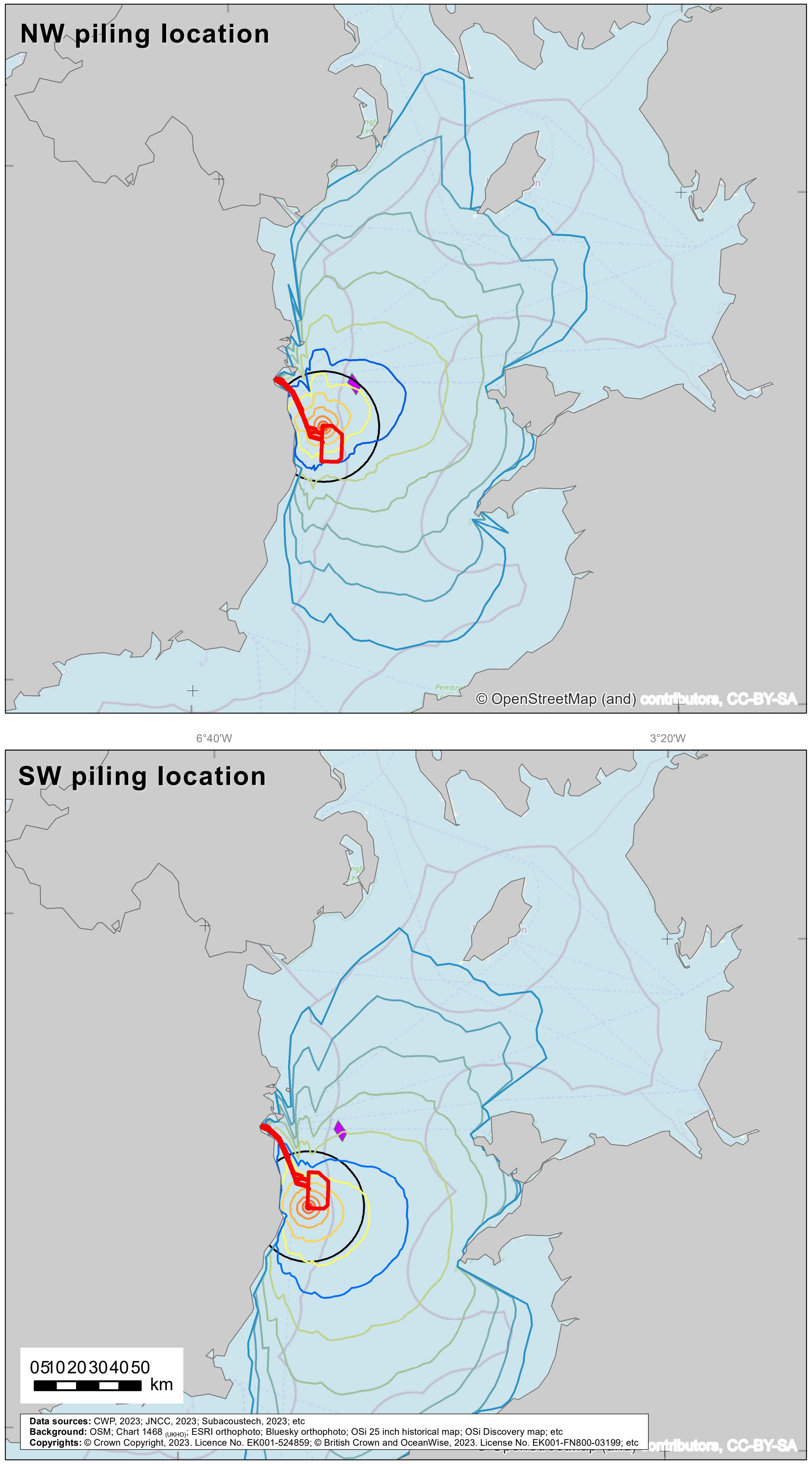
263. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Codling Fault Zone SAC and little potential for disturbance outwith the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

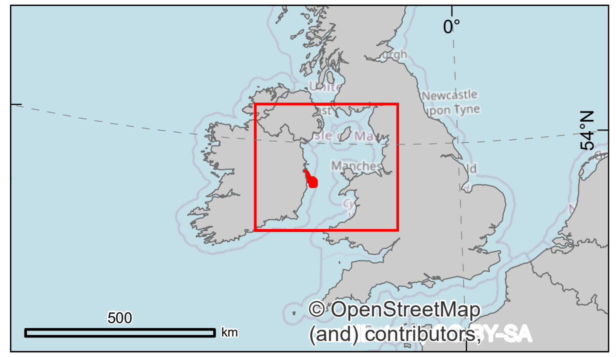
264. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017). There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

265. Using the harbour porpoise dose-response function a portion of the disturbance contours overlap with the Codling Fault Zone SAC boundary (see **Figure 2-2** and **Table 2-11**). Based on the dose-response assumptions, there is effective disturbance to 69% of the SAC area from piling at the NE location, where 6 harbour porpoise within the SAC are predicted to show a disturbance response (**Table 2-10**). When using the Lucke et al. (2009) 145 dB SEL_{ss} threshold, disturbance impact ranges from piling overlap with 100% of the area of the Codling Fault Zone SAC, disturbing 8 harbour porpoise within the SAC. Using the 26 km EDR approach, disturbance impact ranges for piling at the NW location overlap with 79% of the SAC area, disturbing 7 harbour porpoise within the SAC.



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^2s threshold
- 26 km EDR
- SEL_{ss} dB re µPa^2s (5dB contours)
- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- Codling Fault Zone SAC

codling wind park

Project: Codling Wind Park

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understand • assess • mitigate

Figure 2.02:
Disturbance thresholds for piling at all modelling locations and the Codling Fault Zone SAC designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1599

Internal descriptive code:
IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL. 26EDR.CONT.WTGs.CORNERS - CODLING.FZ.SAC - (NIS.Vol.04.Ch.02.FIG.03)

Size: A3
Scale: 1:2,500,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Table 2-10 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the Codling Fault Zone SAC

Disturbance Threshold	Model location	Total overlap (% SAC area)	Effective area disturbed (% SAC)	# porpoise disturbed in SAC[14]
Dose-response	NE (see **Table 2-11** for detail)	29.8 km^2 (100% SAC)	20.7 km^2 (69% SAC)	6
	NW	29.8 km^2 (100% SAC)	16.1 km^2 (54% SAC)	5
	SE	29.8 km^2 (100% SAC)	15.2 km^2 (51% SAC)	4
	SW	29.8 km^2 (100% SAC)	7.0 km^2 (24% SAC)	2
145 dB SEL_{ss}	NE	29.8 km^2 (100% SAC)	NA	8
	NW	29.8 km^2 (100% SAC)		8
	SE	29.8 km^2 (100% SAC)		8
	SW	0		0
26 km EDR	NE	20.4 km^2 (68% SAC)	NA	6
	NW	23.6 km^2 (79% SAC)		7
	SE	0		0
	SW	0		0

[14] Using a density of 0.2803 porpoise/km++2++ in the SAC based on SCANS IV.

Table 2-11 Dose-response function overlap with the Codling Fault Zone SAC for piling at the NE location

Contour (unweighted dB SEL_{ss})	Area of SAC within contour (km^2)	% response within contour	Effective area of SAC disturbed (km^2)	# porpoise predicted to respond
155<160	2.0	83	1.7	<1
150<155	27.8	68	19.0	5
145<150	0	51	0	0
140<145	0	33	0	0
135<140	0	19	0	0
130<135	0	9	0	0
125<130	0	3	0	0
120<125	0	1	0	0
TOTAL	**29.8**	**-**	**20.7**	**6**

266. In English, Welsh and Northern Irish harbour porpoise SACs, disturbance to 20% of the SAC area on a single day is considered significant (JNCC, 2020). The European Commission (EC) Directorate-General for Environment has set binding limits for underwater noise pollution (11 March 2024[15]). This states that for impulsive noise (such as piling): '*For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment / habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20% or lower (≤ 20%)'*. It is important to note that there is no advised threshold value for LOBE ('a sound level above which an adverse biological effect on an indicator species is expected to occur, i.e., an effect that may affect the comfort, survival and vital functions of individual animals'), nor is there guidance on what constitutes 'assessment / habitat area utilised by a species'.

267. **Table 2-10** shows that piling at the CWP Project results in disturbance in up to 100% of Codling Fault Zone SAC. While this obviously exceeds the 20% area threshold, there are other factors to take into consideration here. While harbour porpoise have been added as a qualifying feature to the SAC, it is questionable how an SAC that is 29.8 km^2, containing 8 harbour porpoise[16] at any one time constitutes a site of importance for this species. The 20% area thresholds for disturbance were designed to ensure no significant disturbance within large SACs that have been shown to contain high densities of harbour porpoise. For example, the Southern North Sea SAC is 36,951 km^2 (1,240 times larger than the Codling Fault Zone SAC), and the North Anglesey marine SAC is 3,249 km^2 (109 times larger than the Codling Fault Zone SAC). The area threshold is wholly unsuitable to apply at the Codling Fault Zone SAC given its small size and the current lack of evidence that it is a site of importance for harbour porpoise. While the animals within the SAC are expected to experience disturbance from piling at the CWP Project, the disturbance will be short term and temporary, over a maximum of 78 piling days.

268. To investigate this further, a Dynamic Energy Budget (DEB) model (**Appendix 2** of this document) was run to investigate how piling disturbance might alter the vital rates, (calf mortality rate, adult mortality rate and birth rate) of female harbour porpoises during different life history stages. The DEB model assumes an impacted area with a 30 km radius (resulting in an impacted area of 2,826 km^2 in which animals do not forage). Based on the available evidence, the most realistic scenario is that porpoise cease foraging for <3 hours, and that less than 10% of the individuals within the 30 km impact radius respond (see **Appendix 2** for further details).

269. Using the most realistic effect of disturbance (where disturbance resulted in 4 hours of non-foraging time and where 10% of the individuals present in the impacted area were affected), the model predicted no significant change in any vital rate from the undisturbed simulation. Therefore, using the most realistic limits, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals at the site.

Ex situ disturbance from piling of WTGs

270. For ex situ disturbance from piling of WTGs, the assessment for the Codling Fault Zone SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

[15] https://environment.ec.europa.eu/publications/notice-under-marine-strategy-framework-directive_en.
[16] Assuming a density of 0.2803 porpoise/km++2++ from SCANS IV (Gilles et al., 2023).

Disturbance from vessels

271. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** of the EIAR). Therefore, the introduction of additional vessels during construction of the CWP Project is not a novel impact for marine mammals in the area.

272. Irrespective of this, harbour porpoise may still be disturbed by the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

273. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

274. Vessels associated with the CWP Project are not expected to operate within the Codling Fault Zone SAC. Disturbance impact ranges will not overlap with the Codling Fault Zone SAC.

Conclusion

275. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

276. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

277. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

278. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

279. No additional mitigation is required.

Residual impacts

280. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Codling Fault Zone SAC from increased underwater noise from the CWP Project alone.

2.4.1.1.2 Impact 2: Collision risk

281. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

282. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

283. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 ‘Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters’, the already low risk of vessel collisions will be further reduced.

284. Vessels associated with the CWP Project are not expected to operate within the Codling Fault Zone SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no impediment to the Conservation Objectives of the harbour porpoise community being achieved as a result from collision risk from the CWP Project alone, and no AESI to the Codling Fault SAC.

Proposed mitigation

285. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

286. No additional mitigation is required.

Residual impacts

287. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Codling Fault Zone SAC from vessel collisions from the CWP Project alone.

2.4.1.1.3 Impact 3: Changes in prey availability

288. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

289. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Codling Fault Zone SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

290. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

291. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Codling Fault Zone SAC as a result of changes in prey availability.

Residual impacts

292. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation

Objectives of the harbour porpoise community associated with Codling Fault Zone SAC as a result of changes to prey availability from the CWP Project alone.

2.4.1.1.4 Impact 4: Changes in available habitat

293. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

294. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Codling Fault Zone SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

295. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

296. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Codling Fault Zone SAC as a result of changes in available habitat.

Residual impacts

297. There is expected to be no change to the FCS and no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Codling Fault Zone SAC from changes in available habitat from the CWP Project alone.

2.5 Lambay Island SAC (IE000204)

2.5.1 Grey seals [1364] and harbour seals [1365]

Table 2-12 Summary of assessment, Conservation Objectives, Attributes and Targets for grey seals and harbour seals of the Lambay Island SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Access to suitable habitat The species range within the site is not restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour seals or grey seals arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely (permanently) affect the access to suitable habitat within the site.	No additional mitigation is required.	There is no potential for an AESI associated with access to suitable habitat within the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the access to suitable habitat within the site.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the access to suitable habitat within the site.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in available habitat.	
Breeding / moulting / resting behaviour Conserve the breeding / moult-haul out / resting haul-out sites in a natural condition	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour seals or grey seals arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to affect the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition.	No additional mitigation is required.	There is no potential for an AESI associated with the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to affect the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition.	No additional mitigation is required.	There is no potential for an AESI associated with the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability are not expected to affect the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition.	No additional mitigation is required.	There is no potential for an AESI associated with the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition due to changes in prey availability.	
	Changes in available habitat			
	Given that there will be no construction activities taking place within the site, changes in available habitat are not expected to affect the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition.	No additional mitigation is required.	There is no potential for an AESI associated with the conservation of breeding / moult-haul out / resting haul-out sites in a natural condition due to changes in available habitat.	
Disturbance Human activities should occur at levels that do not adversely affect the grey and harbour seal population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour seals or grey seals arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on grey and harbour seal population within the site or deterioration of key resources upon which seals depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (grey and harbour seal) population due to increased underwater noise.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on grey and harbour seal population within the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (grey and harbour seal) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which grey and harbour seal depend to the extent that could affect seal populations at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (grey and harbour seal) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which grey and harbour seal depend to the extent that could affect seal populations at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (grey and harbour seal) population due to changes in available habitat.	

298. Lambay Island is located 4 km off Portrane on the north Co. Dublin coast. The SAC is 4.04 km^2 and encompasses the entire island in addition to very small area of the intertidal and subtidal areas immediately around it. The SAC is located approximately 19.2 km from the CWP Project.

299. Grey seals are present year-round, both at-sea and on-land. They use the site for breeding (August to December approx.), moulting (December to April approx.) and non-breeding, foraging and resting phases. At the time of designation, the site supported a breeding colony of 196–252 grey seals across all age classes (DAHG, 2014b).

300. Harbour seals are also present year-round, both at-sea and on-land. They use the site for breeding (May to July approx.), moulting (August to September approx.) and non-breeding foraging and resting phases. At the time of designation, the site supported regionally significant numbers of harbour seals, with up to 47 individuals counted at the site (DAHG, 2014b).

2.5.1.1 Conservation Objectives and Targets

301. The Conservation Objectives of the Lambay Island SAC are outlined in NPWS (2013a). They are identical for both seal species and so are listed once below and considered together as part of this assessment, unless otherwise specified where the different life histories of the species may warrant this.

302. The Conservation Objective is to maintain the favourable conservation condition of grey and harbour seals in Lambay Island SAC, which is defined by the following list of attributes and targets applicable to both species:

- Attribute 1: Access to suitable habitat:
  - Target 1: Species range within the site should not be restricted by artificial barriers to site use.
    - This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour / grey seal from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
    - It does not refer to short-term or temporary restriction of access or range.
- Attribute 2: Breeding behaviour:
  - Target 2: Conserve the breeding sites in a natural condition.
    - This target is relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) breeding behaviour by harbour / grey seal within the site and / or (b) aquatic / terrestrial / intertidal habitat used during the annual breeding season.
    - Operations or activities that cause displacement of individuals from a breeding site or alteration of natural breeding behaviour, and that may result in higher mortality or reduced reproductive success, would be regarded as significant and should therefore be avoided.
- Attribute 3: Moulting behaviour:
  - Target 3: Conserve the moult haul-out sites in a natural condition.
    - This target is relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) moulting behaviour by harbour / grey seal within the site and / or (b) aquatic / terrestrial / intertidal habitat used during the annual moult.
    - Operations or activities that cause displacement of individuals from a moult haul-out site or alteration of natural moulting behaviour to an extent that may ultimately

interfere with key ecological functions would be regarded as significant and should therefore be avoided.

- Attribute 4: Resting behaviour:
  - Target 4: Conserve the resting haul-out sites in a natural condition.
    - This target is relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) resting behaviour by harbour / grey seal within the site and / or (b) aquatic / terrestrial / intertidal habitat used for resting.
    - Operations or activities that cause displacement of individuals from a resting haul-out site to an extent that may ultimately interfere with key ecological functions would be regarded as significant and should therefore be avoided.
- Attribute 5: Disturbance:
  - Target 5: Human activities should occur at levels that do not adversely affect the harbour / grey seal population at the site.
    - Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour / grey seal within the site. This refers to both the aquatic and terrestrial / intertidal habitats used by the species in addition to important natural behaviours during the species annual cycle.
    - This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc) upon which harbour / grey seals depend. In the absence of complete knowledge on the species' ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
    - Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour / grey seal population at the site.

2.5.1.1.1 Impact 1: Increased underwater noise

Assessment of the project alone

303. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

304. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (MBES, SBI, SSS, SBP, UHRS, USBL);
- UXO clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

305. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions will draw upon the implementation of primary embedded mitigation measures where appropriate.

Auditory injury (PTS)

306. Target 5 of the Conservation Objectives states that 'Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour / grey seal population at the site' (NPWS, 2013a).

Pre-construction geophysical surveys

307. The impact assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible. There will be no overlap between PTS-onset ranges and the Lambay Island SAC.

UXO clearance

308. For UXO clearance, the maximum PTS-onset impact range for seals from high-order clearance was 2.5 km resulting in impact to up to three grey seals and zero harbour seals. There will be no overlap between PTS-onset ranges and the Lambay Island SAC.

Piling of WTGs

309. For piling of WTGs and the onshore substation, the maximum PTS-onset impact range for seals was <100 m resulting in no seals being impacted. There will be no overlap between PTS-onset ranges and the Lambay Island SAC.

Other construction activities

310. For other construction activities, the maximum PTS-onset impact range for seals was <100 m resulting in no seals being impacted. There will be no overlap between PTS-onset ranges and the Lambay Island SAC.

Operational noise

311. For operational noise, the maximum PTS-onset impact range for seals was <100 m resulting in no seals being impacted. There will be no overlap between PTS-onset ranges and the Lambay Island SAC.

Conclusion

312. There will be no overlap between any of the predicted PTS-onset impact contours and the Lambay Island SAC. Therefore, it is anticipated that there will be no direct potential for AESI to the Conservation Objectives of the grey and harbour seal features from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

313. Targets 2, 3 and 4 state that disturbance should not affect the natural condition of the breeding site, moulting haul-out sites and resting haul-out sites. Target 5 of the Conservation Objectives states that disturbance from '*Human activities should occur at levels that do not adversely affect the harbour / grey seal population at the site'* (NPWS, 2013a).

Pre-construction geophysical surveys

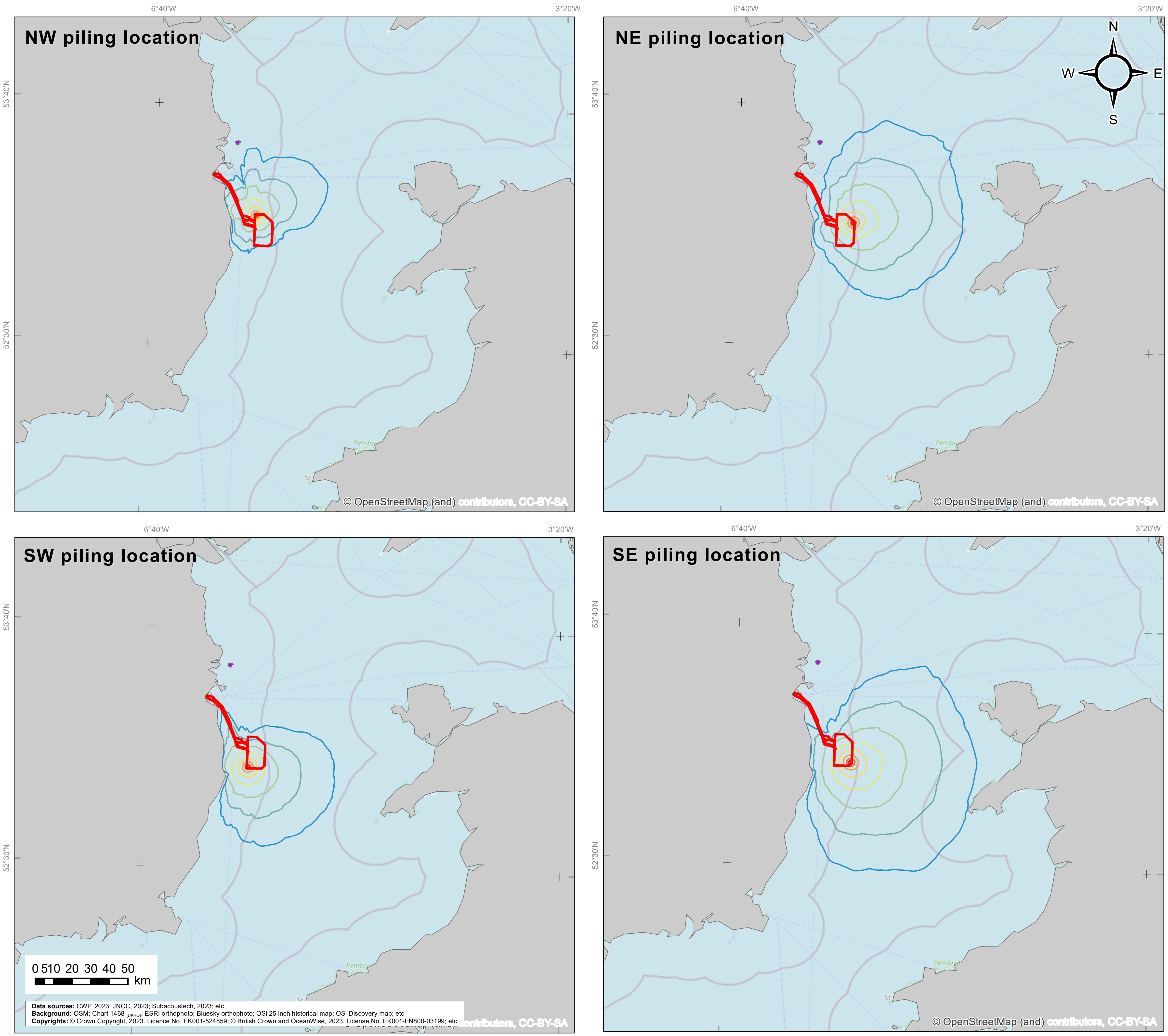
314. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* While seals are not an EPS, the same conclusion is considered to apply here for seals. There will be no overlap between disturbance ranges and the Lambay Island SAC.

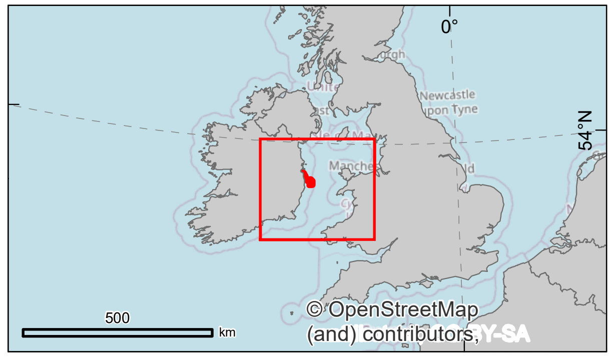
UXO clearance

315. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high-order clearance of a 525 kg UXO (+ donor), the disturbance range is 19 km (using TTS as a proxy for disturbance). For low-order clearance the disturbance range is 0.57 km (using TTS as a proxy for disturbance). The closest part of the CWP OECC is 20.1 km from the Lambay Island SAC. There will be no overlap between disturbance ranges and the Lambay Island SAC.

Piling of WTGs

316. For piling of WTGs, the disturbance assessment used the harbour seal dose-response function presented in Whyte et al. (2020). Even considering piling at a location in the closest proximity to the SAC, there is no overlap between behavioural disturbance ranges and the Lambay Island SAC (**Figure 2-3**) and therefore underwater noise will not lead to the exclusion of grey and harbour seals from their range within the site. Piling is planned to occur between April and October so is unlikely to significantly impact moulting behaviour of grey seals which typically occurs between December and April. While there is a temporal overlap of piling with breeding and resting for both species and also moulting for harbour seals, the lack of spatial overlap between behavioural disturbance ranges and the Lambay Island SAC means piling is not expected to impact breeding, resting or moulting behaviour at the site or adversely affect the populations of either species using the site.





Legend

- Planning application boundary
- SEL_{ss} dB re µPa²s (5dB contours)
  - 145 dB
  - 150 dB
  - 155 dB
  - 160 dB
  - 165 dB
  - 170 dB
  - 175 dB
  - 180 dB
- Lambay Island SAC

Project: Codling Wind Park

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Figure 2.03:
Disturbance thresholds for piling at all modelling locations and the Lambay Island SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1600

Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - LAMBAY.ISL.SAC - (NIS.Vol.04.Ch.02.FIG.04)

Size: A3
Scale: 1:2,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Piling at the onshore substation

317. For piling at the onshore substation, disturbance impact ranges will not overlap with the Lambay Island SAC.

Other construction activities

318. For other construction activities, disturbance ranges were expected to be highly localised (within 5 km). Disturbance impact ranges will not overlap with the Lambay Island SAC.

Operational noise

319. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann *et al*., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Lambay Island SAC. Additionally, it is highly unlikely that seals would be disturbed by operational noise, since it has been shown that tagged harbour and grey seals demonstrated grid-like movement patterns within operational OWFs with animals moving between individual WTGs, strongly suggestive of these structures being used for foraging (Russell *et al*., 2014).

Disturbance from vessels

320. For disturbance from vessels, short-term behavioural responses are predicted within 1 km from a vessel, impacting <1 grey or harbour seal. Vessel activity for the Project is not expected in the vicinity of the SAC and therefore disturbance impact ranges will not overlap with the Lambay Island SAC.

Conclusion

321. Given that there is no overlap between any of the predicted disturbance impact ranges and the Lambay Island SAC, the construction, O&M and decommissioning activities will not result in the displacement of individuals from a breeding site or alteration of natural breeding behaviour and therefore significant interference with or disturbance of breeding, moulting and resting behaviour of grey and harbour seals within the site. There will be no AESI to the grey or harbour seal features of the Lambay Island SAC from the CWP Project alone.

Exclusion

322. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of either grey or harbour seals from the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

323. The primary mitigation already includes implementing both a UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as a EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

324. No additional mitigation is required.

Residual impacts

325. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, or impediment to the Conservation Objectives of grey and harbour seal populations associated with the Lambay Island SAC from increased underwater noise from the CWP Project alone.

2.5.1.1.2 Impact 2: Collision risk

326. Target 5 of the Conservation Objectives states that 'Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour / grey seal population at the site' (NPWS, 2013a).

Assessment of the project alone

327. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array site and the OECC.

328. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

329. Vessels associated with the CWP Project are not expected to operate within the Lambay Island SAC. No seals within the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour / grey seal population at the site. Therefore, there is expected to be no potential for AESI, or impediment to the Conservation Objectives of the harbour / grey seal population from collision risk from the CWP Project alone.

Proposed mitigation

330. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With this primary mitigation measure in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

331. No additional mitigation is required.

Residual impacts

332. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of grey and harbour seal populations associated with the Lambay Island SAC from vessel collision from the CWP Project alone.

2.5.1.1.3 Impact 3: Changes in prey availability

333. Target 5 pf the Conservation Objectives states 'Human activities should occur at levels that do not adversely affect the harbour / grey seal population at the site', specifically, this target also relates to 'proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc) upon which harbour / grey seals depend' (NPWS, 2013a).

Assessment of the project alone

334. Given that seals are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of grey seal diet (Atlantic herring, sprat, salmonids, haddock, whiting, poor cod, ling, Atlantic horse mackerel, sandeel, plaice, sole, squid, octopus) and harbour seal diet (lamprey, herring, salmonids, haddock, whiting, poor cod, ling, hake, sandeel, mackerel, sole) both species are considered to be generalist feeders and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Lambay Island SAC could arise as a result of the impacts of changes in prey availability to seals as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of grey and harbour seals (e.g., whiting, herring, cod, sandeel).

335. In addition, the Lambay Island SAC includes only a very narrow strip of intertidal and subtidal waters around the Island, which is unlikely to be significant to the overall foraging success of either species. Indeed, it is land-based behaviours such as breeding, moulting and resting that make up the Conservation Objectives for the seal species at the Lambay Island SAC. Therefore, there is no potential for AESI, and no impediment to the Conservation Objectives for grey and harbour seals at the Lambay Island SAC from changes in prey availability at the site from the CWP Project alone.

Proposed mitigation

336. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Lambay Island SAC as a result of changes in prey availability.

Residual impacts

337. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of grey and harbour seal populations associated with the Lambay Island SAC from changes in prey availability from the CWP Project alone.

2.5.1.1.4 Impact 4: Changes in available habitat (seal haul-outs)

338. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour / grey seal from part of its range within the site or will permanently prevent access for the species to suitable habitat therein' (NPWS, 2013a).

Assessment of the project alone

339. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent alteration of the terrestrial, intertidal or subtidal (aquatic) habitats that support breeding, moulting and resting behaviours of the seals within the SAC. Therefore, the integrity of the breeding, moulting and resting sites for both species is expected to be maintained in a natural condition.

340. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the grey seal or harbour seal features from changes in available habitat (seal haul-outs) from the CWP Project alone.

Proposed mitigation

341. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Lambay Island SAC as a result of changes in available habitat.

Residual impacts

342. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI to the Conservation Objectives of grey and harbour seal populations associated with the Lambay Island SAC from changes in available habitat from the CWP Project alone.

2.5.2 Harbour porpoise

343. Lambay Island is located 4 km off Portrane on the north Co. Dublin coast. The SAC is 4.04 km^2 and encompasses the entire island in addition to very small area of the intertidal and subtidal areas immediately around it. In March 2024, harbour porpoise were added as a Qualifying Interest to the Lambay Island SAC. While the Site Synopsis was amended in March 2024 to list harbour porpoise, it provides no information on the presence of porpoise within the site, or the importance of the site for harbour porpoise.

344. Since the Lambay Island SAC is primarily on land, and is located within the Rockabill to Dalkey Island SAC (for which a full assessment has been provided), it is not assessed separately here for harbour porpoise.

2.6 North Anglesey Marine SAC (UK0030398)

2.6.1 Harbour porpoise

Table 2-13 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the North Anglesey Marine SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Harbour porpoise is (i.e., remains) a viable component of the site	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore,	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	harbour porpoise are expected to remain a viable component of the site.			
	Changes in prey availability			
	Changes in prey availability is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in habitat are not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in available habitat.	
Population There is no significant disturbance of the species.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to lead to the exclusion of harbour porpoise from a significant proportion	No additional mitigation is required.	There is expected to be no potential for an AESI to the Conservation Objectives of the harbour porpoise population associated with the Bristol Channel Approaches SAC from	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	of the site for a significant period of time, in line with thresholds set in JNCC (2019c).		increased underwater noise from the CWP Project alone.	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	There is no potential impact pathway between changes in available habitat and this Conservation Objective.	N/A	N/A	
Habitat The condition of supporting habitats and processes, and the availability of prey is maintained.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	There is no potential impact pathway between increased underwater noise and this Conservation Objective.	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Effects due to changes in prey availability are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site.	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in prey availability at CWP Project.	
	Changes in available habitat			
	Effects due to changes in available habitat are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site.	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in available habitat at CWP Project.	

345. The North Anglesey Marine SAC is situated off the northwest corner of Wales and extends from the Anglesey coast into the offshore waters (>12 nm) between Ireland and the Isle of Man, within the Irish Sea. The site covers an area of 3,249 km^2, with water depths down to a maximum of 100 m along the western boundary[17].

346. The North Anglesey Marine SAC was designated for the qualifying feature harbour porpoise in February 2019 after its recognition as an important summer (April – September) area for harbour porpoise (DAERA and JNCC, 2017). The site is estimated to support 2.4% of the Celtic and Irish Sea MU (JNCC and NRW, 2017).

2.6.1.1 Conservation Objectives

347. The Conservation Objectives are detailed in (JNCC, 2019b): *'To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:*

- 1) Harbour porpoise is a viable component of the site:
  - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site.
  - Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range.
- 2) There is no significant disturbance of the species:
  - Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.
  - Noise disturbance within an SAC from a plan / project individually or in combination is significant if it excludes harbour porpoises from more than:
    - 1. 20% of the relevant area of the site in any given day; and
    - 2. an average of 10% of the relevant area of the site over a season.
- 3) The condition of supporting habitats and processes, and the availability of prey is maintained:
  - Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.
  - The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site'.

2.6.1.1.1 Impact 1: Increased underwater noise

348. The Conservation Objectives of relevance are to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury) and to ensure that *'there is no significant disturbance of the species'*.

[17] https://jncc.gov.uk/our-work/north-anglesey-marine-mpa/.

Assessment of the project alone

349. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise produced during construction. Therefore, a detailed assessment has been provided for this impact pathway within **Chapter 11 Marine Mammals**.

350. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

351. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

352. The CWP Project is located approximately 38 km away from the North Anglesey Marine SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

353. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance of a 525 kg UXO (+ donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. Therefore, the risk of PTS following mitigation through the UXO MMMP is negligible. There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC.

354. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

355. For piling at the onshore substation, PTS impact ranges will not overlap with the North Anglesey SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

356. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC.

357. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

358. For other construction activities, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

359. For operational noise, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

360. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

361. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS both in situ and ex situ are expected to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for Adverse effect on site integrity (AESI) to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

362. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Disturbance will only cause short-term and / or intermittent and temporary behavioural effects in a limited spatial extent around the source. With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals). Disturbance impact ranges will not overlap with the North Anglesey Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

363. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). Disturbance impact ranges will not overlap with the North Anglesey Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

364. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

365. For piling at the onshore substation, disturbance impact ranges will not overlap with the North Anglesey Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in

temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

366. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges will not overlap with the North Anglesey Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

367. For piling of WTGs, the approach presented here is in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023). This involves the use of the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, as well as the 26 km EDR approach as outlined by JNCC (2020).

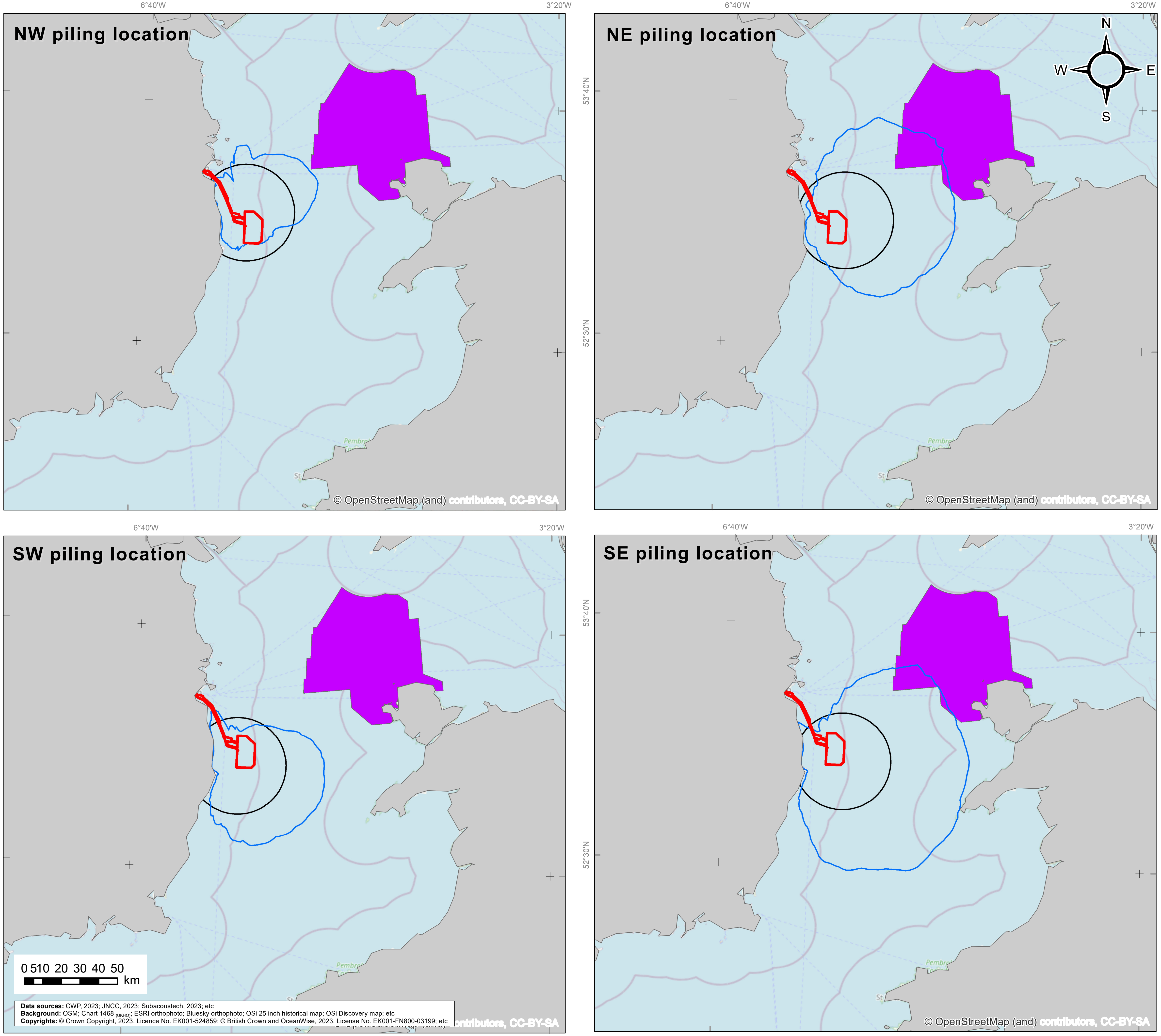
In situ disturbance from piling of WTGs

368. Daily: Using the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), disturbance impact ranges overlap with a maximum of 14% of the area of the North Anglesey Marine SAC. This level of overlap does not constitute a significant disturbance, as it remains below the 20% daily threshold outlined within the Conservation Objectives. Using the 26 km EDR approach, there will be no overlap between the CWP Project and the North Anglesey Marine SAC, and therefore there is no contribution to the noise disturbance thresholds for the SAC (**Table 2-14 & Figure 2-4**).

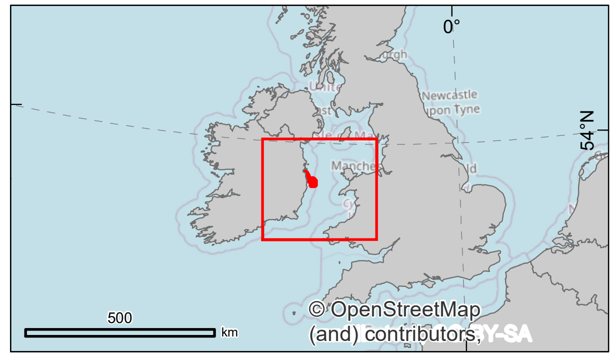
369. Summer season: Consideration also needs to be given to the amount of disturbance that occurs over the summer season specifically. If it is assumed that all 78 piling days occur between April and September, with a daily footprint of 461.5 km^2, then the average area of the SAC disturbed over the summer season is 5.96%. This level of overlap does not constitute a significant disturbance, as it remains below the 10% seasonal threshold outlined within the Conservation Objectives.

Table 2-14 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the North Anglesey Marine SAC

Model location	Disturbance Threshold	Total overlap (% SAC area)
NE	145 dB SEL_{ss}	461.5 km^2 (14% SAC)
NW	145 dB SEL_{ss}	0 km^2 (0% SAC)
SE	145 dB SEL_{ss}	254.7 km^2 (8% SAC)
SW	145 dB SEL_{ss}	0 km^2 (0% SAC)
All	26 km EDR	0 km^2 (0% SAC)



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^{2}s threshold
- 26 km EDR
- North Anglesey Marine SAC

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Figure 2.04:
Disturbance thresholds for piling at all modelling locations and the North Anglesey Marine SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1601

Internal descriptive code: IS - PAB..DPNM.THRESH.SEL.26EDR.CONT.WTGs.CORNERS - NORTH.ANGLESEY.MARINE.SAC - (NIS.Vol.04.Ch.02.FIG.05)

Size: A3
Scale: 1:2,000,000
CRS: EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/07/16	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

370. For ex situ disturbance from piling of WTGs, the assessment for the North Anglesey Marine SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

371. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** of the EIAR). Therefore, the introduction of additional vessels associated with the CWP Project is not a novel impact for marine mammals present in the area.

372. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

373. The project has committed to the adoption of a **EVMP** to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

374. Vessels associated with the CWP Project are not expected to operate within the North Anglesey Marine SAC. Disturbance impact ranges will not overlap with the North Anglesey Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

Conclusion

375. Considering the impact pathways described above, disturbance effects from increased underwater noise are below the thresholds for significant disturbance. Therefore, there is expected to be no potential for AESI to the North Anglesey Marine SAC from the CWP Project alone.

Exclusion

376. None of the activities associated with the construction, O&M and decommissioning of WTGs at the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

377. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

378. No additional mitigation is required.

Residual impacts

379. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise associated with the North Anglesey Marine SAC from increased underwater noise from the CWP Project alone.

2.6.1.1.2 Impact 2: Collision risk

380. The Conservation Objective of relevance is to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury).

Assessment of the project alone

381. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC. Vessels associated with the CWP Project are not expected to operate within the North Anglesey Marine SAC.

382. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. No harbour porpoise within or outwith the SAC are expected to experience death or injury from collisions with Project vessels. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

383. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

384. No additional mitigation is required.

Residual impacts

385. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of harbour porpoise associated with the North Anglesey Marine SAC from vessel collisions from the CWP Project alone.

2.6.1.1.3 Impact 3: Changes in prey availability

386. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes, and the availability of prey is maintained'.

Assessment of the project alone

387. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the North Anglesey Marine SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

388. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition or diversity in situ or ex situ. There is therefore no potential for AESI to the Conservation Objectives of harbour porpoise from changes in prey availability from the CWP Project alone.

Proposed mitigation

389. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the North Anglesey Marine SAC as a result of changes in prey availability.

Residual impacts

390. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the North Anglesey Marine SAC as a result of changes to prey availability from the CWP Project alone.

2.6.1.1.4 Impact 4: Changes in available habitat

391. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes […] is maintained. Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat'.

Assessment of the project alone

392. To inform this NIS, **Chapter 6: Marine Geology, Sediments and Coastal processes** and **Chapter 7: Marine Water Quality** of the EIAR prepared for the Project were referred to, for the purposes of establishing whether adverse effects on the integrity of the North Anglesey Marine SAC could arise as a result of the impacts to the supporting habitats and processes.

393. The EIAR concludes that there will be no significant impact to marine geology, sediments and coastal processes from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations and associated deposition, alteration to seabed morphology or composition and alteration to the hydrodynamic, wave and sediment regimes and coastal processes). Likewise, the EIAR concludes that there will be no significant impact to marine water quality from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations, resuspension of contaminated sediments, or accidental pollution). All impacts are expected to be highly localised and will not affect the supporting habitat within the North Anglesey Marine SAC.

Proposed mitigation

394. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the North Anglesey Marine SAC as a result of changes in available supporting habitat.

Residual impacts

395. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise population associated with the North Anglesey Marine SAC from changes in available supporting habitat from the CWP Project alone.

2.7 Blackwater Bank SAC (IE002953)

2.7.1 Harbour porpoise

Table 2-15 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour Porpoise of the Blackwater Bank SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

396. The Blackwater Bank SAC is a series of sandbanks parallel to the coastline of Co. Wexford. The SAC was originally designated for Sandbanks [1110].

397. In March 2024, harbour porpoise [1351] were added as a Qualifying Interest to the Blackwater Bank SAC. While the Site Synopsis was amended in March 2024 to list harbour porpoise, it provides no information on the presence of porpoise within the site, or the importance of the site for harbour porpoise.

2.7.1.1 Conservation Objectives and Targets

398. No Conservation Objectives have been set for harbour porpoise at this site yet. Therefore, it is assumed that the Conservation Objectives at the nearby Rockabill to Dalkey Island SAC apply here.

399. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)).

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.7.1.1.1 Impact 1: Increased underwater noise

400. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site' NPWS (2013b).

Assessment of the project alone

401. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

402. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

403. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

404. The CWP array site is located approximately 55.6 km from the SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Blackwater Bank SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

405. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. There will be no overlap between PTS-onset ranges and the Blackwater Bank SAC for either high- or low-order UXO clearance and no impacts to the SAC in situ.

406. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

407. For piling at the onshore substation, PTS impact ranges will not overlap with the Blackwater Bank SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

408. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Blackwater Bank SAC in situ.

409. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

410. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Blackwater Bank SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

411. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Blackwater Bank SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

412. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

413. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS both in situ and ex situ are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

414. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Blackwater Bank SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

415. The underwater noise modelling (see **Chapter 11 Marine Mammals** of the EIA) which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and the Blackwater Bank SAC.

416. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

417. For piling at the onshore substation, disturbance impact ranges will not overlap with the Blackwater Bank SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

418. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Blackwater Bank SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

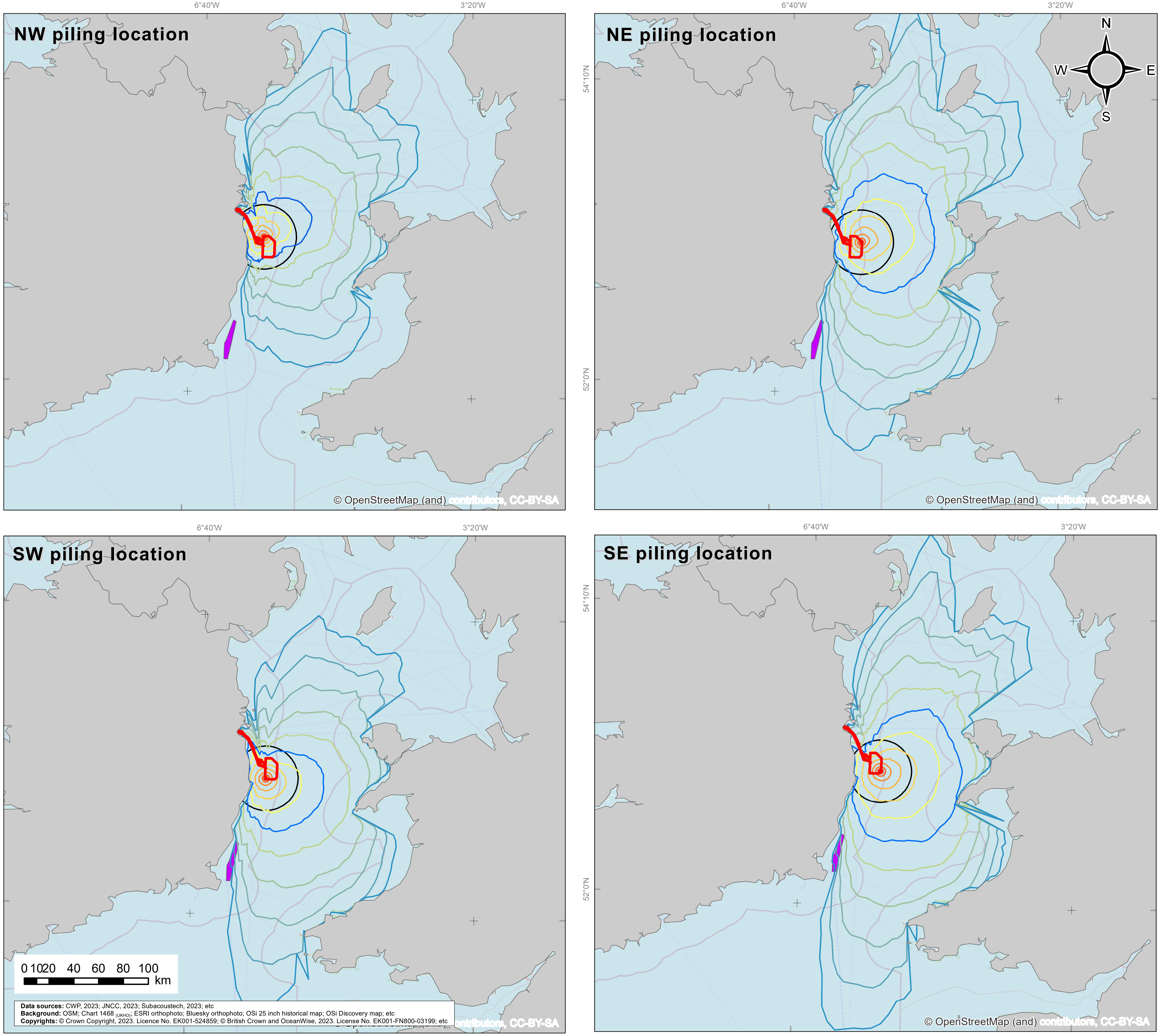
Piling of WTGs

419. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

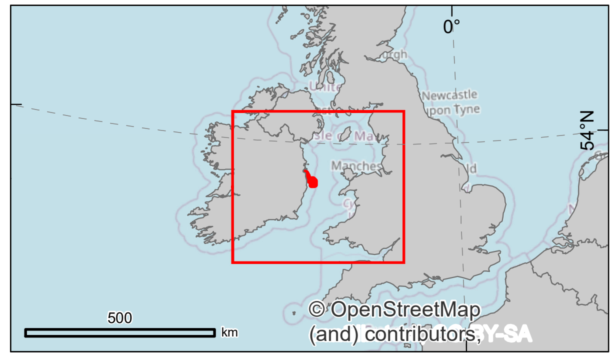
420. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

421. Using the harbour porpoise dose-response function a portion of the disturbance contours overlap with the Blackwater Bank SAC boundary (see **Figure 2-5** and **Table 2-17**). Based on the dose-response assumptions, there is effective disturbance to 3% of the SAC area from piling at the SE location, where 1 harbour porpoise within the SAC is predicted to show a disturbance response (**Table 2-16**). When using the Lucke et al*.* (2009) 145 dB SEL_{ss} threshold, none of the disturbance impact ranges overlap with the Blackwater Bank SAC. When using the 26 km EDR approach, none of disturbance impact ranges overlap with the Blackwater Bank SAC.



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re μPa^{2}s threshold
- 26 km EDR
- SEL_{ss} dB re μPa^{2}s (5dB contours)
  - 120 dB
  - 125 dB
  - 130 dB
  - 135 dB
  - 140 dB
  - 145 dB
  - 150 dB
  - 155 dB
  - 160 dB
  - 165 dB
  - 170 dB
  - 175 dB
  - 180 dB
- Blackwater Bank SAC

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Figure 2.05:
Disturbance thresholds for piling at all modelling locations and the Blackwater Bank SAC designated for harbour porpoise

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Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - BLACKWATER.BANK.SAC - (NIS.Vol.04.Ch.02.FIG.06)

Size: A3
Scale: 1:3,000,000

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A	Final version	2024/08/01	JC	RRS/EA	EA

Table 2-16 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the Blackwater Bank SAC

Disturbance Threshold	Model location	Total overlap (% SAC area)	Effective area disturbed (% SAC)	# porpoise disturbed in SAC[18]
Dose-response	NE	2.3 km^2 (2% SAC)	0.03 km^2 (0.02% SAC)	<1
	NW	0	0	0
	SE (see **Table 2-17** for detail)	112 km^2 (90% SAC)	3.7 km^2 (3% SAC)	1
	SW	63.5 km^2 (51% SAC)	1.5 km^2 (1.2% SAC)	<1
145 dB SEL_{ss}	NE	0 km^2	NA	0
	NW	0 km^2		0
	SE	0 km^2		0
	SW	0 km^2		0
26 km EDR	NE	0 km^2	NA	0
	NW	0 km^2		0
	SE	0 km^2		0
	SW	0 km^2		0

[18] Using a density of 0.2803 from SCANS IV.

Table 2-17 Dose-response function overlap with the Blackwater Bank SAC for piling at the SE location

Contour (unweighted dB SEL_{ss})	Area of SAC within contour (km^2)	% response within contour	Effective area of SAC disturbed (km^2)	# porpoise predicted to respond
130<135	20.0	9	1.8	<1
125<130	39.8	3	1.4	<1
120<125	52.2	1	0.6	<1
TOTAL	**112**	**-**	**3.7**	**1**

422. In English, Welsh and Northern Irish harbour porpoise SACs, disturbance to 20% of the SAC area on a single day is considered significant (JNCC, 2020). The European Commission (EC) Directorate-General for Environment has set binding limits for underwater noise pollution (11 March 2024[19]). This states that for impulsive noise (such as piling): *'For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment / habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20% or lower (≤ 20%)'*. It is important to note that there is no advised threshold value for LOBE ('*a sound level above which an adverse biological effect on an indicator species is expected to occur, i.e., an effect that may affect the comfort, survival, and vital functions of individual animals*'), nor is there guidance on what constitutes '*assessment / habitat area utilised by a species'.* In the absence of specific guidance from NPWS on the application of the aforementioned EC limits for impulsive noise, the suitability of the approaches to estimating disturbance described in paragraph 316 for determining the LOBE is unknown. Similarly, given the wide-ranging and highly mobile nature of harbour porpoise, it is not clear if an individual SAC constitutes an appropriate assessment / habitat area. Nonetheless, a precautionary approach is to assume that disturbance, estimated by the methods described above, to 20% of the SAC area on a single piling day could constitute significant disturbance and a breach of the EC limits. **Table 2-16** shows that none of the disturbance thresholds for any of the piling locations will breach this 20% area threshold and thus there is considered to be no significant disturbance impact to porpoise within the SAC.

Ex situ disturbance from piling of WTGs

423. For ex situ disturbance from piling of WTGs, the assessment for the Blackwater Bank SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

424. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** of the EIAR). Therefore, the introduction of additional vessels during construction of the CWP Project is not a novel impact for marine mammals in the area.

425. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

426. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise

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[19] https://environment.ec.europa.eu/publications/notice-under-marine-strategy-framework-directive_en.

the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

427. Vessels associated with the CWP Project are not expected to operate within the Blackwater Bank SAC. Disturbance impact ranges will not overlap with the Blackwater Bank SAC.

Conclusion

428. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

429. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

430. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

431. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

432. No additional mitigation is required.

Residual impacts

433. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI on the harbour porpoise community associated with the Blackwater Bank SAC from increased underwater noise from the CWP Project alone.

2.7.1.1.2 Impact 2: Collision risk

434. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

435. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

436. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

437. Vessels associated with the CWP Project are not expected to operate within the Blackwater Bank SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

438. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

439. No additional mitigation is required.

Residual impacts

440. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Blackwater Bank SAC from vessel collisions from the CWP Project alone.

2.7.1.1.3 Impact 3: Changes in prey availability

441. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

442. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen *et al*., 2021, Eerkes-Medrano *et al*., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was

referred to, for the purposes of establishing whether adverse effects on the integrity of the Blackwater Bank SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

443. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

444. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Blackwater Bank SAC as a result of changes in prey availability.

Residual impacts

445. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with Blackwater Bank SAC as a result of changes to prey availability from the CWP Project alone.

2.7.1.1.4 Impact 4: Changes in available habitat

446. Target 1 of the Conservation Objectives states that ‘Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein’.

Assessment of the project alone

447. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Blackwater Bank SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

448. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

449. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Blackwater Bank SAC as a result of changes in available habitat.

Residual impacts

450. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Blackwater Bank SAC from changes in available habitat from the CWP Project alone.

2.8 Blasket Islands SAC (IE002172)

2.8.1 Harbour porpoise

Table 2-18 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the Blasket Islands SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

451. The Blasket Islands SAC (site code 002172) is designated for harbour porpoise and are located off the Dingle peninsula in Co. Kerry. The site includes all of the islands in the group as well as a substantial area of the surrounding seas and has a site area of 227 km^2.

452. The site is of importance for harbour porpoise, a species which has a regular presence in Blasket Sound. Abundance estimation surveys for harbour porpoise have been carried out in the Blasket Island SAC in 2007, 2008, 2014, 2018 and 2022 under contract to the National Parks and Wildlife Services (NPWS) (O'Brien and Berrow, 2014, Berrow et al., 2007, O'Brien et al., 2022). In the most recent 2022 survey, harbour porpoise abundance within the SAC was calculated at 18 (95% CI: 8–41) and density was estimated at 0.08 (95% CI: 0.03–0.18) individuals per km^2 (O'Brien et al., 2022). The density estimate recorded during the 2022 survey was dramatically lower than previous estimates from the Blasket Islands SAC in 2007, 2008, 2014 and 2018 but follows a downward trend since 2008 where density peaked at 1.65 porpoises per km^2 (O'Brien et al., 2022).

2.8.1.1 Conservation Objectives and Targets

453. The Conservation Objective is to maintain the favourable conservation condition of harbour porpoise in the Blasket Islands SAC, which is defined by the following list of attributes and targets (as listed in (NPWS, 2014a)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.8.1.1.1 Impact 1: Increased underwater noise

454. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

455. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

456. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

457. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

458. The CWP array site is located approximately 450 km away from the Blasket Islands SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Blasket Islands SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

459. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. There will be no overlap between PTS-onset ranges and the Blasket Islands SAC. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. Therefore, the risk of PTS following mitigation through the UXO MMMP is negligible. There will be no overlap between PTS-onset ranges and the North Anglesey Marine SAC.

460. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity

for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

461. For piling at the onshore substation, PTS impact ranges will not overlap with the Blasket Islands SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

462. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Blasket Islands SAC.

463. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

464. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Blasket Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

465. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Blasket Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

466. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of

MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

467. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

468. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Blasket Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

469. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and the Blasket Islands SAC.

470. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

471. For piling at the onshore substation, disturbance impact ranges will not overlap with the Blasket Islands SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

472. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Blasket Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

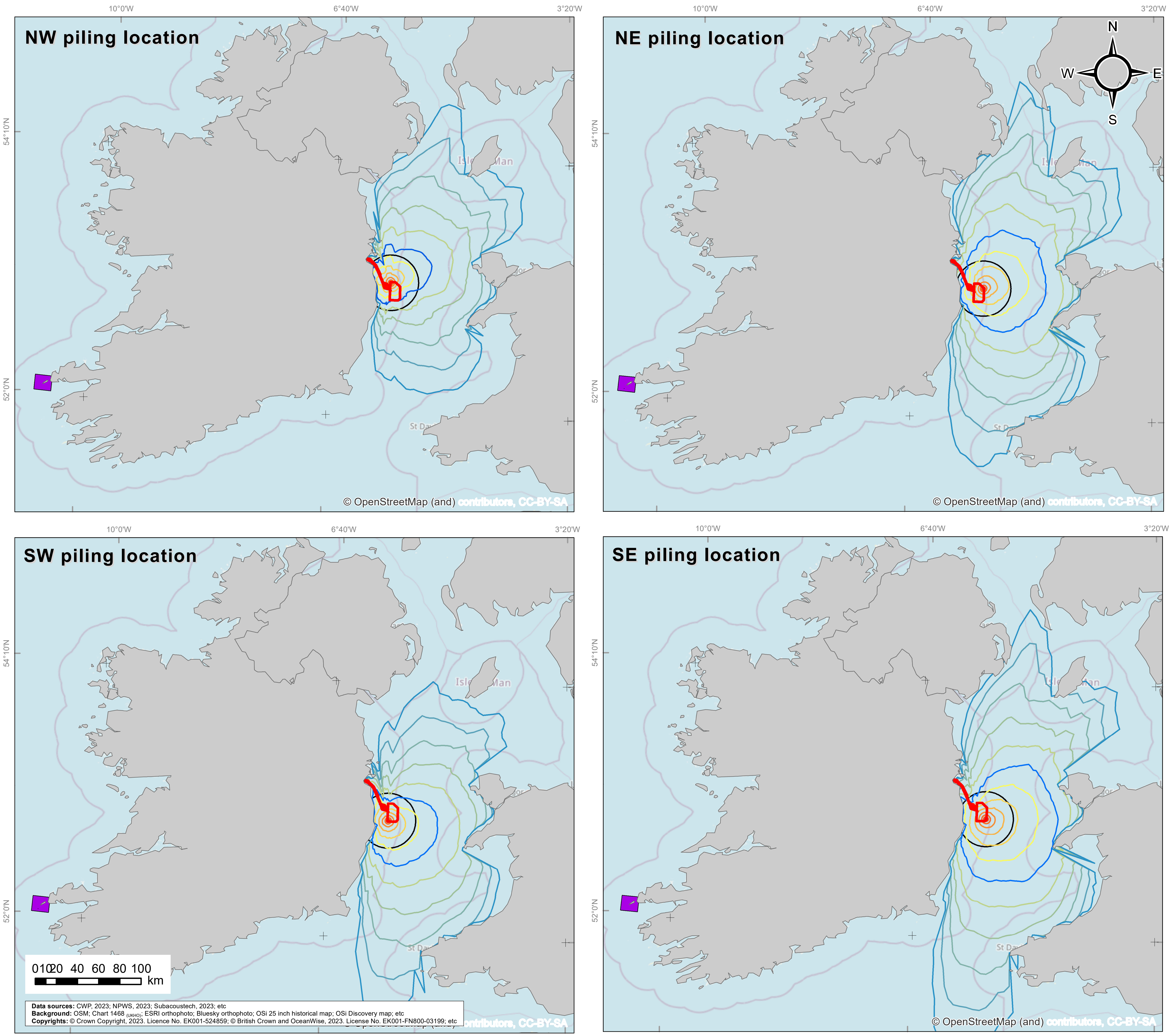
Piling of WTGs

473. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

474. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

475. None of the disturbance contours overlap with the Blasket Islands SAC (**Figure 2-6**).



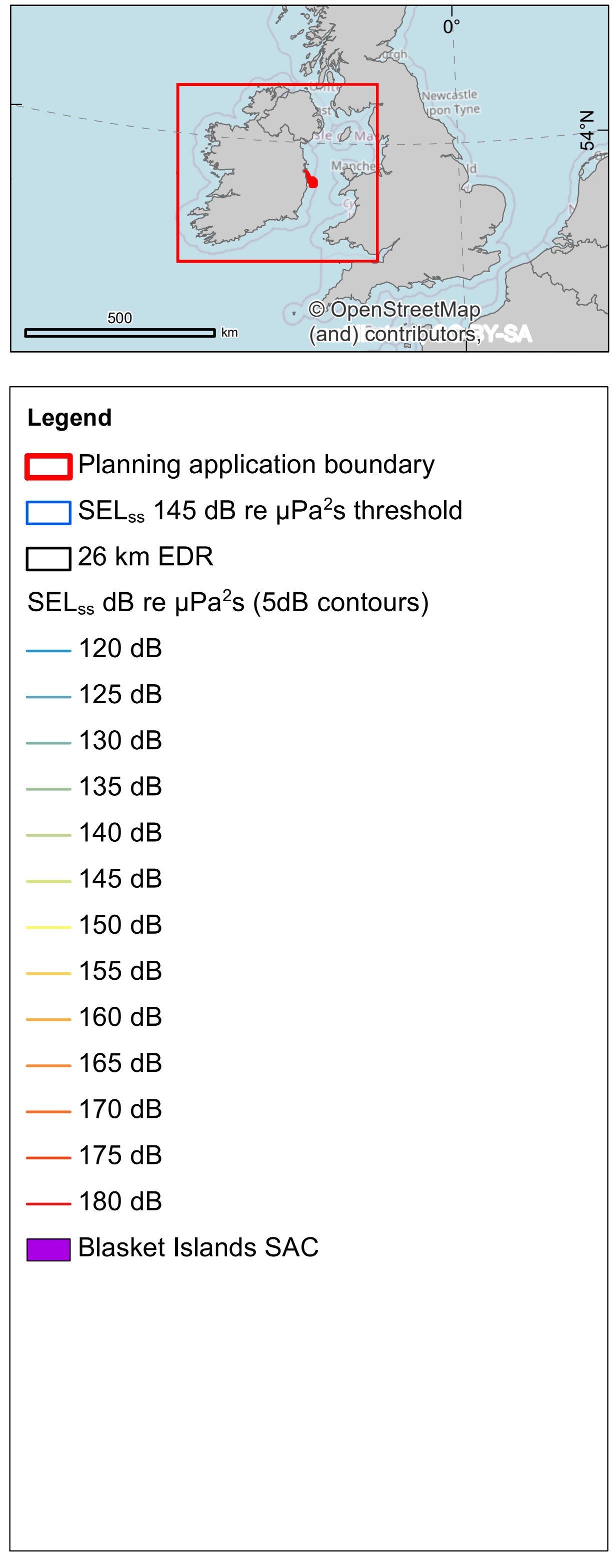


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Figure 2.06:
Disturbance thresholds for piling at all modelling locations and the Blasket Islands SAC designated for harbour porpoise

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Internal descriptive code: IRE - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR. CONT.WTGs.CORNERS - BLASKET.ISL.SAC - (NIS.Vol.04.Ch.02.FIG.07)

Size: A3
Scale: 1:3,500,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

476. For ex situ disturbance from piling of WTGs, the assessment for the Blasket Islands SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

477. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

478. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

479. Vessels associated with the CWP Project are not expected to operate within the Blasket Islands SAC. Disturbance impact ranges will not overlap with the Blasket Islands SAC.

Conclusion

480. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

481. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

482. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

483. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

484. No additional mitigation is required.

Residual impacts

485. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Blasket Islands SAC from increased underwater noise from the CWP Project alone.

2.8.1.1.2 Impact 2: Collision risk

486. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

487. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

488. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 ‘Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters’, the already low risk of vessel collisions will be further reduced.

489. Vessels associated with the CWP Project are not expected to operate within the Blasket Islands SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

490. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

491. No additional mitigation is required.

Residual impacts

492. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Blasket Islands SAC from vessel collisions from the CWP Project alone.

2.8.1.1.3 Impact 3: Changes in prey availability

493. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

494. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Blasket Islands SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

495. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

496. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Blasket Islands SAC as a result of changes in prey availability.

Residual impacts

497. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation

Objectives of the harbour porpoise community associated with Blasket Islands SAC as a result of changes to prey availability from the CWP Project alone.

2.8.1.1.4 Impact 4: Changes in available habitat

498. Target 1 of the Conservation Objectives states that ‘Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein’.

Assessment of the project alone

499. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Blasket Islands SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

500. Considering the above, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

501. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Blasket Islands SAC as a result of changes in available habitat.

Residual impacts

502. There is expected to be no change to the FCS and no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Blasket Islands SAC from changes in available habitat from the CWP Project alone.

2.9 Carnsore Point SAC (IE002269)

2.9.1 Harbour porpoise

Table 2-19 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the Carnsore Point SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its	No additional	There is no potential for an AESI associated with	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	range within the site and will not permanently prevent access for the species to suitable habitat.	mitigation is required.	maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise	No additional	There is no potential for an AESI associated with	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	depend to the extent that could affect harbour porpoise population at the site.	mitigation is required.	maintaining the species (harbour porpoise) population due to changes in available habitat.	

503. The Carnsore Point SAC is located southeast of Co. Wexford and comprises the area of sea and underlying bedrock and sediments off Carnsore Point. It was originally designated for Mudflats and sandflats not covered by seawater at low tide [1140] and Reefs [1170].

504. In March 2024, harbour porpoise [1351] were added as a Qualifying Interest to the Carnsore Point SAC. While the Site Synopsis was amended in March 2024 to list harbour porpoise, it provides no information on the presence of porpoise within the site, or the importance of the site for harbour porpoise.

2.9.1.1 Conservation Objectives and Targets

505. No Conservation Objectives have been set for harbour porpoise at this site yet. Therefore, it is assumed that the Conservation Objectives at the nearby Rockabill to Dalkey Island SAC apply here.

506. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.9.1.1.1 Impact 1: Increased underwater noise

507. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site’, and ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

508. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

509. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

510. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

511. The CWP array site is located approximately 87 km away from the Carnsore Point SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Carnsore Point SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

512. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. There will be no overlap between PTS-onset ranges and the Carnsore Point SAC.

513. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

514. For piling at the onshore substation, PTS impact ranges will not overlap with the Carnsore Point SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

515. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Carnsore Point SAC.

516. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

517. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Carnsore Point SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

518. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Carnsore Point SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

519. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that will be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that can be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

520. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

521. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Carnsore Point SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

522. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and the Carnsore Point SAC.

523. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

524. For piling at the onshore substation, disturbance impact ranges will not overlap with the Carnsore Point SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

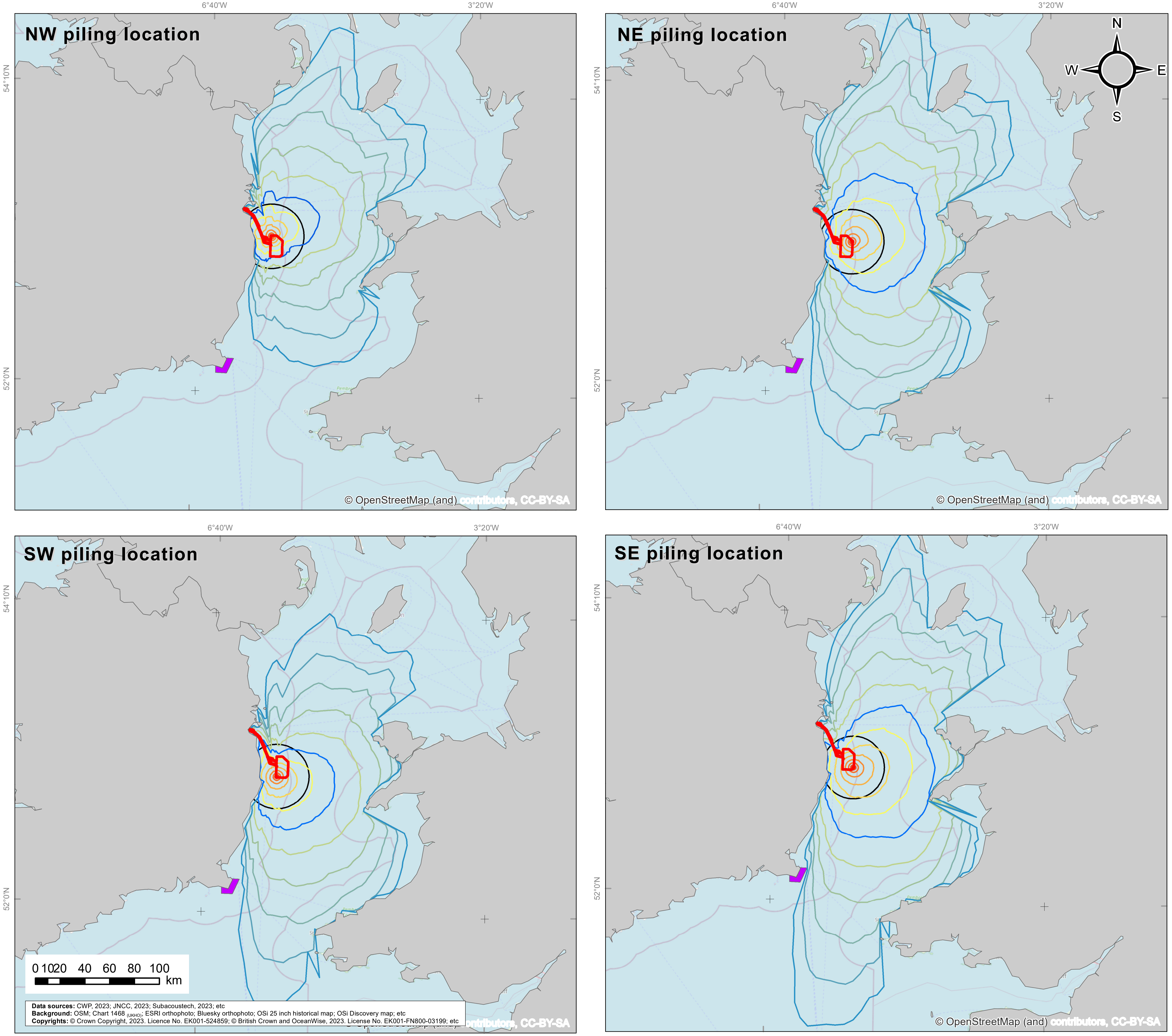
525. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Carnsore Point SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

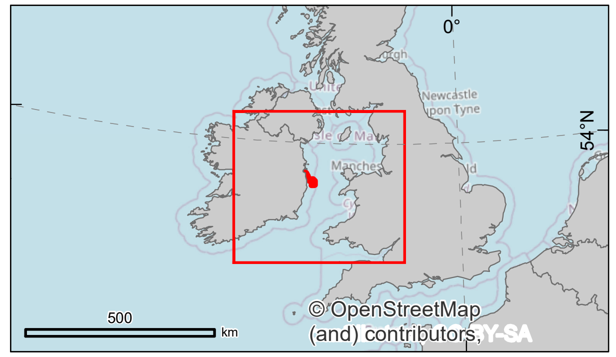
526. For piling of WTGs, the disturbance assessment using the harbour porpoise dose-response function presented in (Graham et al., 2017). There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

527. None of the disturbance thresholds overlap with the Carnsore Point SAC boundary (see **Figure 2-7** and **Table 2-20**).



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa²s threshold
- 26 km EDR

SEL_{ss} dB re µPa²s (5dB contours)

- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- Carnsore Point SAC

Project: Codling Wind Park

SMRU Consulting
understand • assess • mitigate

Figure 2.07:
Disturbance thresholds for piling at all modelling locations and the Carnsore Point SAC designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1604

Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - CARNSORE.POINT.SAC - (NIS.Vol.04.Ch.02.FIG.08)

Size: A3
Scale: 1:3,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Table 2-20 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and Carnsore Point SAC

Disturbance Threshold	Model location	Total overlap (% SAC area)	Effective area disturbed (% SAC)	# porpoise disturbed in SAC[20]
Dose-response	all	0	0	0
145 dB SEL_{ss}	all	0	0	0
26 km EDR	all	0	0	0

[20] Using a density of 0.2803 porpoise/km++2++ from SCANS IV.

Ex situ disturbance from piling of WTGs

528. For ex situ disturbance from piling of WTGs, the assessment for Carnsore Point SAC is synonymous with that for Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

529. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** in the EIAR). Therefore, the introduction of additional vessels during construction of the CWP Project is not a novel impact for marine mammals present in the area.

530. Irrespective of this, harbour porpoise may still be disturbed by the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

531. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

532. Vessels associated with the CWP Project are not expected to operate within Carnsore Point SAC. Disturbance impact ranges will not overlap with Carnsore Point SAC.

Conclusion

533. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

534. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

535. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

536. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

537. No additional mitigation is required.

Residual impacts

538. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and no potential for an AESI on the harbour porpoise community associated with Carnsore Point SAC from increased underwater noise from the CWP Project alone.

2.9.1.1.2 Impact 2: Collision risk

539. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

540. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

541. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 ‘Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters’, the already low risk of vessel collisions will be further reduced.

542. Vessels associated with the CWP Project are not expected to operate within the Carnsore Point SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

543. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

544. No additional mitigation is required.

Residual impacts

545. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI on the harbour porpoise community associated with Carnsore Point SAC from vessel collisions from the CWP Project alone.

2.9.1.1.3 Impact 3: Changes in prey availability

546. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

547. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Carnsore Point SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

548. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

549. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of Carnsore Point SAC as a result of changes in prey availability.

Residual impacts

550. There is expected to be no change to the FCS, no impediment to the Conservation Objectives being achieved, and there is no potential for an AESI on the harbour porpoise community associated with Carnsore Point SAC as a result of changes to prey availability from the CWP Project alone.

2.9.1.1.4 Impact 4: Changes in available habitat

551. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

552. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within Carnsore Point SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

553. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

554. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Carnsore Point SAC as a result of changes in available habitat.

Residual impacts

555. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Carnsore Point SAC from changes in available habitat from the CWP Project alone.

2.10 Hook Head SAC (IE000764)

2.10.1 Harbour porpoise

Table 2-21 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the Hook Head SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See Impact 1: Increased underwater noise	There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See Impact 2: Collision risk	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See Impact 3: Changes in prey availability	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See Impact 4: Changes in available habitat	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend. See Impact 1: Increased underwater noise	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site. See Impact 2: Collision risk	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise)	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See Impact 3: Changes in prey availability	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See Impact 4: Changes in available habitat	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

556. The Hook Head SAC is a marine subtidal reef, located south and east of Hook Head Peninsula. The SAC was originally designated for Large shallow inlets and bays [1160], Reefs [1170], Vegetated sea cliffs of the Atlantic and Baltic coasts [1230].

557. In March 2024, harbour porpoise [1351] were added as a Qualifying Interest to the Hook Head SAC. While the Site Synopsis was amended in March 2024 to list harbour porpoise, it provides no information on the presence of porpoise within the site, or the importance of the site for harbour porpoise.

2.10.1.1 Conservation Objectives and Targets

558. No Conservation Objectives have been set for harbour porpoise at this site yet. Therefore, it is assumed that the Conservation Objectives at the nearby Rockabill to Dalkey Island SAC apply here.

559. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.10.1.1.1 Impact 1: Increased underwater noise

560. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site’, and ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

561. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

562. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

563. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

564. The CWP array site is located approximately 130 km away from Hook Head SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Hook Head SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

565. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

566. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

567. For piling at the onshore substation, PTS impact ranges will not overlap with the Hook Head SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

568. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

569. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

570. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

571. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

572. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

573. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

574. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

575. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and the Hook Head SAC.

576. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

577. For piling at the onshore substation, disturbance impact ranges will not overlap with the Hook Head SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

578. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

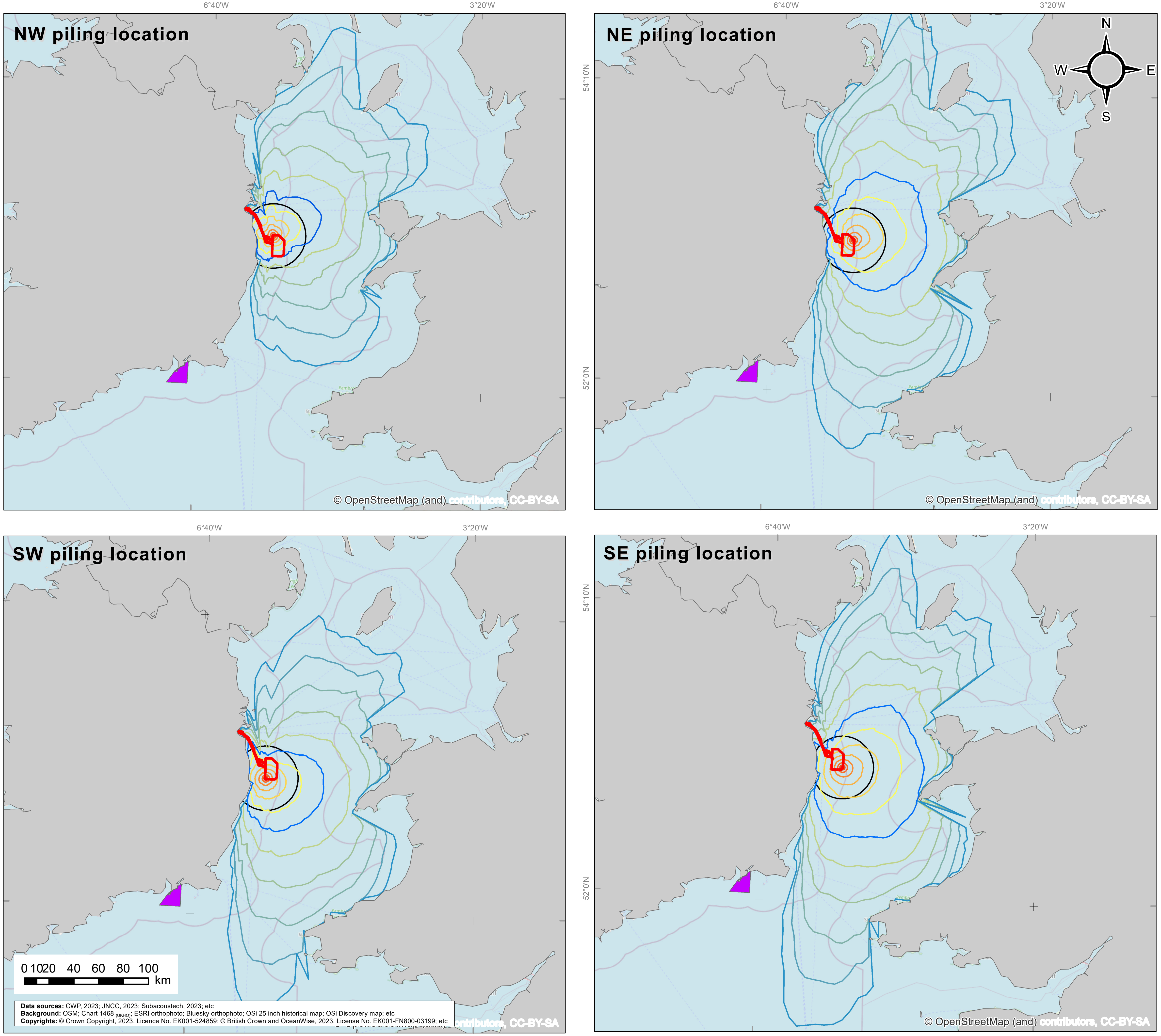
Piling of WTGs

579. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

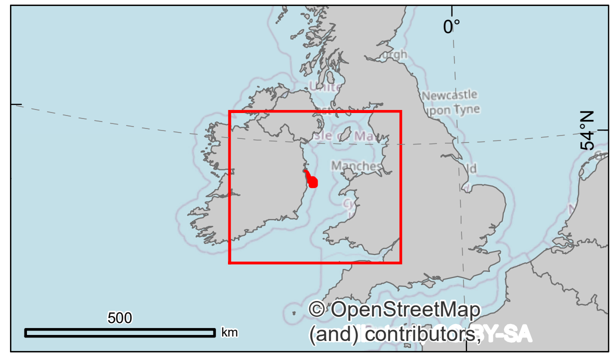
580. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

581. None of the disturbance contours overlap with the Hook Head SAC (**Figure 2-8**).



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^{2}s
- 26 km EDR
- SEL_{ss} dB re µPa^{2}s (5dB contours)
- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- Hook Head SAC

Project: Codling Wind Park

SMRU Consulting — understand • assess • mitigate

Figure 2.08:
Disturbance thresholds for piling at all modelling locations and the Hook Head SAC designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1605

Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - HOOK.HEAD.SAC - (NIS.Vol.04.Ch.02.FIG.09)

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

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

582. For ex situ disturbance from piling of WTGs, the assessment for the Hook Head SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

583. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

584. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

585. Vessels associated with the CWP Project are not expected to operate within the Hook Head SAC. Disturbance impact ranges will not overlap with the Hook Head SAC.

Conclusion

586. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

587. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

588. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

589. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

590. No additional mitigation is required.

Residual impacts

591. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Hook Head SAC from increased underwater noise from the CWP Project alone.

2.10.1.1.2 Impact 2: Collision risk

592. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

593. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

594. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

595. Vessels associated with the CWP Project are not expected to operate within the Hook Head SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

596. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

597. No additional mitigation is required.

Residual impacts

598. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI to the Conservation Objectives of the harbour porpoise community associated with the Hook Head SAC from vessel collisions from the CWP Project alone.

2.10.1.1.3 Impact 3: Changes in prey availability

599. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

600. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Hook Head SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

601. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

602. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Hook Head SAC as a result of changes in prey availability.

Residual impacts

603. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI to the Conservation Objectives of the harbour

porpoise community associated with Hook Head SAC as a result of changes to prey availability from the CWP Project alone.

2.10.1.1.4 Impact 4: Changes in available habitat

604. Target 1 of the Conservation Objectives states that ‘Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein’.

Assessment of the project alone

605. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Hook Head SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

606. Considering the above, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

607. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Hook Head SAC as a result of changes in available habitat.

Residual impacts

608. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with the Hook Head SAC from changes in available habitat from the CWP Project alone.

2.10.2 Bottlenose dolphin

Table 2-22 Conservation Objectives, Attributes and Targets for bottlenose dolphin of the Hook Head SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of bottlenose dolphin from any part of its range within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with the species range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of bottlenose dolphin from any part of its range within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with the species range due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the access to suitable habitat within the site(s).	No additional mitigation is required.	There is no potential for an AESI the species range due to changes in available habitat.	
	Increased underwater noise			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Habitat Critical areas, representing habitat used preferentially by bottlenose dolphin, should be conserved in a natural condition.	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in significant disturbance to habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to increased underwater noise.	There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect critical habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect critical habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to alter the natural behaviour to an extent that may ultimately interfere with key ecological functions.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to changes in available habitat.	
Population	Increased underwater noise			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site.	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on bottlenose dolphin population within the site(s) or deterioration of key resources upon which dolphins depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to increased underwater noise.	There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on bottlenose dolphin population within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which bottlenose dolphin depend to the extent that could affect dolphin populations at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which bottlenose dolphin depend to the extent that could affect dolphin populations at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin)	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			population due to changes in available habitat.	

609. The Hook Head SAC is a marine subtidal reef, located south and east of Hook Head Peninsula. The SAC was originally designated for Large shallow inlets and bays [1160], Reefs [1170], Vegetated sea cliffs of the Atlantic and Baltic coasts [1230].

610. In March 2024, bottlenose dolphins [1349] were added as a Qualifying Interest to the Hook Head SAC. While the Site Synopsis was amended in March 2024 to list bottlenose dolphins, it provides no information on the presence of dolphins within the site, or the importance of the site for bottlenose dolphins.

2.10.2.1 Conservation Objectives and Targets

611. No Conservation Objectives have been set for bottlenose dolphins at this site yet. Therefore, it is assumed that the Conservation Objectives at the West Connacht Coast SAC apply here.

612. The Conservation Objective for the West Connacht Coast SAC (used here as a proxy) is to maintain the favourable conservation condition of bottlenose dolphins in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2015)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of bottlenose dolphins from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of bottlenose dolphins within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which bottlenose dolphins depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population at the site.

2.10.2.1.1 Impact 1: Increased underwater noise

613. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of bottlenose dolphins within the site’, and ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphins at the site’.

Assessment of the project alone

614. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

615. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

616. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

617. The CWP array site is located approximately 130 km away from the Hook Head SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible on bottlenose dolphins within the Irish Sea MU, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Hook Head SAC.

618. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

619. The underwater noise assessment concluded that for UXO clearance, the maximum PTS-onset impact range for bottlenose dolphins from high-order clearance was 730 m resulting in <1 dolphin in the Irish Sea MU being injured which is of negligible impact. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

620. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs and onshore substation

621. The underwater noise assessment concluded that for piling of WTGs and at the onshore substation, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in

the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

622. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Other construction activities

623. The underwater noise assessment concluded that for other construction activities, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

624. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

625. The underwater noise assessment concluded that for operational noise, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Hook Head SAC.

626. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

627. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

628. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

629. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

630. The underwater noise modelling which supports the impact assessment used TTS as a proxy for disturbance for UXO clearance. For the low-order clearance of UXOs the predicted impact range was 100 m for bottlenose dolphins and for high-order detonation of a 525 kg UXO (+ donor) the predicted impact range was 1.3 km for bottlenose dolphins. This results in impact to <1 individual dolphin in the Irish Sea MU, which is of negligible impact. There will be no overlap between disturbance impact ranges and the Hook Head SAC.

631. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas (e.g., the Irish Sea MU) and thus could potentially be disturbed by UXO activities at the CWP Project. It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). The duration of impact will be short-term and intermittent throughout a UXO clearance campaign, with animals expected to return to the area once the activity has ceased. The range within the inter-connected areas (Irish Sea MU) will therefore not be constrained or hindered.

632. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling at the onshore substation

633. For piling at the onshore substation, <1 bottlenose dolphin in the Irish Sea MU was predicted to be disturbed per piling day, which is of negligible impact. Disturbance impact ranges will not overlap with the Hook Head SAC.

634. Within the Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIAR).

Operational noise

635. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and

thus there will be no overlap with the Hook Head SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

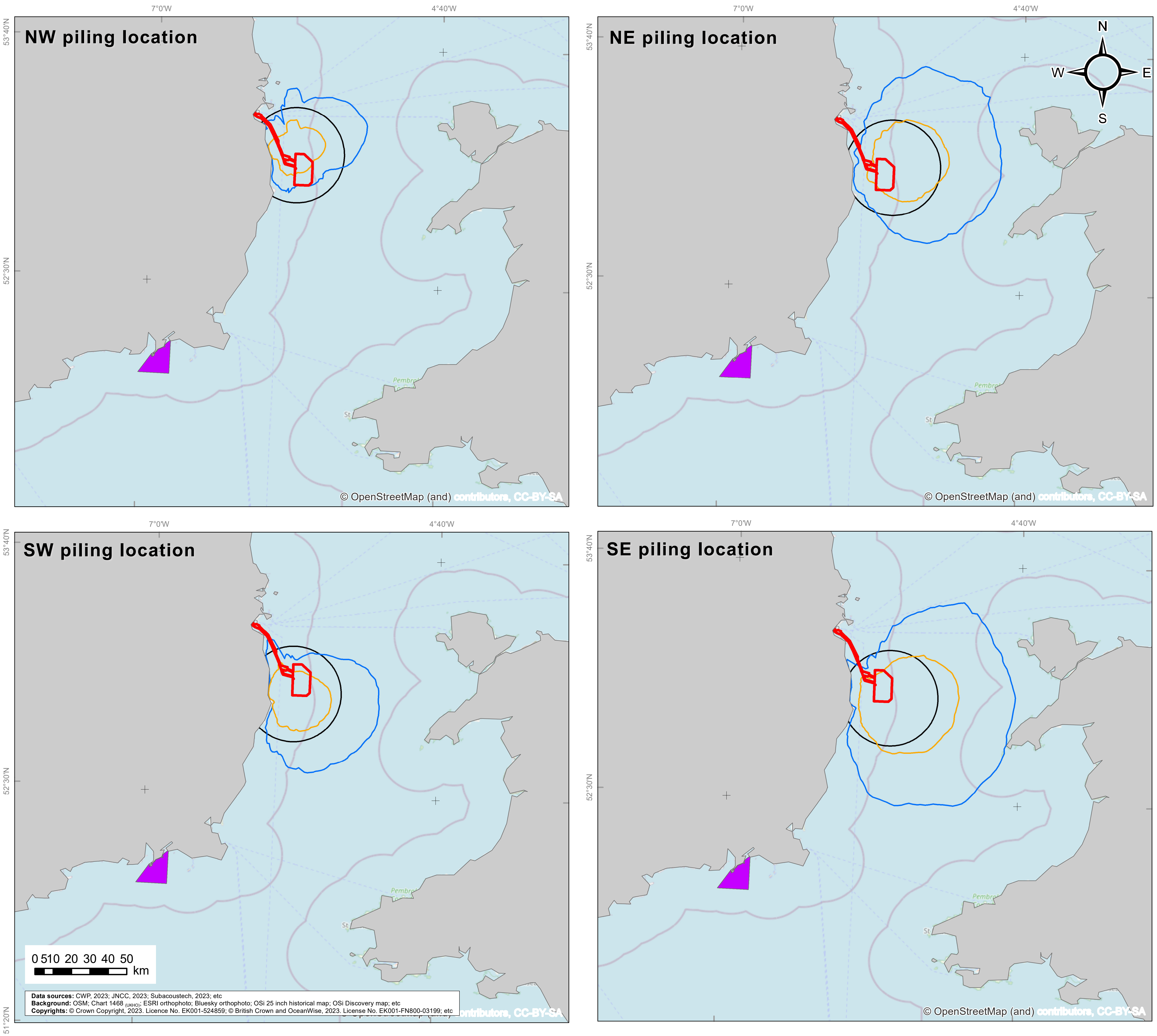
Piling of WTGs

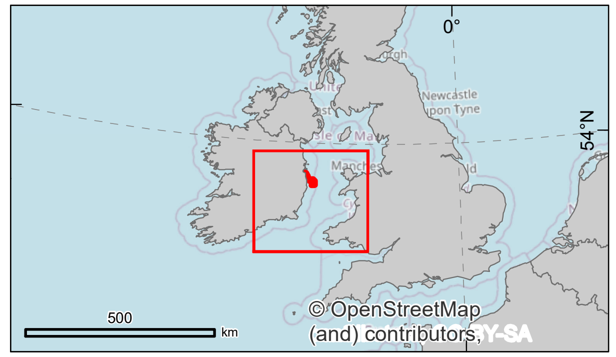
636. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017)

637. alongside the 160 dB SPL_{rms} Level B harassment threshold (NMFS, 2005). There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the population of bottlenose dolphins within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here, in the absence of advise specific to bottlenose dolphins. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020) alongside the dose-response function and level B threshold.

In situ disturbance from piling of WTGs

638. None of the disturbance contours overlap with the Hook Head SAC (**Figure 2-9**).





Legend

- Planning application boundary
- Level B threshold 160 dB re μPa (SPL $_{RMS}$)
- SEL_{ss} 145 dB re $\mu Pa^2 s$
- 26 km EDR
- Hook Head SAC

codling wind park

Project: Codling Wind Park

SMRU Consulting
understand • assess • mitigate

Figure 2.09:
Disturbance thresholds for piling at all modelling locations and the Hook Head SAC designated for bottlenose dolphins

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1606

Internal descriptive code: IS - PAB..DPNM.THRESH.B160.SEL.26EDR.CONT.WTGs.CORNERS - HOOK.HEAD.SAC - (NIS.Vol.04.Ch.02.FIG.10)

Size: A3
Scale: 1:2,000,000

CRS: EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

639. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas where they could potentially be disturbed by piling activities at the CWP Project. Here, it is assumed that the inter-connected area includes the entire Irish Sea MU. The underwater noise assessment used the harbour porpoise dose-response curve (Graham et al., 2017) to assess potential impacts of disturbance from piling in the absence of species-specific information for bottlenose dolphins. The maximum number of bottlenose dolphins predicted to be disturbed on a single piling day using the porpoise dose-response function is 2,060 dolphins (using the SCANS IV block density (Gilles et al., 2023)), equating to 24.74% of the Irish Sea MU (assuming the MU is 8,326 based on (Gilles et al., 2023)). To determine if this level of disturbance results in a population level effect, iPCoD modelling was conducted. This assumed disturbance to 2,060 dolphins per day over 78 piling days between April and October 2027. The results of the iPCoD modelling shows a very slight deviation from the baseline resulting from the pile driving disturbance at CWP (**Plate 2-3**). The mean impacted population size decreases very slightly from the mean unimpacted population size initially in response to piling, after which it continues on the same, stable trajectory at 98.5% of the mean unimpacted population size. It is noted that iPCoD does not currently allow for a density-dependent response, and as such there is no way for the impacted population to increase in size after the piling disturbance (as would be expected in reality). The impacted population does, however, continue on a stable trajectory in the long-term. The results show that temporary changes in behaviour can result in potential reductions to lifetime reproductive success and survival to some individuals, although not enough to affect the population trajectory over a generational scale. Therefore, pile driving of WTGs at the CWP Project does not hinder the population from maintaining itself on a long-term basis as a viable component of its natural habitat.

640. It is noted that under the ‘restoration and recovery’ Conservation Objective, the bottlenose dolphin population should be increasing. However, the most recent feature condition assessment concluded that the population has a stable medium-term trend (2001–2016), which is what was assumed in the population modelling here. The impact of disturbance from piling at the CWP Project will not alter the long-term trajectory of the population, but it is important to note that the current population trajectory is stable, not increasing, in the absence of the CWP Project.

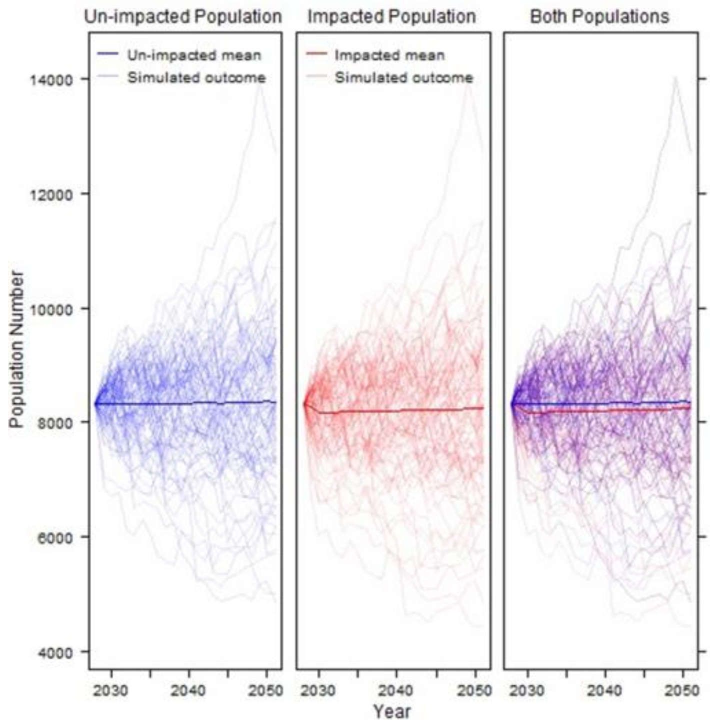


Plate 2-3 Predicted population trajectories for the unimpacted (baseline) and impacted bottlenose dolphin iPCoD simulations (78 days piling in 2027) using the results for the dose-response function

Disturbance from vessels

641. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. Vessels within 400 m of a bottlenose dolphin group have been found to result in short-term changes to bottlenose dolphin behaviour through both targeted and non-targeted approaches (Clarkson *et al*., 2020, Bas et al., 2017, Puszka et al., 2021). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with the Hook Head SAC.

642. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals.

643. Vessels associated with the CWP Project are not expected to operate within the Hook Head SAC. Disturbance impact ranges will not overlap with the Hook Head SAC.

644. It is acknowledged that bottlenose dolphins from the SAC population can range outside of the SAC, and thus have the potential to be disturbed out with the SAC boundary within the Irish Sea MU. However, disturbance is expected to be temporary and highly unlikely to result in any changes to the trajectory of the Irish Sea MU. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from disturbance caused by underwater noise from the CWP Project alone.

Conclusion

645. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the bottlenose dolphin population at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

646. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

647. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

648. No additional mitigation is required.

Residual impacts

649. There is expected to be no change to the FCS, and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI to the Conservation Objectives of the bottlenose dolphin population associated with the Hook Head SAC from increased underwater noise from the CWP Project alone.

2.10.2.1.2 Impact 2: Collision risk

650. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population at the site'.

Assessment of the project alone

651. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

652. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

653. Vessels associated with the CWP Project are not expected to operate within the Hook Head SAC. No bottlenose dolphins within and outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the bottlenose dolphin population at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins from collision risk from the CWP Project alone.

Proposed mitigation

654. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

655. No additional mitigation is required.

Residual impacts

656. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI on the bottlenose dolphins associated with the Hook Head SAC from vessel collisions from the CWP Project alone.

2.10.2.1.3 Impact 3: Changes in prey availability

657. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which bottlenose dolphins depend'.

Assessment of the project alone

658. Given that bottlenose dolphins are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. Stomach contents analysis from stranded bottlenose dolphins in Irish waters has shown that their diet is diverse, with a preference for whiting / blue whiting and pelagic squid (Hernandez-Milian et al., 2011). To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Hook Head SAC could arise as a result of the impacts of changes in prey availability on bottlenose dolphins as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of CWP Project alone (this includes: direct damage, disturbance, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of bottlenose dolphins (e.g., whiting).

659. Considering the above, there is expected to be no change to bottlenose dolphin prey species presence, abundance, condition, or diversity in situ and ex situ; as such, there will be no deterioration of key resources (feeding) upon which bottlenose dolphins depend. There is therefore no potential for

AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin from changes in prey availability from the CWP Project alone.

Proposed mitigation

660. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Hook Head SAC as a result of changes in prey availability.

Residual impacts

661. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. There is no potential for an AESI on the bottlenose dolphins associated with Hook Head SAC as a result of changes to prey availability from the CWP Project alone.

2.10.2.1.4 Impact 4: Changes in available habitat

662. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of bottlenose dolphins from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

663. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the Hook Head SAC nor will they permanently remove, or prevent access for bottlenose dolphins to, suitable habitat therein.

664. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from changes in available habitat from the CWP Project alone.

Proposed mitigation

665. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Hook Head SAC as a result of changes in available habitat.

Residual impacts

666. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins associated with the Hook Head SAC from changes in available habitat from the CWP Project alone.

2.11 West Wales Marine SAC (UK0030397)

2.11.1 Harbour porpoise

Table 2-23 Summary of assessment, Conservation Objectives, Attributes and Targets for harbour porpoise of the West Wales Marine SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Harbour porpoise is (i.e., remains) a viable component of the site	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in habitat are not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in available habitat.	
Population There is no significant disturbance of the species.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to lead to the exclusion of harbour porpoise from a significant proportion of the site for a significant period of time, in line with thresholds set in JNCC (2019c). See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is expected to be no potential for an AESI to the Conservation Objectives of the harbour porpoise population associated with the Bristol Channel Approaches SAC from increased underwater noise from the CWP Project alone.	
	Collision risk			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	There is no potential impact pathway between collision risk and this Conservation Objective. See **Impact 2: Collision risk**	N/A	N/A	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See **Impact 3: Changes in prey availability**	N/A	N/A	
	Changes in available habitat			
	There is no potential impact pathway between changes in available habitat and this Conservation Objective. See **Impact 4: Changes in available habitat**	N/A	N/A	
Habitat The condition of supporting habitats and processes, and the availability of prey is maintained.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	There is no potential impact pathway between increased underwater noise and this Conservation Objective. See **Impact 1: Increased underwater noise**	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective. See **Impact 2: Collision risk**	N/A	N/A	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Effects due to changes in prey availability are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in prey availability at CWP Project.	
	Changes in available habitat			
	Effects due to changes in available habitat are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in available habitat at CWP Project.	

667. The West Wales Marine SAC (site code 0030397) is located off the coast of Wales, from the Llŷn peninsula in the north, to Pembrokeshire in the southwest, and has been identified as an area of importance for harbour porpoise. The SAC is located within the Irish Sea and thus the Celtic and Irish Sea MU.

668. Covering an area of 7,376 km^2, the West Marine Wales SAC spans water depths down to 100 m along the western boundary though much of the site has water depths 50 m or shallower[10]. The whole SAC has been identified as an important summer area (April – September) for harbour porpoise, and a smaller section to the south of the site, around Cardigan Bay, has also been identified as winter habitat (October – March) for this species (NRW and JNCC, 2017). The site is estimated to support ~5.4% of the Celtic and Irish Sea MU (NRW and JNCC, 2017).

2.11.1.1 Conservation Objectives

669. The Conservation Objectives are detailed in (NRW, 2019): *'To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:*

- 1) Harbour porpoise is a viable component of the site:
  - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site.
  - Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range.
- 2) There is no significant disturbance of the species:
  - Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.
  - Noise disturbance within an SAC from a plan / project individually or in combination is significant if it excludes harbour porpoises from more than:
    - 1. 20% of the relevant area of the site in any given day; and
    - 2. an average of 10% of the relevant area of the site over a season.
- 3) The condition of supporting habitats and processes, and the availability of prey is maintained:
  - Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.
  - The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site'.

2.11.1.1.1 Impact 1: Increased underwater noise

670. The Conservation Objectives of relevance are to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury) and to ensure that *'there is no significant disturbance of the species'*.

Assessment of the project alone

671. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise produced during construction. Therefore, a detailed assessment has been provided for this impact pathway within **Chapter 11 Marine Mammals**.

672. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (Wind Turbine Generators (WTGs) and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

673. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

674. The CWP Project is located approximately 58 km away from the West Wales Marine SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the West Wales Marine SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

675. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance of a 525 kg UXO (+ donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. Therefore, the risk of PTS following mitigation through the UXO MMMP is negligible. There will be no overlap between PTS-onset ranges and the West Wales Marine SAC.

676. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

677. For piling at the onshore substation, PTS impact ranges will not overlap with the West Wales Marine SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

678. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the West Wales Marine SAC.

679. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

680. For other construction activities, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the West Wales Marine SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

681. For operational noise, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the West Wales Marine SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

682. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

683. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

684. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Disturbance will only cause short-term and / or intermittent and temporary behavioural effects in a limited spatial extent around the source. With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals). Disturbance impact ranges will not overlap with the West Wales Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

685. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). Disturbance impact ranges will not overlap with the West Wales Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

686. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

687. For piling at the onshore substation, disturbance impact ranges will not overlap with the West Wales Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in

temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

688. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges will not overlap with the West Wales Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

689. For piling of WTGs, the approach presented here is in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023). This involves the use of the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, as well as the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

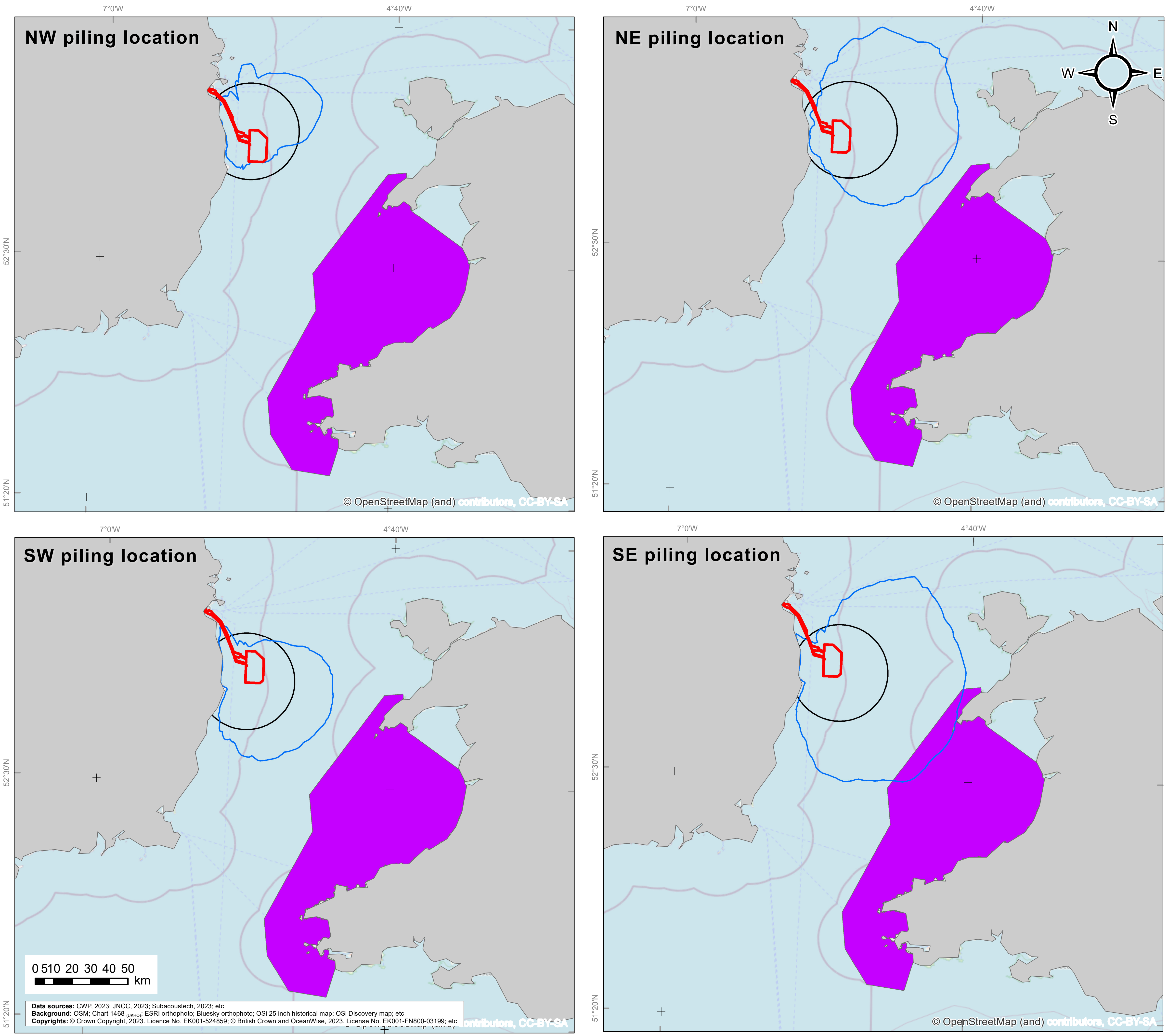
690. Daily: Using the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), disturbance impact ranges overlap with a maximum of 7% of the area of the West Wales Marine SAC. This level of overlap does not constitute a significant disturbance, as it remains below the 20% daily threshold outlined within the Conservation Objectives. Using the 26 km EDR approach, there will be no overlap between the CWP Project and the West Wales Marine SAC, and therefore there is no contribution to the noise disturbance thresholds for the SAC (**Table 2-24 and Figure 2-10**).

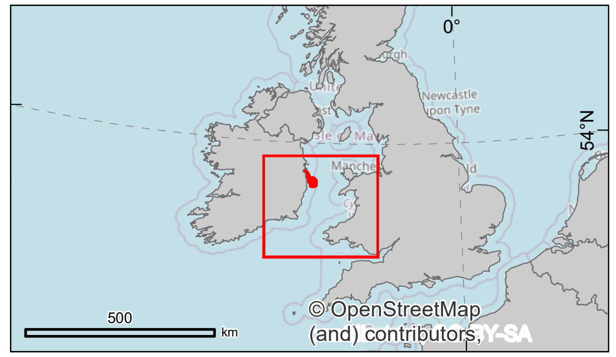
691. Summer season: Consideration needs to be given to the amount of disturbance that occurs over each season specifically. If it is assumed that all 78 piling days occur between April and September, with a daily footprint of 487.9 km^2, then the average area of the SAC disturbed over the summer season is 3.0%. This level of overlap does not constitute a significant disturbance, as it remains below the 10% seasonal threshold outlined within the Conservation Objectives.

692. Winter season: The disturbance impact ranges do not overlap with the winter area of the West Wales Marine SAC.

Table 2-24 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the West Wales Marine SAC

Model location	Disturbance Threshold	Total overlap (% SAC area)
NE	145 dB SEL_{ss}	0 km^2 (0% SAC)
NW	145 dB SEL_{ss}	0 km^2 (0% SAC)
SE	145 dB SEL_{ss}	487.9 km^2 (7% SAC)
SW	145 dB SEL_{ss}	0 km^2 (0% SAC)
All	26 km EDR	0 km^2 (0% SAC)





Legend

- Planning application boundary
- SEL_{ss} 145 dB re μPa^{2}s threshold
- 26 km EDR
- West Wales Marine SAC

Project: Codling Wind Park

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Figure 2.10:
Disturbance thresholds for piling at all modelling locations and the West Wales Marine SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1607

Internal descriptive code: IS - PAB..DPNM.THRESH.SEL.26EDR.CONT.WTGs.CORNERS - WEST.WALES.MARINE.SAC - (NIS.Vol.04.Ch.02.FIG.11)

Size: A3
Scale: 1:2,000,000

CRS: EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

693. For ex situ disturbance from piling of WTGs, the assessment for the West Wales Marine SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

694. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigation Risk Assessment** in the EIAR). Therefore, the introduction of additional vessels associated with the CWP Project is not a novel impact for marine mammals present in the area.

695. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

696. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

697. Vessels associated with the CWP Project are not expected to operate within the West Wales Marine SAC. Disturbance impact ranges will not overlap with the West Wales Marine SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

Conclusion

698. Considering the impact pathways described above, disturbance effects from increased underwater noise are below the thresholds for significant disturbance. Therefore, there is expected to be no potential for AESI to the West Wales Marine SAC from the CWP Project alone.

Exclusion

699. None of the activities associated with the construction, O&M and decommissioning of WTGs at the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

700. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

701. No additional mitigation is required.

Residual impacts

702. There is expected to be no change to the FCS (FCS) and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise associated with the West Wales Marine SAC from increased underwater noise from the CWP Project alone.

2.11.1.1.2 Impact 2: Collision risk

703. The Conservation Objective of relevance is to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury).

Assessment of the project alone

704. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC. Vessels associated with the CWP Project are not expected to operate within the West Wales Marine SAC.

705. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. No harbour porpoise within or outwith the SAC are expected to experience death or injury from collisions with Project vessels. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

706. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

707. No additional mitigation is required.

Residual impacts

708. There is expected to be no change to the FCS, and there is no potential for an AESI, and no impediment to the Conservation Objectives of harbour porpoise associated with the West Wales Marine SAC from vessel collisions from the CWP Project alone.

2.11.1.1.3 Impact 3: Changes in prey availability

709. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes, and the availability of prey is maintained'.

Assessment of the project alone

710. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the West Wales Marine SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

711. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition or diversity in situ or ex situ. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of harbour porpoise from changes in prey availability from the CWP Project alone.

Proposed mitigation

712. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the West Wales Marine SAC as a result of changes in prey availability.

Residual impacts

713. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the West Wales Marine SAC as a result of changes to prey availability from the CWP Project alone.

2.11.1.1.4 Impact 4: Changes in available habitat

714. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes […] is maintained. Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat'.

Assessment of the project alone

715. To inform this NIS, **Chapter 6 Marine Geology, Sediments and Coastal processes** and **Chapter 7 Marine Water Quality** of the EIAR prepared for the Project were referred to, for the purposes of establishing whether adverse effects on the integrity of the West Wales Marine SAC could arise as a result of the impacts to the supporting habitats and processes.

716. The EIAR concludes that there will be no significant impact to marine geology, sediments and coastal processes from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations and associated deposition, alteration to seabed morphology or composition and alteration to the hydrodynamic, wave and sediment regimes and coastal processes). Likewise, the EIAR concludes that there will be no significant impact to marine water quality from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations, resuspension of contaminated sediments, or accidental pollution). All impacts are expected to be highly localised and will not affect the supporting habitat within the West Wales Marine SAC.

Proposed mitigation

717. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the West Wales Marine SAC as a result of changes in available supporting habitat.

Residual impacts

718. There is expected to be no change to the FCS, no AESI and no impediment to the Conservation Objectives being achieved for the harbour porpoise population associated with the West Wales Marine SAC from changes in available supporting habitat from the CWP Project alone.

2.12 Llŷn Peninsula and the Sarnau SAC (UK0013117)

2.12.1 Bottlenose dolphin

Table 2-25 Summary of assessment, Conservation Objectives, Attributes and Targets for bottlenose dolphin of the Llŷn Peninsula and the Sarnau SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability are not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in available habitat.	
Supporting habitats and species The presence, abundance, condition and diversity of habitats and species	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising
	There is no potential impact pathway between increased underwater noise and this Conservation Objective.	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Changes in prey availability are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (bottlenose dolphin) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in prey availability.	from the CWP Project.
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (bottlenose dolphin) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in available habitat.	
Populations The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to increased underwater noise.	
	Collision risk			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to changes available habitat.	

719. The Llŷn Peninsula and the Sarnau (Pen Llŷn a`r Sarnau) SAC is located in Wales. The boundary extends from Nefyn on the north coast of Llŷn and includes parts of the seashore and the waters and seabed around the Llŷn Peninsula, in north Cardigan Bay and along the Meirionnydd coast to Clarach in Ceredigion south of the Dyfi estuary, including the Glaslyn / Dwyryd, Artro, Mawddach and Dyfi estuaries. Bottlenose dolphins are present year-round in the SAC with increased sightings in the summer months (NRW, 2018b).

720. Bottlenose dolphins associated with the Llŷn Peninsula and the Sarnau SAC are part of a larger coastal population that is mainly associated with the Cardigan Bay SAC. There is a high degree of connectivity between the two SACs and thus the two SACs are considered to be a 'super-site' that do not have separate populations (NRW, 2018b). The advice by NRW states that '*Bottlenose dolphins are considered of significant importance within Pen Llŷn a'r Sarnau SAC even though they do not appear to form a semi-resident group within the sea area encompassed by this site. Bottlenose dolphins have been seen all around the Welsh coast since the early part of the 20th Century, but mainly throughout Cardigan Bay where they use the area for all essential activities including feeding, socialising and nurture of young*' (NRW, 2018c). Additionally, the NRW position paper on the use of marine mammal MUs for assessment in HRA for SACs with marine mammal features (NRW, 2022) suggests that since the populations of the two SACs are highly connected, there is likely a single generic population across the Irish Sea MU. Therefore, the assessment here considers impacts to a single population of bottlenose dolphins that is present in both the Llŷn Peninsula and the Sarnau SAC and the Cardigan Bay SAC.

721. Population estimates have been modelled using photo-ID closed population mark-recapture modelling for the wider Cardigan Bay area (referring to both the Cardigan Bay SAC and northern Cardigan Bay – which includes the Pen Llŷn a'r Sarnau SAC) by Lohrengel et al. (2018). Using a closed population Capture-Recapture Model, in 2016 there were estimated to be a population of 174 bottlenose dolphins in the wider Cardigan Bay area (95% CI: 150–246, CV: 0.30).

2.12.1.1 Conservation Objectives

722. The vision statement for the Llŷn Peninsula and the Sarnau SAC is as follows: 'The SAC will continue to provide a productive and supportive marine area for bottlenose dolphin. Bottlenose dolphin will continue to be widespread within the waters of the SAC and those frequenting the SAC will reflect a healthy population structure including immature and adult male and female dolphins. The bottlenose dolphins in the SAC will form an important component a larger population of this species present in Cardigan Bay and in the wider sea area around Wales and the north east Atlantic. The animals using the SAC will reflect good physiological health. The bottlenose dolphins will have access to and sufficient availability of prey, and they will have widespread availability and access to good quality essential habitats free from excessive disturbance. The quality and distribution of essential habitats (such as for feeding, calving, resting and travelling) within the site will be maintained or improved through appropriate management' (NRW, 2018c).

723. The Conservation Objectives (as listed in NRW (2018c)) states that *'To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term:*

- *Populations:*
  - *The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:*
    - *Population size;*
    - *Structure, production; and*
    - *Condition of the species within the site.*
  - *As part of this objective it should be noted that for bottlenose dolphin:*

- - Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.

- *Range:*
  - *The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.*
  - *As part of this objective it should be noted that for bottlenose dolphin:*
    - *Their range within the SAC and adjacent inter-connected areas is not constrained or hindered;*
    - *There are appropriate and sufficient food resources within the SAC and beyond; and*
    - *The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.*

- *Supporting habitats and species:*
  - *The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include:*
    - *Distribution;*
    - *Extent;*
    - *Structure;*
    - *Function and quality of habitat; and*
    - *Prey availability and quality.*
  - *As part of this objective it should be noted that:*
    - *The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.*
    - *The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.*
    - *Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.*
    - *Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.*

- *Restoration and recovery:*
  - *As part of this objective, it should be noted that the bottlenose dolphin populations should be increasing'.*

2.12.1.1.1 Feature condition assessment

724. The latest feature condition assessment (NRW, 2018b) concluded an overall favourable assessment for bottlenose dolphins in the Llŷn Peninsula and the Sarnau SAC, with a medium confidence level.

725. For the 'population' component of the assessment, it was highlighted that the Llŷn Peninsula and the Sarnau SAC is part of a larger coastal population that is also associated with the Cardigan Bay SAC. The population is estimated to be 174 dolphins across these two sites (Lohrengel et al., 2018). Between 2001 and 2016 there was no significant trend in this SAC population estimate and it is considered to be stable in the medium term (though it is noted that there was a decline in the short term between 2007 and 2016). Overall, the population was assessed as **favourable**.

726. For the ‘range’ component of the assessment, it was highlighted that bottlenose dolphins are found throughout Welsh waters, making it a wide-ranging population that should be considered as one MU. Overall, the range was assessed as **favourable**.

727. For the ‘supporting habitats’ component of the assessment, it was highlighted that ‘there is no specifically defined ‘dolphin habitat’. The presence of dolphins at a location implies that the habitat is suitable but presence is largely driven by prey availability. This component has been assessed as unknown.’ (NRW, 2018b). Likewise, when considering prey availability and quality, it was highlighted that ‘we do not have enough information about bottlenose dolphin prey species and the status of fish stocks to produce a meaningful assessment for this component.’ (NRW, 2018b). Overall, the supporting habitat was assessed as **unknown**. This makes it unfeasible to provide any meaningful assessment of the supporting habitat within this NIS.

2.12.1.1.2 Impact 1: Increased underwater noise

728. With regards to underwater noise (injury and disturbance) the Conservation Objectives state that ‘The population is maintaining itself on a long-term basis as a viable component of its natural habitat’ and ‘The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future’ NRW (2018c).

Assessment of project alone

729. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

730. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (Wind Turbine Generators (WTGs) and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

731. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

732. The risk of auditory injury to bottlenose dolphins from MBES and SSS is negligible according to the EPS Guidance (JNCC et al., 2010). The source levels of USBLs, SBIs, SBPs and URHS are below the PTS-onset thresholds for dolphins. As such, there is no risk of PTS to bottlenose dolphins in situ or ex situ. Further, the CWP array site is located approximately 62.1 km away from the Pen Llŷn a’r

Sarnau SAC and there will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

733. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

734. The underwater noise assessment concluded that for UXO clearance, the maximum PTS-onset impact range for bottlenose dolphins from high-order clearance was 730 m resulting in <1 dolphin in the Irish Sea MU being injured which is of negligible impact. Further, there will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

735. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs and onshore substation

736. The underwater noise assessment concluded that for piling of WTGs and at the onshore substation, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

737. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Other construction activities

738. The underwater noise assessment concluded that for other construction activities, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. Further, there will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

739. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

740. The underwater noise assessment concluded that for operational noise, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. Further, there will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

741. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Conclusion

742. The proposed activities at the CWP Project will not cause auditory injury to bottlenose dolphins. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of

its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

743. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Therefore, the impact to the Irish Sea MU is negligible and there will be no overlap between disturbance ranges and the Llŷn Peninsula and the Sarnau SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

744. The underwater noise assessment used TTS as a proxy for disturbance for UXO clearance. For the low-order clearance of UXOs the predicted impact range was 100 m for bottlenose dolphins and for high-order detonation of a 525 kg UXO (+ donor) the predicted impact range was 1.3 km for bottlenose dolphins. This results in impact to <1 individual dolphin in the Irish Sea MU, which is of negligible impact. There is no overlap between the disturbance ranges and the Llŷn Peninsula and the Sarnau SAC, and therefore the species population within the site will not be reduced within the SAC.

745. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas (e.g., the Irish Sea MU) and thus could potentially be disturbed by UXO activities at the CWP Project. It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). The duration of impact will be short-term and intermittent throughout a UXO clearance campaign, with animals expected to return to the area once the activity has ceased. The range within the inter-connected areas (Irish Sea MU) will therefore not be constrained or hindered.

746. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ

Piling of WTGs

747. To assess disturbance within the SAC boundary, various assessment approaches are presented here, in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs (NRW, 2023). The same disturbance thresholds have been applied here for dolphins in the absence of specific guidance for bottlenose dolphin SACs. The disturbance thresholds assessed include the 145 dB SEL_{ss} threshold (Lucke et al., 2009), the 160 dB SPL_{rms} Level B harassment threshold (NMFS, 2005), and a 26 km EDR for monopiles (JNCC, 2020).

In situ disturbance from piling of WTGs

748. The 145 dB SEL_{ss} threshold overlapped with the Llŷn Peninsula and the Sarnau SAC for the SE WTG modelling location only (**Table 2-26**). The area of overlap was 5% of the total SAC which equates to disturbance to 2 bottlenose dolphins (1.1% wider SAC population of 174 animals). Level B harassment threshold impact contours did not overlap with the Llŷn Peninsula and the Sarnau SAC from any of the WTG locations modelled. The 26 km EDR contour does not overlap with the Llŷn Peninsula and the Sarnau SAC. Therefore, a maximum of 5% of the Llŷn Peninsula and the Sarnau SAC area is predicted to experience disturbance from WTG pile driving on a single piling day at CWP Project. As such, the majority of bottlenose dolphin range within the SAC will not be constrained or hindered. The duration of impact is expected to be temporary and short-term, will occur over less than a year (maximum 78 days WTG piling).

749. In English, Welsh and Northern Irish harbour porpoise SACs, disturbance to 20% of the SAC area on a single day is considered significant (JNCC, 2020). There is no equivalent guidance for bottlenose dolphin SACs. The European Commission (EC) Directorate-General for Environment has set binding limits for underwater noise pollution (11 March 2024[21]). This states that for impulsive noise (such as piling): *'For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment / habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20% or lower (≤ 20%)'*. It is important to note that there is no advised threshold value for LOBE ('*a sound level above which an adverse biological effect on an indicator species is expected to occur, i.e., an effect that may affect the comfort, survival, and vital functions of individual animals*'), nor is there guidance on what constitutes '*assessment / habitat area utilised by a species'.* In the absence of specific guidance from NPWS on the application of the aforementioned EC limits for impulsive noise, the suitability of the approaches to estimating disturbance for determining the LOBE is unknown. Similarly, given the wide-ranging and highly mobile nature of bottlenose dolphins, it is not clear if an individual SAC constitutes an appropriate assessment / habitat area. Nonetheless, a precautionary approach is to assume that disturbance, estimated by the methods described above, to 20% of the SAC area on a single piling day could constitute significant disturbance and a breach of the EC limits. Disturbance levels predicted within the Llŷn Peninsula and the Sarnau SAC are significantly below the 20% area threshold and so do not constitute significant disturbance to the SAC.

Table 2-26 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the Llŷn Peninsula and the Sarnau SAC

Approach	Model location	Area overlap	Density (#/km^2)	# dolphins	% wider SAC population (174)
145 dB SEL_{ss}	NE	0 km^2	na	0	0.0%
	NW	0 km^2	na	0	0.0%
	SE	68.6 km^2 (5% SAC)	0.035[22]	2	1.1%
	SW	0 km^2	na	0	0.0%

[21] https://environment.ec.europa.eu/publications/notice-under-marine-strategy-framework-directive_en.

[22] Density of 0.035 dolphins/km++2++ in the wider Cardigan Bay area (Lohrengel et al., 2018).

Approach	Model location	Area overlap	Density (#/km^2)	# dolphins	% wider SAC population (174)
160 dB SPL_{rms} Level B	All	0 km^2	na	0	0.0%
26 km EDR	All	0 km^2	na	0	0.0%

Ex situ disturbance from piling of WTGs

750. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas where they could potentially be disturbed by piling activities at the CWP Project. Here, it is assumed that the inter-connected area includes the entire Irish Sea MU. The underwater noise assessment used the harbour porpoise dose-response curve (Graham et al., 2017) to assess potential impacts of disturbance from piling in the absence of species-specific information for bottlenose dolphins. The maximum number of bottlenose dolphins predicted to be disturbed on a single piling day using the porpoise dose-response function is 2,060 dolphins (using the SCANS IV block density (Gilles et al., 2023)), equating to 24.74% of the Irish Sea MU (assuming the MU is 8,326 based on (Gilles et al., 2023)). To determine if this level of disturbance results in a population level effect, iPCoD modelling was conducted. This assumed disturbance to 2,060 dolphins per day over 78 piling days between April and October 2027. The results of the iPCoD modelling shows a very slight deviation from the baseline resulting from the pile driving disturbance at CWP (**Plate 2-4**). The mean impacted population size decreases very slightly from the mean unimpacted population size initially in response to piling, after which it continues on the same, stable trajectory at 98.5% of the mean unimpacted population size. It is noted that iPCoD does not currently allow for a density-dependent response, and as such there is no way for the impacted population to increase in size after the piling disturbance (as would be expected in reality). The impacted population does, however, continue on a stable trajectory in the long-term. The results show that temporary changes in behaviour can result in potential reductions to lifetime reproductive success and survival to some individuals, although not enough to affect the population trajectory over a generational scale. Therefore, pile driving of WTGs at the CWP Project does not hinder the population from maintaining itself on a long-term basis as a viable component of its natural habitat.

751. It is noted that under the ‘restoration and recovery’ Conservation Objective, the bottlenose dolphin population should be increasing. However, the most recent feature condition assessment concluded that the population has a stable medium-term trend (2001-2016), which is what was assumed in the population modelling here. The impact of disturbance from piling at the CWP Project will not alter the long-term trajectory of the population, but it is important to note that the current population trajectory is stable, not increasing, in the absence of the CWP Project.

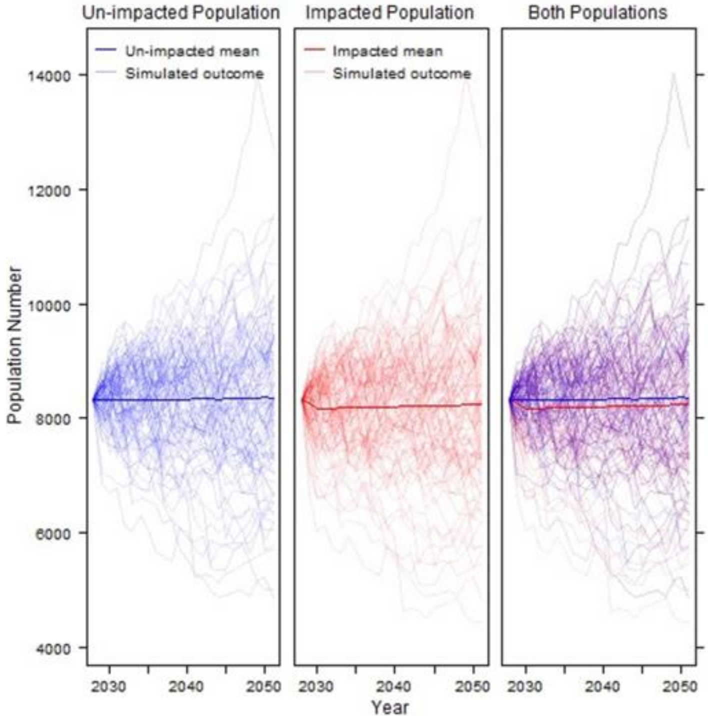
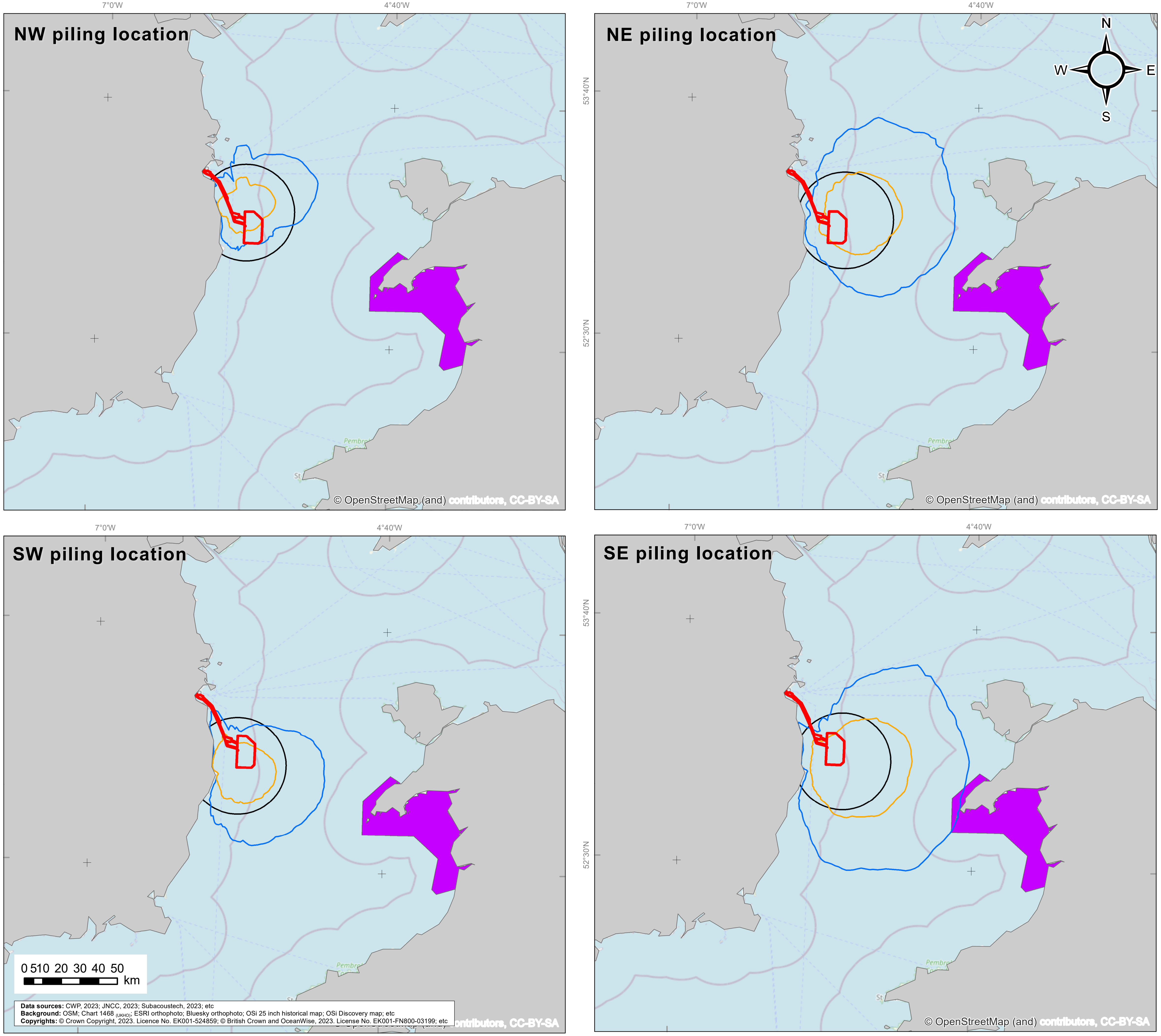
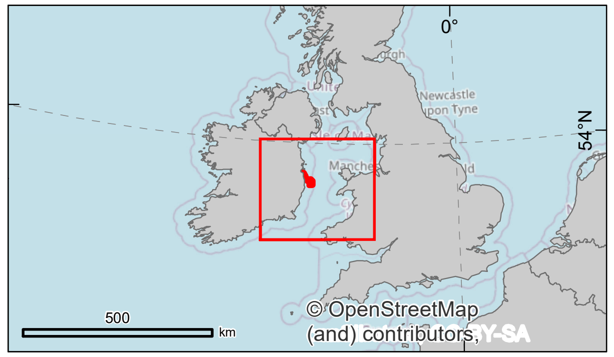


Plate 2-4 Predicted population trajectories for the unimpacted (baseline) and impacted bottlenose dolphin iPCoD simulations (78 days piling in 2027) using the results for the dose-response function





Legend

- Planning application boundary
- Level B threshold 160 dB re μPa (SPL RMS)
- SEL_{ss} 145 dB re μPa^2s threshold
- 26 km EDR
- Lleyn Peninsula and the Sarnau SAC

codling wind park | Project: Codling Wind Park | SMRU Consulting understand • assess • mitigate

Figure 2.11:
Disturbance thresholds for piling at all modelling locations and the Lleyn Peninsula and the Sarnau SAC

CWP doc. number:	CWP-SMR-ENG-08-01-MAP-1608	
Internal descriptive code: IS - PAB..DPNM.THRESH.B160.SEL.26EDR. CONT.WTGs.CORNERS - LLEYN.PEN.SARNAU.SAC - (NIS.Vol.04.Ch.02.FIG.13)	Size: A3 Scale: 1:2,000,000	CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Piling at the onshore substation

752. For piling at the onshore substation, <1 bottlenose dolphin in the Irish Sea MU was predicted to be disturbed per piling day, which is of negligible impact. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC.

753. Within the Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

754. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Other construction activities

755. For other construction activities, disturbance ranges were expected to be highly localised (within 5 km) based on evidence in the existing literature (e.g., for disturbance from dredging activities bottlenose dolphin presence reduced though temporarily and at a small scale, see Pirotta et al. (2013) and Pirotta et al. (2013)). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

756. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Llŷn Peninsula and the Sarnau SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Vessel presence

757. Vessels within 400 m of a bottlenose dolphin group have been found to result in short-term changes to bottlenose dolphin behaviour through both targeted and non-targeted approaches (Clarkson et al., 2020, Bas et al., 2017, Puszka et al., 2021). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC.

758. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Conclusion

759. In summary, there is expected to be only negligible impacts to the Irish Sea MU. Although there is a potential for an overlap of the 145 dB SEL_{ss} threshold with the Llŷn Peninsula and the Sarnau SAC boundary, the intersection would be across 5% of the total area of the SAC intermittently during the piling activities only. This is significantly below the 20% area threshold and so does not constitute a significant disturbance to the SAC.

760. It is acknowledged that bottlenose dolphins from the SAC population can range outside of the SAC, and thus have the potential to be disturbed out with the SAC boundary within the Irish Sea MU.

However, disturbance is expected to be temporary and highly unlikely to result in any changes to the trajectory of the Irish Sea MU. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from disturbance caused by underwater noise from the CWP Project alone.

Exclusion

761. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the SAC or within the Irish Sea MU and as such, the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from disturbance caused by underwater noise from the CWP Project alone.

Proposed mitigation

762. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP Project alone from increased underwater noise.

763. No additional mitigation is required.

Residual impacts

764. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI to the Conservation Objectives for bottlenose dolphins associated with the Llŷn Peninsula and the Sarnau SAC from increased underwater noise from the CWP Project alone.

2.12.1.1.3 Impact 2: Collision risk

765. With regards to collision risk the Conservation Objectives state that *'The population is maintaining itself on a long-term basis as a viable component of its natural habitat'* NRW (2018c). Therefore, injury or mortality from vessel collisions should not result in a change to the population size.

Assessment of the project alone

766. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

767. No vessel activity associated with the CWP Project is expected within the Llŷn Peninsula and the Sarnau SAC and thus no direct impact to bottlenose dolphins within the SAC boundary is expected.

768. There is however the potential for vessel collision to occur out with the boundary of the SAC within the inter-connected areas used by the population (the Irish Sea MU). The CWP development has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regards to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. As such, although there will be vessel activity within the wider Irish Sea MU, it is anticipated that the risk of vessel collision is negligible.

769. Considering the above, no bottlenose dolphins within or associated with the SAC are expected to experience death or injury from vessel collisions and as such, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from collision risk from the CWP Project alone.

Proposed mitigation

770. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP.

771. No additional mitigation is required.

Residual impacts

772. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins associated with the Llŷn Peninsula and the Sarnau SAC from vessel collision from the CWP Project alone.

2.12.1.1.4 Impact 3: Changes in prey availability

773. The Conservation Objectives state that 'The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing' (NRW, 2018c).

774. As stated in the latest feature condition assessment (NRW, 2018b) *'we do not have enough information about bottlenose dolphin prey species and the status of fish stocks to produce a meaningful assessment for this component.'* (NRW, 2018b). Overall, the supporting habitat (including the prey availability and quality component) was assessed as **unknown**. This makes it unfeasible to provide a meaningful assessment of the in situ prey availability and quality within this NIS.

Assessment of the project alone

775. Given that bottlenose dolphins are dependent on fish prey, there is the potential for indirect effects as a result of impacts upon fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. Stomach contents analysis from stranded bottlenose dolphins in Irish waters has shown that their diet is diverse, with a preference for whiting / blue whiting and pelagic squid (Hernandez-Milian et al., 2011). To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Llŷn Peninsula and the Sarnau SAC

could arise as a result of the impacts of changes in prey availability on bottlenose dolphins as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of CWP Project alone (this includes: direct damage, disturbance, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of bottlenose dolphins (e.g., whiting).

776. Considering the above, there is expected to be no long-term change to bottlenose dolphin prey species presence, abundance, condition or diversity. As such, changes in prey availability will not affect the distribution, abundance and population dynamics of bottlenose dolphins within and beyond the site. There is therefore no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from changes in prey availability from the CWP Project alone.

Proposed mitigation

777. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Llŷn Peninsula and the Sarnau SAC as a result of changes in prey availability.

Residual impacts

778. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of bottlenose dolphins associated with the Llŷn Peninsula and the Sarnau SAC from changes in prey availability from the CWP Project alone.

2.12.1.1.5 Impact 4: Changes in available habitat

779. The Conservation Objectives state that 'The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future' (NRW, 2018c).

780. As stated in the latest feature condition assessment (NRW, 2018b) *'there is no specifically defined 'dolphin habitat'. The presence of dolphins at a location implies that the habitat is suitable but presence is largely driven by prey availability. This component has been assessed as unknown.'* (NRW, 2018b). This makes it unfeasible to provide a meaningful assessment of the available habitat within this NIS.

Assessment of the project alone

781. None of the activities associated with the construction, O&M and decommissioning of the CWP Project are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the Llŷn Peninsula and the Sarnau SAC or across the wider area used by the population. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from changes in available habitat from the CWP Project alone.

Proposed mitigation

782. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Llŷn Peninsula and the Sarnau SAC as a result of changes in available habitat.

Residual impacts

783. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of bottlenose dolphins associated with the Llŷn Peninsula and the Sarnau SAC from changes in available habitat from the CWP Project alone.

2.12.2 Grey seals

Table 2-27 Conservation Objectives, Attributes and Targets for grey seals of the Llŷn Peninsula and the Sarnau SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on grey seals arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the natural range of the population.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the natural range of the population.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the natural range of the population.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in prey availability.	
	Changes in available habitat			

	Changes in available habitat are not expected to adversely affect the natural range of the population.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in available habitat.	
Supporting habitats and species The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on grey seals arising from the CWP Project.
	There is no potential impact pathway between increased underwater noise and this Conservation Objective.	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (grey seal) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (grey seal) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in available habitat.	
Populations	Increased underwater noise			

The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the long-term maintenance of grey seal population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (grey seal) population at the site due to increased underwater noise.	There will be no adverse effects on the integrity of the SAC as a result of impacts on grey seals arising from the CWP Project.
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the long-term maintenance of grey seal population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (grey seal) population at the site due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the long-term maintenance of grey seal population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (grey seal) population at the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the long-term maintenance of grey seal population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (grey seal) population at the site due to changes available habitat.	

784. The Llŷn Peninsula and the Sarnau SAC covers an area of approximately 1,460.35 km^2 (Feingold and Evans, 2014). The nature of the seabed and coast and the range of environmental conditions present vary throughout the SAC with great differences in rock and sediment type, aspect, sediment movement, exposure to tidal currents and wave action, water clarity and salinity throughout the site (NRW, 2018a). The SAC is located approximately 61.7 km from the CWP Project.

785. Grey seals range throughout the open coast areas of the Llŷn Peninsula and the Sarnau SAC and beyond but are commonly observed within the SAC around the Llŷn, Bardsey Island and the islands along the south Llŷn coast (NRW, 2018a). The site contains several important pupping sites which are located around the northwest of the SAC including Bardsey Island, with the majority of pups born from September to October, but with some pupping activity occurring from early August to the end of November (NRW, 2018a). Haul out sites are distributed throughout the SAC and non-pupping seals are present year round at these haul out sites. Haul out sites are predominantly located on intertidal rocky outcrops, rock and boulder / cobble beaches, sea caves that are tidally exposed, and occasionally sandy beaches and tidally exposed sandflats (NRW, 2018a).

786. Grey seals in the SAC are part of a wider population, considered to be at the scale of the SW England and Wales MUs (NRW, 2018a). Therefore, it is important to acknowledge the impacts as a result of CWP Project in the context of this wider population.

787. The most recent 2021 August haul-out estimate for grey seals in the SW England and Wales MUs is 500 and 900 individuals, respectively (SCOS, 2023). The total August count estimates for the SW England and Wales MUs can be scaled by the estimated proportion of animals hauled-out (25.15%, SCOS, 2022) to provide an estimate of the total population (hauled-out and at-sea). The combined count totals 1,400 grey seals resulted in a population estimate of 5,557 grey seals in the reference population (SW England and Wales MU).

788. It is important to note that the Llŷn Peninsula and the Sarnau SAC is located in the SW England and Wales MU, while the CWP Project is located in the East Ireland and Northern Ireland MUs. However, since grey seals tagged in Wales (at Bardsey Island and the River Dee) have shown telemetry tracks that enter into Irish waters, including in the vicinity of the CWP Project, it is considered appropriate to assess potential impacts to this Welsh SAC.

2.12.2.1 Conservation Objectives

789. The vision statement for the Llŷn Peninsula and the Sarnau SAC is as follows:

- '*NRW's vision for the Pen Llŷn a'r Sarnau SAC is for a high quality marine and coastal environment which is healthy, productive and biologically diverse, supporting resilient marine ecosystems and communities. The special habitat and species features of the SAC will be maintained and, where necessary, restored so that they will be able to sustain themselves in the long-term as part of naturally functioning ecosystems. The diversity of the wildlife habitats and species in the SAC will not be degraded*' (NRW, 2018c).
- '*The SAC will continue to provide a productive and supportive marine area for grey seals. The population of grey seals frequenting the SAC will form and important component of a larger southwest UK population of grey seals. Grey seals will continue to be widespread throughout the SAC predominantly in areas of open coast and sea. Grey seals will have access to, and sufficient availability of prey, and they will have widespread availability and access to good quality essential habitats, including areas for hauling out and pupping, that are free from excessive disturbance. The quality and distribution of haul out and breeding sites for grey seals within the site will be maintained or improved through appropriate management*' (NRW, 2018c).

790. The Conservation Objectives of the Llŷn Peninsula and the Sarnau SAC are outlined in NRW (2018a):

- To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long term. If these objectives are not met restoration measures will be needed to achieve FCS.
- Populations:
    - The population is maintaining itself on a long term basis as a viable component of its natural habitat. Important elements include:
        - population size;
        - structure, production; and
        - condition of the species within the site.
    - As part of this objective, it should be noted that for grey seal:
        - contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
        - population should not be reduced as a consequence of human activity.
- Range:
    - The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.
    - As part of this objective it should be noted that for grey seal:
        - their range within the SAC and adjacent interconnected areas is not constrained or hindered.
        - there are appropriate and sufficient food resources within the SAC and beyond.
        - the sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.
- Supporting habitats and species:
    - The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include:
        - distribution;
        - extent;
        - structure;
        - function and quality of habitat; and
        - prey availability and quality.
    - As part of this objective, it should be noted that:
        - the abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
        - the management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
        - contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
        - disturbance by human activity is below levels that suppress reproductive success, physiological health or long term behaviour.

2.12.2.1.1 Feature condition assessment

791. The latest feature condition assessment (NRW, 2018b) concluded an overall favourable assessment for grey seals in the Llŷn Peninsula and the Sarnau SAC, with a medium confidence level.

792. For the 'population' component of the assessment, it was highlighted that at regularly monitored sites (Bardsey Island), pup production and haul-out numbers have been maintained or increased since

2009. In North Wales, it is assumed that '*grey seals are doing well*' based on pup production estimates at Pembrokeshire and the rest of the UK (NRW, 2018b). Overall, the population was assessed as **favourable**.

793. For the 'range' component of the assessment, it was highlighted that known pupping site use has not contracted and that several new sites have been observed. It is '*likely that pupping site distribution is stable or increasing (no loss in range)*' (NRW, 2018b). Overall, the range was assessed as **favourable**.

794. For the 'supporting habitats' component of the assessment, it was highlighted that seals in the SAC are part of the wider population covering the SW England and Wales Management Unit. It was stated that '*the growth or stability of pup production over at least the last decade […] suggests that the supporting habitat is functioning well and likely to be of sufficient quality to maintain the population or enable population growth. However, information has not been collected on supporting habitats so they have been assessed as **unknown***'. This makes it unfeasible to provide any meaningful assessment of the supporting habitat within this NIS.

2.12.2.1.2 Impact 1: Increased underwater noise

795. With regards to underwater noise (injury and disturbance) the Conservation Objectives state that 'The population is maintaining itself on a long-term basis as a viable component of its natural habitat' and 'The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future' NRW (2018c).

796. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

797. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

798. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

799. The risk of auditory injury to grey seals from MBES and SSS is negligible according to the EPS Guidance (JNCC et al., 2010). For USBLs the impact range is expected to be a few meters from the source. For SBPs and URHS modelled impact ranges are ~10 m for seals (Department for Business Energy and Industrial Strategy, 2019). With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals), it is expected that no seals will experience PTS. The CWP array site is located approximately 62.1 km

away from the Pen Llŷn a'r Sarnau SAC. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

UXO clearance

800. The underwater noise assessment concluded that for UXO clearance, the maximum PTS-onset impact range for grey seals from high-order clearance of a 525 kg UXO (+ donor) was 2.5 km resulting in 3 grey seals being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

Piling

801. The underwater noise assessment concluded that for piling of WTGs and at the onshore substation, the maximum PTS-onset impact range for grey seals was <100 m resulting in <1 seal being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

Other construction activities

802. The underwater noise assessment concluded that for other construction activities, the maximum PTS-onset impact range for grey seals was <100 m resulting in <1 seal being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

Operational noise

803. The underwater noise assessment concluded that for operational noise, the maximum PTS-onset impact range for grey seals was <100 m resulting in <1 seal being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Llŷn Peninsula and the Sarnau SAC.

Conclusion

804. The proposed activities at the CWP Project will not cause auditory injury to grey seals. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the grey seal feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

805. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the

use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Therefore, the impact is negligible. There will be no overlap between disturbance ranges and the Llŷn Peninsula and the Sarnau SAC.

UXO clearance

806. The underwater noise assessment used TTS as a proxy for disturbance for UXO clearance. For the low-order clearance of UXOs the predicted impact range was 570 m for grey seals. For high-order detonation of a 525 kg UXO (+ donor) the predicted impact range was 19 km for grey seals, which results in impact to 174 grey seals (2.88% of the combined east Ireland and Northern Ireland MU). It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). Given the percentage of the MU predicted to be impacted, and the fact the consequence of the impact is likely to be short-term, intermittent during a UXO clearance campaign, and with temporary behavioural effects that are very unlikely to alter survival and reproductive rates to the extent that the population trajectory would be altered, disturbance effects associated with UXO clearance using TTS-onset as a proxy is of Low magnitude. It is also worth highlighting that Southall et al. (2007) states that the use of TTS as a proxy for disturbance is *'expected to be precautionary because TTS at onset levels is unlikely to last a full diel cycle or to have serious biological consequences during the time TTS persists.'* TTS-onset thresholds are therefore likely to over-estimate the true behavioural response of any number of individuals predicted to be impacted.

807. There is no overlap between the disturbance ranges and the Llŷn Peninsula and the Sarnau SAC, and therefore the species population within the site will not be reduced within the SAC. It is recognised that grey seals are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas (**Plate 2-5**) and thus could potentially be disturbed by UXO activities at the CWP Project. It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). The duration of impact will be short-term and intermittent throughout a UXO clearance campaign, with animals expected to return to the area once the activity has ceased. The range within the inter-connected areas will therefore not be constrained or hindered.

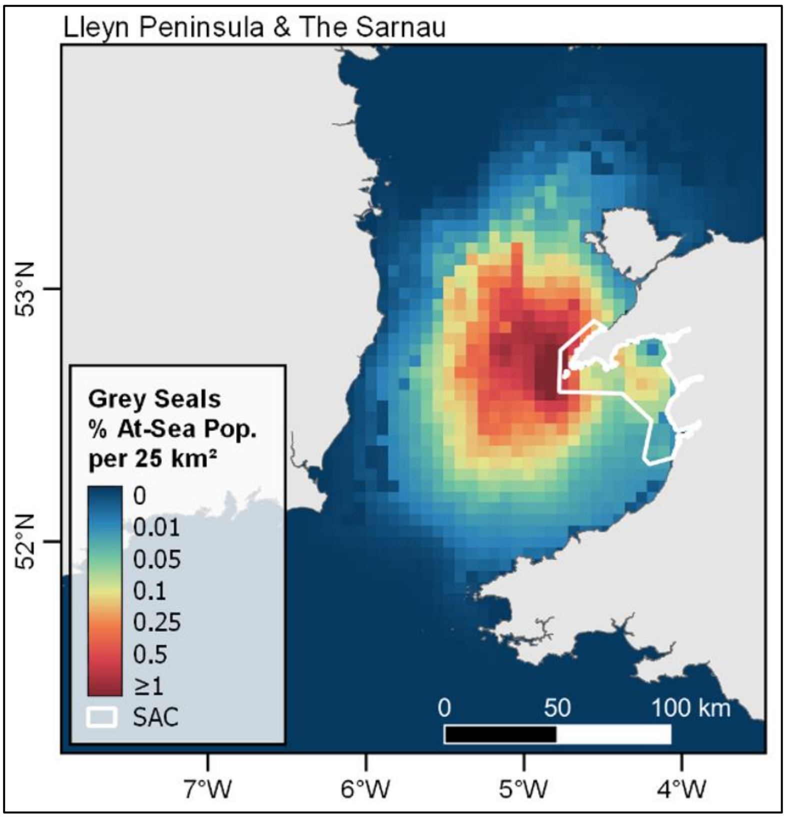


Plate 2-5 The mean percentage of the Llŷn Peninsula and the Sarnau SAC grey seal population estimated to be present in each 5 km x 5 km grid cell at any one time. Figure from Carter et al. (2022) Supplementary Material S10.2.

Piling of WTGs

808. To assess disturbance within the SAC boundary, various assessment approaches are presented here, in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs (NRW, 2023). The same disturbance thresholds have been applied here for grey seals in the absence of specific guidance for grey seal SACs. The disturbance thresholds assessed include the 145 dB SELss threshold (Lucke et al., 2009), the 160 dB SPLrms Level B harassment threshold (NMFS, 2005), and a 26 km EDR for monopiles (JNCC, 2020).

809. The 145 dB SELss threshold overlapped with the Llŷn Peninsula and the Sarnau SAC for the SE WTG modelling location only (**Table 2-28**). The area of overlap was 5% of the total SAC. Level B harassment threshold impact contours did not overlap with the Llŷn Peninsula and the Sarnau SAC from any of the WTG locations modelled. The 26 km EDR contour does not overlap with the Llŷn Peninsula and the Sarnau SAC. Therefore, a maximum of 5% of the Llŷn Peninsula and the Sarnau SAC area is predicted to experience disturbance from WTG pile driving on a single piling day at CWP Project. As such, the majority of the grey seal range within the SAC will not be constrained or hindered. The duration of impact is expected to be temporary and short-term, will occur over less than a year (maximum 78 days WTG piling).

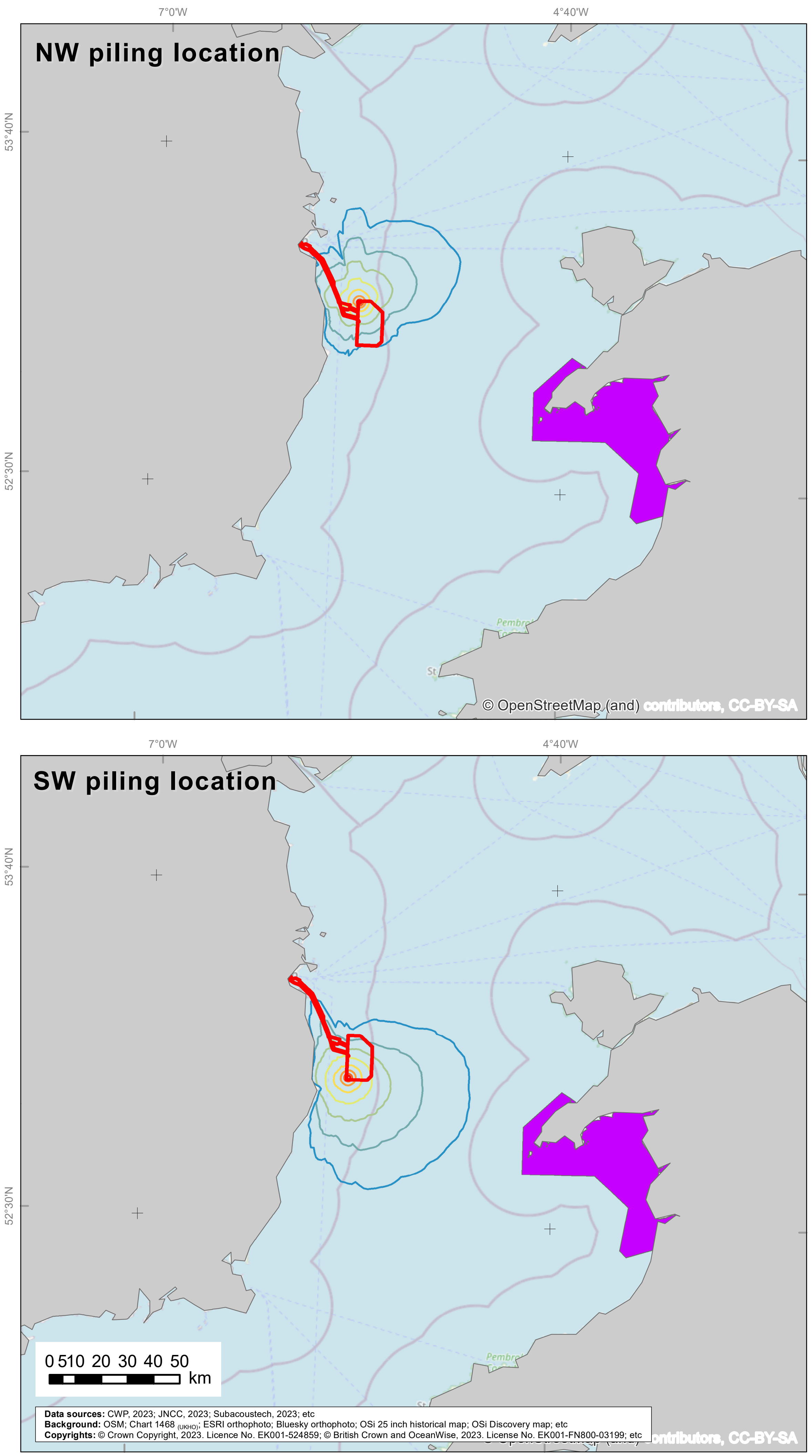
810. In English, Welsh and Northern Irish harbour porpoise SACs, disturbance to 20% of the SAC area on a single day is considered significant (JNCC, 2020). There is no equivalent guidance for grey seal SACs. The European Commission (EC) Directorate-General for Environment has set binding limits for

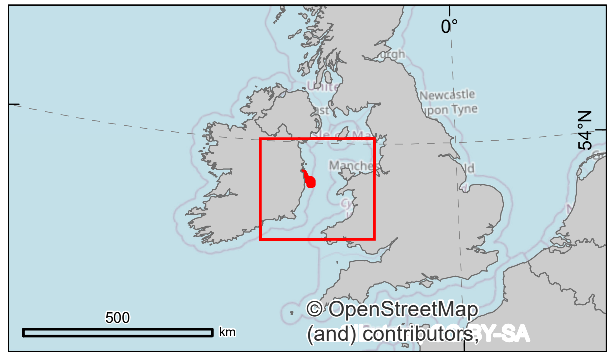
underwater noise pollution (11 March 2024[23]). This states that for impulsive noise (such as piling): *'For short-term exposure (1 day, i.e., daily exposure), the maximum proportion of an assessment / habitat area utilised by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biologically adverse Effects (LOBE), over 1 day, is 20% or lower (≤ 20%)'*. It is important to note that there is no advised threshold value for LOBE ('*a sound level above which an adverse biological effect on an indicator species is expected to occur, i.e., an effect that may affect the comfort, survival, and vital functions of individual animals*'), nor is there guidance on what constitutes '*assessment / habitat area utilised by a species'.* In the absence of specific guidance from NPWS on the application of the aforementioned EC limits for impulsive noise, the suitability of the approaches to estimating disturbance for determining the LOBE is unknown. Similarly, given the wide-ranging and highly mobile nature of grey seal, it is not clear if an individual SAC constitutes an appropriate assessment / habitat area. Nonetheless, a precautionary approach is to assume that disturbance, estimated by the methods described above, to 20% of the SAC area on a single piling day could constitute significant disturbance and a breach of the EC limits. Disturbance levels predicted within the Llŷn Peninsula and the Sarnau SAC are significantly below the 20% area threshold and so do not constitute significant disturbance to the SAC.

Table 2-28 Predicted overlap between predicted disturbance contours from piling of WTGs at CWP and the Llŷn Peninsula and the Sarnau SAC

Approach	Model location	Area overlap
145 dB SEL_{ss}	NE	0 km^2
	NW	0 km^2
	SE	68.6 km^2 (5% SAC)
	SW	0 km^2
160 dB SPL_{rms} Level B	All	0 km^2
26 km EDR	All	0 km^2

[23] https://environment.ec.europa.eu/publications/notice-under-marine-strategy-framework-directive_en.





Legend

- Planning application boundary
- SEL_{ss} dB re µPa^{2}s (5dB contours)
  - 145 dB
  - 150 dB
  - 155 dB
  - 160 dB
  - 165 dB
  - 170 dB
  - 175 dB
  - 180 dB
- Lleyn Peninsula and the Sarnau SAC

Project: Codling Wind Park

SMRU Consulting
understand • assess • mitigate

Figure 2.12:
Disturbance thresholds for piling at all modelling locations and the Lleyn Peninsula and the Sarnau SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1609

Internal descriptive code: IS - PAB..DPNM.CONT.CORNERS - LLEYN.PEN.SARNAU.SAC - (NIS.Vol.04.Ch.02.FIG.15)

Size: A3
Scale: 1:2,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

811. It is recognised that grey seals are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas where they could potentially be disturbed by piling activities at the CWP Project (**Figure 2-12**). The underwater noise assessment used the harbour seal dose-response function (Whyte et al., 2020) to assess potential impacts of disturbance from piling. The maximum number of grey seals predicted to be disturbed on a single piling day using the dose-response function is 394 seals (using the seal habitat preference density surface (Carter et al., 2020, Carter et al., 2022)), equating to 6.51% of the combined east Irland and Northern Irland MUs. To determine if this level of disturbance results in a population level effect, iPCoD modelling was conducted. This assumed disturbance to 394 grey seals per day over 78 piling days between April and October 2027. The results of the iPCoD modelling shows that the level of disturbance is not sufficient to result in any changes at the population level, since the impacted population is predicted to continue on the same stable trajectory and at exactly the same size as the unimpacted population (**Plate 2-6** and **Table 2-29**). Therefore, pile driving of WTGs at the CWP Project does not hinder the population from maintaining itself on a long-term basis as a viable component of its natural habitat.

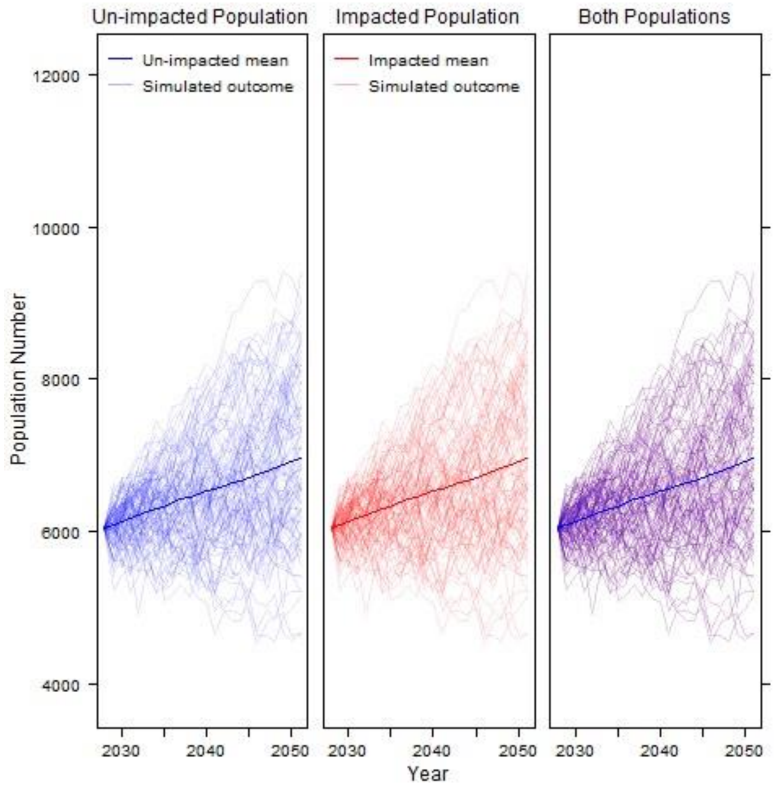


Plate 2-6 Predicted population trajectories for the unimpacted (baseline) and impacted grey seal iPCoD simulations (78 days piling in 2027) using the results for the dose-response function

Table 2-29 Predicted mean population size for the unimpacted (baseline) and impacted grey seal iPCoD simulations (78 days piling in 2027), impacting 394 grey seals per day

	Unimpacted population mean size	Unimpacted population mean size	Impacted population as a proportion of the unimpacted population
Start 2027 (before piling commences)	6054	6054	100.0%
End 2027 (after piling ends)	6079	6079	100.0%
End 2033 (6 years after piling ends)	6330	6330	100.0%
End 2039 (12 years after piling ends)	6557	6557	100.0%
End 2045 (18 years after piling ends)	6790	6790	100.0%

Piling at the onshore substation

812. For piling at the onshore substation, <1 grey seal was predicted to be disturbed per piling day, which is of negligible impact. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC.

Other construction activities

813. For other construction activities, disturbance ranges were expected to be highly localised (within 5 km) based on evidence in the existing literature (e.g., see Pirotta et al. (2013) and McQueen et al. (2020)). This will result in a negligible impact. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC.

Operational noise

814. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). This will result in a negligible impact. Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Llŷn Peninsula and the Sarnau SAC.

Vessel presence

815. Vessel disturbance studies on seals have demonstrated flushing of seals in response to large vessels can occur out as far as 1 km (Young et al., 2014). This will result in a negligible impact. Disturbance impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC.

Conclusion

816. In summary, there is expected to be only negligible impacts to grey seals. Although there is a potential for an overlap of the 145 dB SEL_{ss} threshold with the Llŷn Peninsula and the Sarnau SAC boundary, the intersection would be across 5% of the total area of the SAC intermittently during the piling activities only. This is significantly below the 20% area threshold and so does not constitute a significant disturbance to the SAC.

817. It is acknowledged that grey seals from the SAC population can range outside of the SAC, and thus have the potential to be disturbed out with the SAC boundary. However, disturbance is expected to be temporary and highly unlikely to result in any changes to the trajectory of the MU. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the grey seal feature from disturbance caused by underwater noise from the CWP Project alone.

Exclusion

818. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of grey seals from part of their range within the SAC or across the wider MU and as such, the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the grey seal feature from disturbance caused by underwater noise from the CWP Project alone.

Proposed mitigation

819. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP Project alone from increased underwater noise.

820. No additional mitigation is required.

Residual impacts

821. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives for grey seals associated with the Llŷn Peninsula and the Sarnau SAC from increased underwater noise from the CWP Project alone.

2.12.2.1.3 Impact 2: Collision risk

822. With regards to collision risk the Conservation Objectives state that 'The population is maintaining itself on a long-term basis as a viable component of its natural habitat' NRW (2018c). Therefore, injury or mortality from vessel collisions should not result in a change to the population size.

823. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

824. No vessel activity associated with the CWP Project is expected within the Llŷn Peninsula and the Sarnau SAC and thus no direct impact to grey seals within the SAC boundary is expected.

825. There is however the potential for vessel collision to occur out with the boundary of the SAC within the inter-connected areas used by the population. The CWP development has committed to the implementation of an EVMP as primary mitigation. With the adoption of industry best practice with regards to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. As such, although there will be vessel activity within the wider Irish Sea, it is anticipated that the risk of vessel collision is negligible.

826. Considering the above, no grey seals within or associated with the SAC are expected to experience death or injury from vessel collisions and as such, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the grey seal feature from collision risk from the CWP Project alone.

Proposed mitigation

827. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP.

828. No additional mitigation is required.

Residual impacts

829. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the grey seals associated with the Llŷn Peninsula and the Sarnau SAC from vessel collision from the CWP Project alone.

2.12.2.1.4 Impact 3: Changes in prey availability

830. The Conservation Objectives state that 'The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing' (NRW, 2018c).

831. As stated in the latest feature condition assessment (NRW, 2018b) the supporting habitat (including the prey availability and quality component) was assessed as unknown. This makes it unfeasible to provide a meaningful assessment of the in situ prey availability and quality within this NIS.

Assessment of the project alone

832. Given that grey seals are dependent on fish prey, there is the potential for indirect effects as a result of impacts upon fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. Scat analysis from the Blasket islands (Co. Kerry) has shown that their diet is diverse and that they are considered to be generalist feeders (Gosch et al., 2014). To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of

the Llŷn Peninsula and the Sarnau SAC could arise as a result of the impacts of changes in prey availability on grey seals as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of CWP Project alone (this includes: direct damage, disturbance, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of grey seals.

833. Considering the above, there is expected to be no long-term change to grey seal prey species presence, abundance, condition or diversity. As such, changes in prey availability will not affect the distribution, abundance and population dynamics of grey seals within and beyond the site. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the grey seal feature from changes in prey availability from the CWP Project alone.

2.12.2.1.5 Impact 4: Changes in available habitat (seal haul-outs)

Assessment of the project alone

834. Grey seals could potentially be disturbed at and around haul-out sites from offshore activities. However, given the distance between the CWP Project and the Llŷn Peninsula and the Sarnau SAC (61.7 km) it is anticipated that there is no potential for the alteration of natural breeding behaviours, the displacement of individuals from a moult haul-out site or alteration of natural moulting behaviours nor the displacement of individuals from a resting haul-out site to an extent that may ultimately interfere with key ecological functions. In addition, planned activities at CWP Project will not affect the amount of supporting habitat used by these species in form of haul-out sites on land. There is therefore no potential for an AESI, and no impediment to the Conservation Objectives of the grey seal features from changes in available habitat (seal haul-outs) from CWP Project alone.

Proposed mitigation

835. No specific mitigation is proposed.

Residual impacts

836. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of grey seal population associated with the Llŷn Peninsula and the Sarnau SAC from changes in available habitat from CWP Project alone.

2.13 Cardigan Bay / Bae Ceredigion SAC (UK0012712)

837. The Cardigan Bay / Bae Ceredigion SAC is 100 km from the offshore development area and is screened in for bottlenose Dolphin, Sea Lamprey and River Lamprey.

2.13.1 Bottlenose dolphin

Table 2-30 Assessment summary, Conservation Objectives, Attributes and Targets for bottlenose dolphin of the Cardigan Bay / Bae Ceredigion SAC (Natural Resources Wales, 2018)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the natural range of the population within the site and adjacent areas.	No additional mitigation is required.	There is no potential for an AESI associated with the access to suitable habitat within the site due to changes in available habitat.	
Supporting habitats and species The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	There is no potential impact pathway between increased underwater noise and this Conservation Objective.	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (bottlenose dolphin) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in prey availability.	
	Changes in available habitat			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
and populations dynamics of the species within the site and population beyond the site is stable or increasing.	Changes in available habitat are not expected to adversely affect the distribution, extent, structure, function and quality of the habitat and prey availability to the extent that could affect species (bottlenose dolphin) population dynamics.	No additional mitigation is required.	There is no potential for an AESI associated with supporting habitats and species due to changes in available habitat.	
Populations The population is maintaining itself on a long-term basis as a viable component of its natural habitat.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to adversely affect the long-term maintenance of bottlenose dolphin population as a viable component of its natural habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining species (bottlenose dolphin) population at the site due to changes available habitat.	

838. The Cardigan Bay (Bae Ceredigion) SAC is located in Wales, off the south Ceredigion and north Pembrokeshire coast, in the southern part of Cardigan Bay, covering an area of ~960 km^2.

839. Bottlenose dolphins associated with the Cardigan Bay are part of a larger coastal population that is also associated with the Llŷn Peninsula and the Sarnau SAC. There is a high degree of connectivity between the two SACs and thus the two SACs are considered to be a 'super-site' that do not have separate populations (NRW, 2018b). The advice by NRW states that '*Bottlenose dolphins have been seen all around the Welsh coast since the early part of the 20th Century, but mainly throughout Cardigan Bay where they use the area for all essential activities including feeding, socialising and nurture of young*' (NRW, 2018c). The NRW position paper on the use of marine mammal MUs for assessment in HRA for SACs with marine mammal features (NRW, 2022) suggests that since the populations of the two SACs are highly connected, there is likely a single generic population across the Irish Sea MU. Therefore, the assessment here considers impacts to a single population of bottlenose dolphins that is present in both the Cardigan Bay SAC and the Llŷn Peninsula and the Sarnau SAC.

840. Population estimates have been modelled using photo-ID closed population mark-recapture modelling for the wider Cardigan Bay area (referring to both the Cardigan Bay SAC and northern Cardigan Bay – which includes the Pen Llŷn a'r Sarnau SAC) by Lohrengel et al. (2018). Using a closed population Capture-Recapture Model, in 2016 there were estimated to be a population of 174 bottlenose dolphins in the wider Cardigan Bay area (95% CI: 150–246, CV: 0.30).

2.13.1.1 Conservation Objectives

841. The Vision statement for Cardigan Bay SAC is as follows: '*Our vision for the Cardigan Bay Special Area of Conservation (SAC) is one of a high quality marine environment, where the protected habitats and species of the site are in a condition as good as or better than when the site was selected; where human activities co-exist in harmony with the habitats and species of the site and where use of the marine environment is undertaken sustainably*' NRW (2018b).

842. The Conservation Objectives (as listed in NRW (2018c)) states that *'To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term:*

- *Populations:*
    - *The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:*
        - *Population size;*
        - *Structure, production; and*
        - *Condition of the species within the site.*
    - *As part of this objective it should be noted that for bottlenose dolphin:*
        - *Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.*
- *Range:*
    - *The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.*
    - *As part of this objective, it should be noted that for bottlenose dolphin:*
        - *Their range within the SAC and adjacent inter-connected areas is not constrained or hindered.*
        - *There are appropriate and sufficient food resources within the SAC and beyond.*
        - *The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.*
- *Supporting habitats and species:*

- *The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include:*
  - *Distribution;*
  - *Extent;*
  - *Structure;*
  - *Function and quality of habitat; and*
  - *Prey availability and quality.*
- *As part of this objective, it should be noted that:*
  - *The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.*
  - *The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.*
  - *Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.*
  - *Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.*

- *Restoration and recovery:*
  - *As part of this objective it should be noted that the bottlenose dolphin populations should be increasing'.*

2.13.1.1.1 Feature condition assessment

843. The latest feature condition assessment (NRW, 2018a) concluded an overall favourable assessment for bottlenose dolphins in the Cardigan Bay SAC, with a medium confidence level.

844. For the 'population' component of the assessment, it was highlighted that the Cardigan Bay SAC is part of a larger coastal population that is also associated with the Llŷn Peninsula and the Sarnau SAC. The population is estimated to be 174 dolphins across these two sites (Lohrengel et al., 2018). Between 2001 and 2016 there was no significant trend in this SAC population estimate and it is considered to be stable in the medium term (though it is noted that there was a decline in the short term between 2007 and 2016). Overall, the population was assessed as **favourable**.

845. For the 'range' component of the assessment, it was highlighted that bottlenose dolphins are found throughout Welsh waters, making it a wide-ranging population that should be considered as one MU. Overall, the range was assessed as **favourable**.

846. For the 'supporting habitats' component of the assessment, it was highlighted that 'there is no specifically defined 'dolphin habitat'. The presence of dolphins at a location implies that the habitat is suitable but presence is largely driven by prey availability. This component has been assessed as unknown.' (NRW, 2018a). Likewise, when considering prey availability and quality, it was highlighted that 'we do not have enough information about bottlenose dolphin prey species and the status of fish stocks to produce a meaningful assessment for this component.' (NRW, 2018a). Overall, the supporting habitat was assessed as **unknown**. This makes it unfeasible to provide any meaningful assessment of the supporting habitat within this NIS.

2.13.1.1.2 Impact 1: Increased underwater noise

847. With regards to underwater noise (injury and disturbance) the Conservation Objectives state that 'The population is maintaining itself on a long-term basis as a viable component of its natural habitat' and 'The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future' NRW (2018c).

Assessment of project alone

848. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

849. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (Wind Turbine Generators (WTGs) and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

850. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

851. The risk of auditory injury to bottlenose dolphins from MBES and SSS is negligible according to the EPS Guidance (JNCC et al., 2010). The source levels of USBLs, SBIs, SBPs and URHS are below the PTS-onset thresholds for dolphins. As such, there is no risk of PTS within the Irish Sea MU. Further, the CWP array site is located approximately 99 km away from the Cardigan Bay SAC. There will be no overlap between PTS-onset ranges and the Cardigan Bay SAC.

852. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

853. The underwater noise assessment concluded that for UXO clearance, the maximum PTS-onset impact range for bottlenose dolphins from high-order clearance was 730 m resulting in <1 dolphin in the Irish Sea MU being injured which is of negligible impact. There will be no overlap between PTS-onset ranges and the Cardigan Bay SAC.

854. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs and onshore substation

855. The underwater noise assessment concluded that for piling of WTGs and at the onshore substation, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Cardigan Bay SAC.

856. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Other construction activities

857. The underwater noise assessment concluded that for other construction activities, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Cardigan Bay SAC.

Operational noise

858. The underwater noise assessment concluded that for operational noise, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and the Cardigan Bay SAC.

859. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Conclusion

860. The proposed activities at the CWP Project will not cause auditory injury to bottlenose dolphins. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

861. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be*

considered as disturbance in terms of the Regulations'. Therefore, the impact to the Irish Sea MU is negligible. There will be no overlap between disturbance ranges and the Cardigan Bay SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

862. The underwater noise assessment used TTS as a proxy for disturbance for UXO clearance. For the low-order clearance of UXOs the predicted impact range was 100 m for bottlenose dolphins and for high-order detonation of a 525 kg UXO (+ donor) the predicted impact range was 1.3 km for bottlenose dolphins. This results in impact to <1 individual dolphin in the Irish Sea MU, which is of negligible impact.

863. There is no overlap between the disturbance ranges and the Cardigan Bay SAC, and therefore the species population within the site will not be reduced within the SAC. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas (e.g., the Irish Sea MU) and thus could potentially be disturbed by UXO activities at the CWP Project. It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). The duration of impact will be short-term and intermittent throughout a UXO clearance campaign, with animals expected to return to the area once the activity has ceased. The range within the inter-connected areas (Irish Sea MU) will therefore not be constrained or hindered.

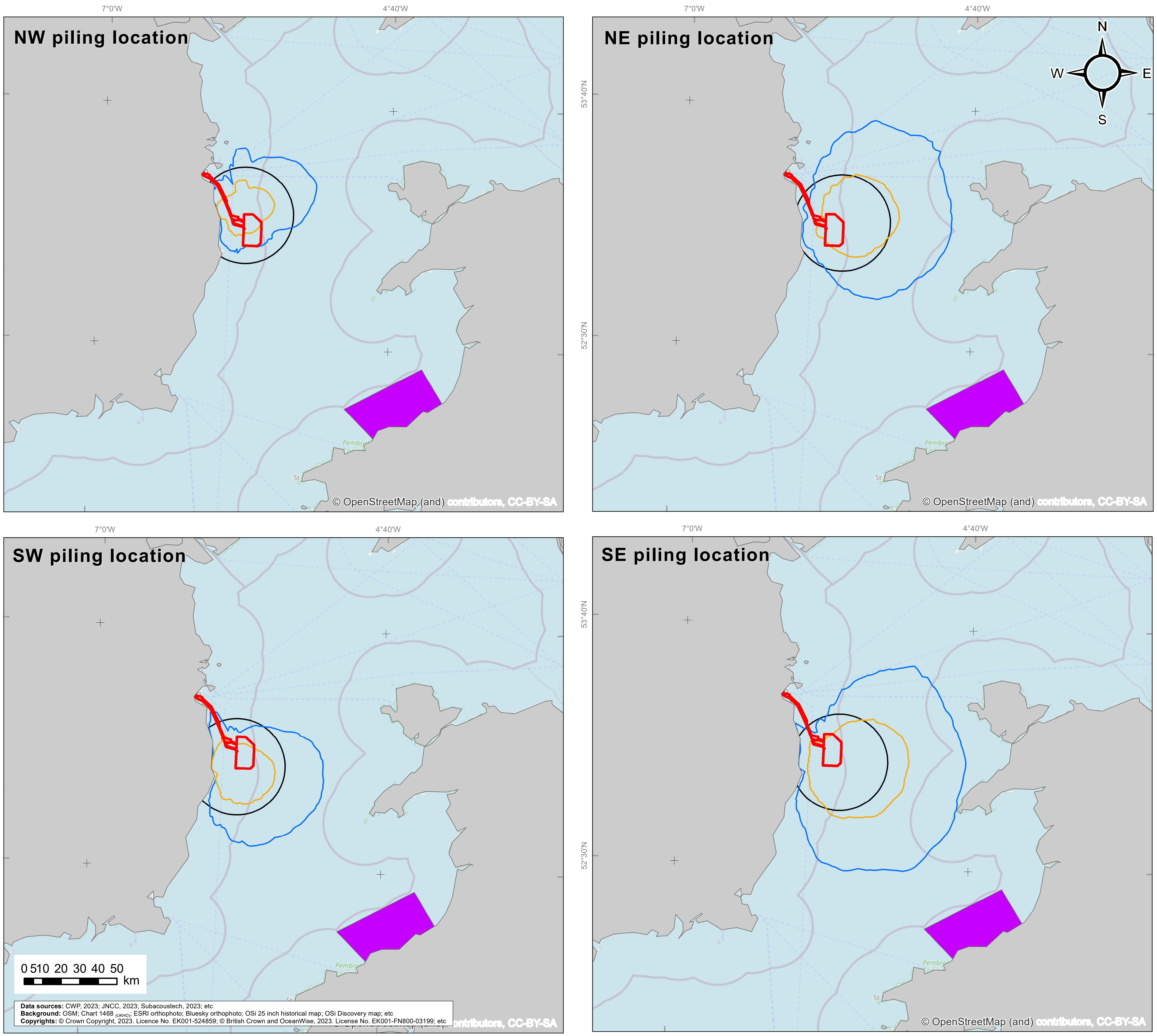
864. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

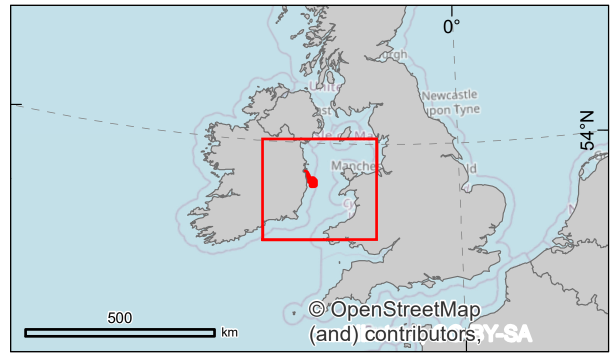
865. To assess disturbance within the SAC boundary, various assessment approaches are presented here, in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs (NRW, 2023). The same disturbance thresholds have been applied here for dolphins in the absence of specific guidance for bottlenose dolphin SACs. The disturbance thresholds assessed include the 145 dB SEL_{ss} threshold (Lucke et al., 2009), the 160 dB SPL_{rms} Level B harassment threshold (NMFS, 2005), and a 26 km EDR for monopiles (JNCC, 2020).

In situ disturbance from piling of WTGs

866. None of the disturbance contours overlap with the Cardigan Bay SAC (**Figure 2-13**).



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- Level B threshold 160 dB re µPa (SPL $_{RMS}$)
- SEL_{ss} 145 dB re µPa^{2}s threshold
- 26 km EDR
- Cardigan Bay SAC

codling wind park	*Project:* Codling Wind Park	SMRU Consulting understand • assess • mitigate

Figure 2.13:
Disturbance thresholds for piling at all modelling locations and the Cardigan Bay SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1610

Internal descriptive code:	*Size:*	*CRS:*
IS - PAB..DPNM.THRESH.B160.SEL.26EDR. CONT.WTGs.CORNERS - CARDIGAN.BAY.SAC - (NIS.Vol.04.Ch.02.FIG.17)	A3; *Scale:* 1:2,000,000	EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

867. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas where they could potentially be disturbed by piling activities at the CWP Project (**Figure 2-13**). Here, it is assumed that the inter-connected area includes the entire Irish Sea MU. The underwater noise assessment used the harbour porpoise dose-response curve (Graham et al., 2017) to assess potential impacts of disturbance from piling in the absence of species-specific information for bottlenose dolphins. The maximum number of bottlenose dolphins predicted to be disturbed on a single piling day using the porpoise dose-response function is 2,060 dolphins (using the SCANS IV block density (Gilles et al., 2023)), equating to 24.74% of the Irish Sea MU (assuming the MU is 8,326 based on (Gilles et al., 2023)). To determine if this level of disturbance results in a population level effect, iPCoD modelling was conducted. This assumed disturbance to 2,060 dolphins per day over 78 piling days between April and October 2027. The results of the iPCoD modelling shows a very slight deviation from the baseline resulting from the pile driving disturbance at CWP (**Plate 2-7**). The mean impacted population size decreases very slightly from the mean unimpacted population size initially in response to piling, after which it continues on the same, stable trajectory at 98.5% of the mean unimpacted population size. It is noted that iPCoD does not currently allow for a density-dependent response, and as such there is no way for the impacted population to increase in size after the piling disturbance (as would be expected in reality). The impacted population does, however, continue on a stable trajectory in the long-term. The results show that temporary changes in behaviour can result in potential reductions to lifetime reproductive success and survival to some individuals, although not enough to affect the population trajectory over a generational scale. Therefore, pile driving of WTGs at the CWP Project does not hinder the population from maintaining itself on a long-term basis as a viable component of its natural habitat.

868. It is noted that under the ‘restoration and recovery’ Conservation Objective, the bottlenose dolphin population should be increasing. However, the most recent feature condition assessment concluded that the population has a stable medium-term trend (2001–2016), which is what was assumed in the population modelling here. The impact of disturbance from piling at the CWP Project will not alter the long-term trajectory of the population, but it is important to note that the current population trajectory is stable, not increasing, in the absence of the CWP Project.

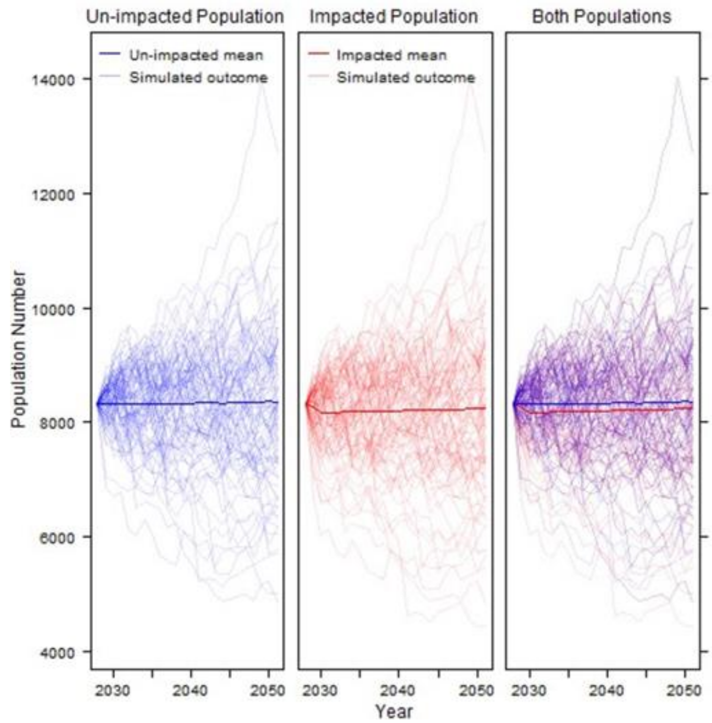


Plate 2-7 Predicted population trajectories for the unimpacted (baseline) and impacted bottlenose dolphin iPCoD simulations (78 days piling in 2027) using the results for the dose-response function

Piling at the onshore substation

869. For piling at the onshore substation, <1 bottlenose dolphin in the Irish Sea MU was predicted to be disturbed per piling day, which is of negligible impact. Disturbance impact ranges will not overlap with the Cardigan Bay SAC.

870. Within the Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

871. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Other construction activities

872. For other construction activities, disturbance ranges were expected to be highly localised (within 5 km) based on evidence in the existing literature (e.g., for disturbance from dredging activities bottlenose dolphin presence reduced though temporarily and at a small scale, see Pirotta et al. (2013) and Pirotta et al. (2013)). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with the Cardigan Bay SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

873. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Cardigan Bay SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Vessel presence

874. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. Vessels within 400 m of a bottlenose dolphin group have been found to result in short-term changes to bottlenose dolphin behaviour through both targeted and non-targeted approaches (Clarkson et al., 2020, Bas et al., 2017, Puszka et al., 2021). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with the Cardigan Bay SAC.

875. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Conclusion

876. In summary, there is expected to be only negligible impacts to the Irish Sea MU. None of the disturbance impact ranges overlap with the Cardigan Bay SAC.

877. It is acknowledged that bottlenose dolphins from the SAC population can range outside of the SAC, and thus have the potential to be disturbed out with the SAC boundary within the Irish Sea MU. However, disturbance is expected to be temporary and highly unlikely to result in any changes to the trajectory of the Irish Sea MU. Therefore, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat and the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from disturbance caused by underwater noise from the CWP Project alone.

Exclusion

878. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the SAC or within the Irish Sea MU and as such, the natural range of the population is not expected to be reduced. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the bottlenose dolphin feature from disturbance caused by underwater noise from the CWP Project alone.

Proposed mitigation

879. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from

vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP Project alone from increased underwater noise.

880. No additional mitigation is required.

Residual impacts

881. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives for bottlenose dolphins associated with the Cardigan Bay SAC from increased underwater noise from the CWP Project alone.

2.13.1.1.3 Impact 2: Collision risk

882. With regards to collision risk the Conservation Objectives state that *'The population is maintaining itself on a long-term basis as a viable component of its natural habitat'* NRW (2018c). Therefore, injury or mortality from vessel collisions should not result in a change to the population size.

Assessment of the project alone

883. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

884. No vessel activity associated with the CWP Project is expected within the Cardigan Bay SAC and thus no direct impact to bottlenose dolphins within the SAC boundary is expected.

885. There is however the potential for vessel collision to occur out with the boundary of the SAC within the inter-connected areas used by the population (the Irish Sea MU). The CWP development has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regards to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. As such, although there will be vessel activity within the wider Irish Sea MU, it is anticipated that the risk of vessel collision is negligible.

886. Considering the above, no bottlenose dolphins within or associated with the SAC are expected to experience death or injury from vessel collisions and as such, the population is expected to maintain itself on a long-term basis as a viable component of its natural habitat. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from collision risk from the CWP Project alone.

Proposed mitigation

887. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from CWP.

888. No additional mitigation is required.

Residual impacts

889. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins associated with the Cardigan Bay SAC from vessel collision from the CWP Project alone.

2.13.1.1.4 Impact 3: Changes in prey availability

890. The Conservation Objectives state that 'The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing' (NRW, 2018c).

891. As stated in the latest feature condition assessment (NRW, 2018b) *'we do not have enough information about bottlenose dolphin prey species and the status of fish stocks to produce a meaningful assessment for this component.'* (NRW, 2018b). Overall, the supporting habitat (including the prey availability and quality component) was assessed as **unknown**. This makes it unfeasible to provide a meaningful assessment of the in situ prey availability and quality within this NIS.

Assessment of the project alone

892. Given that bottlenose dolphins are dependent on fish prey, there is the potential for indirect effects as a result of impacts upon fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. Stomach contents analysis from stranded bottlenose dolphins in Irish waters has shown that their diet is diverse, with a preference for whiting / blue whiting and pelagic squid (Hernandez-Milian et al., 2011). To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Cardigan Bay SAC could arise as a result of the impacts of changes in prey availability on bottlenose dolphins as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of CWP Project alone (this includes: direct damage, disturbance, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of bottlenose dolphins (e.g., whiting).

893. Considering the above, there is expected to be no long-term change to bottlenose dolphin prey species presence, abundance, condition or diversity. As such, changes in prey availability will not affect the distribution, abundance and population dynamics of bottlenose dolphins within and beyond the site. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from changes in prey availability from the CWP Project alone.

Proposed mitigation

894. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Cardigan Bay SAC as a result of changes in prey availability.

Residual impacts

895. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of bottlenose dolphins associated with the Cardigan Bay SAC from changes in prey availability from the CWP Project alone.

2.13.1.1.5 Impact 4: Changes in available habitat

896. The Conservation Objectives state that 'The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future' (NRW, 2018c).

897. As stated in the latest feature condition assessment (NRW, 2018b) *'there is no specifically defined 'dolphin habitat'. The presence of dolphins at a location implies that the habitat is suitable but presence is largely driven by prey availability. This component has been assessed as unknown.'* (NRW, 2018b). This makes it unfeasible to provide a meaningful assessment of the available habitat within this NIS.

Assessment of the project alone

898. None of the activities associated with the construction, O&M and decommissioning of the CWP Project are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within the Cardigan Bay SAC or across the wider area used by the population. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature from changes in available habitat from the CWP Project alone.

Proposed mitigation

899. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Cardigan Bay SAC as a result of changes in available habitat.

Residual impacts

900. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved. Therefore, there is no potential for an AESI to the Conservation Objectives of bottlenose dolphins associated with the Cardigan Bay SAC from changes in available habitat from the CWP Project alone.

2.13.2 Sea lamprey [1095] and River lamprey [1099]

Table 2-31 Assessment summary, Conservation Objectives, Attributes and Targets for Cardigan Bay / Bae Ceredigion and summary of associated assessment

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1095] Sea lamprey Conservation Objective: *To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.13.2**	None required	N/A	No impediment to the Conservation Objective being met, and therefore no adverse effect on site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and therefore no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Direct impacts on habitats See **Section 2.13.2**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.13.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Direct impacts on habitats See **Section 2.13.2**			
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.13.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.	Increase in underwater noise and vibration Presence of EMF and heat Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.13.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

901. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

902. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

903. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

2.13.2.1 Increase in underwater noise and vibration

904. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

905. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

906. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low.

Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

907. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[24], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

908. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.13.2.1.1 Mortality

909. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

910. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

911. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.13.2.1.2 Recoverable injury

912. Recoverable injury from piling operations under the stationary model may 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

[24] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the more realistic fleeing model is used.

913. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.13.2.1.3 Temporary threshold shift and behavioural responses

914. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

915. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

916. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

917. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

918. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*.130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.13.2.1.4 Conclusions relating to underwater noise impacts

919. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

920. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration in the Cardigan Bay SAC.

2.13.2.2 Presence of EMF and heat

921. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

922. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

923. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

924. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-8**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-9**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-10**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-8**, **Plate 2-9**).

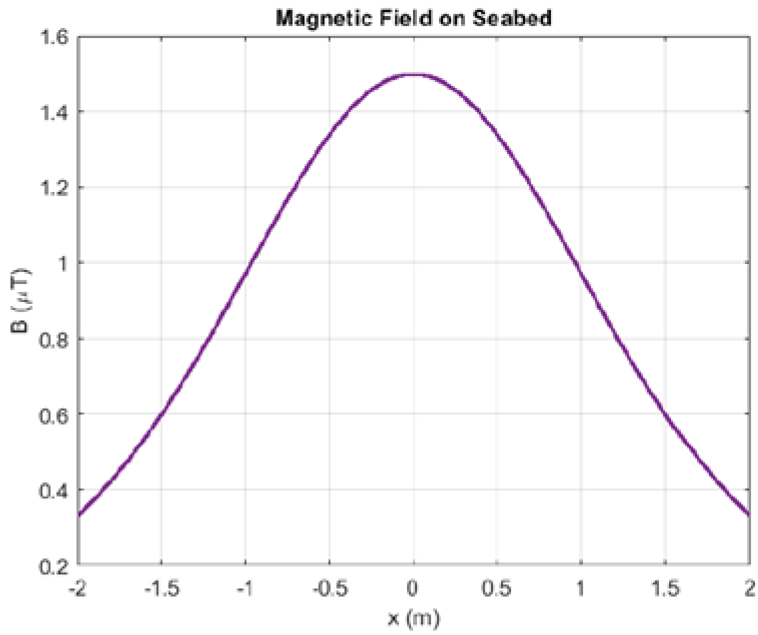


Plate 2-8 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

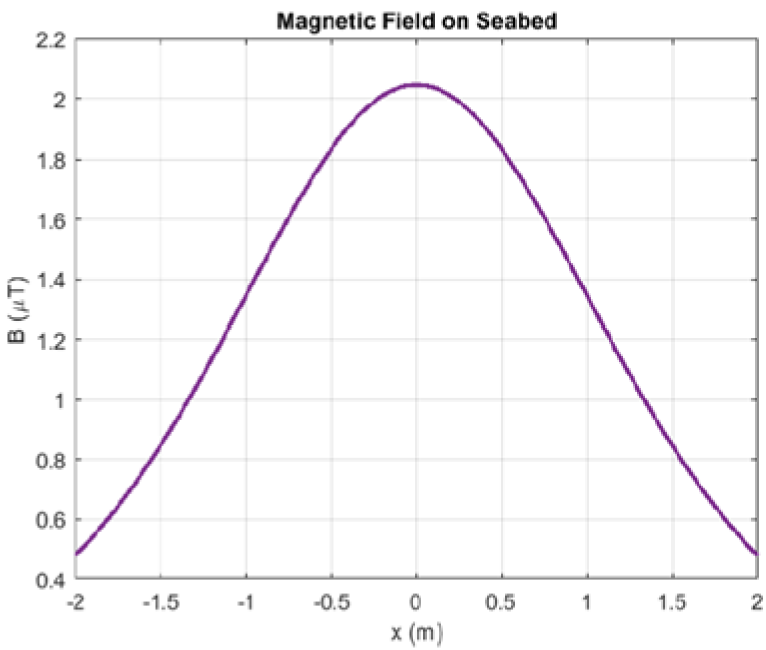


Plate 2-9 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

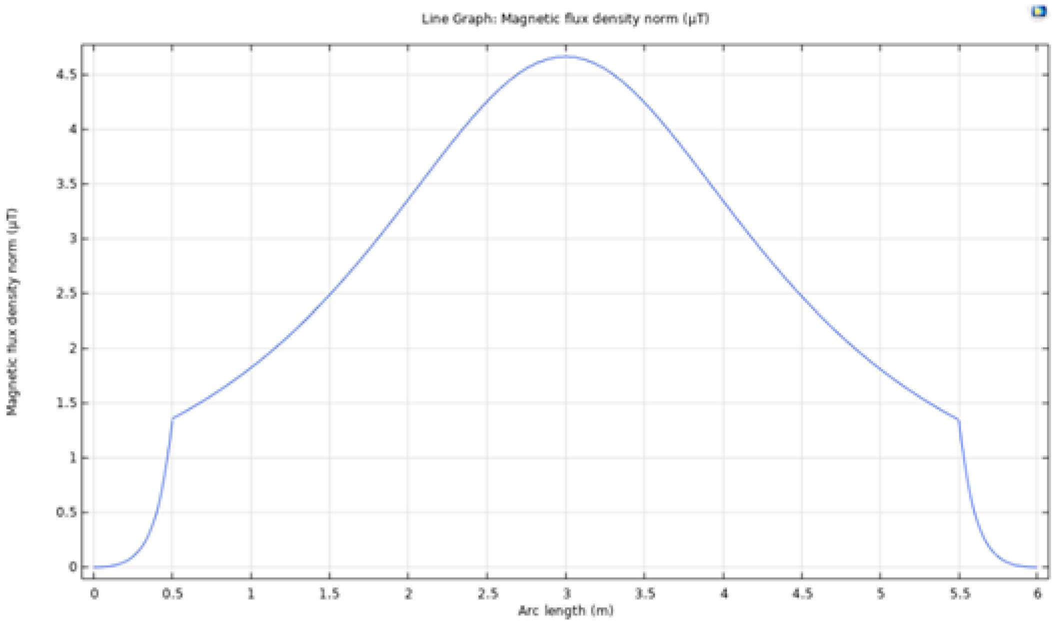


Plate 2-10 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

925. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

926. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

927. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

928. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF, in the Cardigan Bay SAC.

2.13.2.3 Temporary increase in SSC and contaminated sediments

929. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

930. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

931. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

932. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.13.2.3.1 Dredging and dredge disposal

933. 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).

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

935. 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.

2.13.2.3.2 Trenching

936. 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.

937. Based upon the representative scenario, the modelled 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.

938. 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.

939. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

940. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

941. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments in the Cardigan Bay SAC.

2.13.2.4 Direct impacts on habitats

942. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

943. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

944. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

945. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

946. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats in the Cardigan Bay SAC.

2.14 North Channel SAC (UK0030399)

2.14.1 Harbour porpoise

Table 2-32 Assessment summary, Conservation Objectives, Attributes and Targets for harbour porpoise of the North Channel SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Harbour porpoise is (i.e., remains) a viable component of the site	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in habitat are not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in available habitat.	
Population There is no significant disturbance of the species.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to lead to the exclusion of harbour porpoise from a significant proportion of the site for a significant period of time, in line with thresholds set in JNCC (2019c). See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is expected to be no potential for an AESI to the Conservation Objectives of the harbour porpoise population associated with the Bristol Channel Approaches	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			SAC from increased underwater noise from the CWP Project alone.	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective. See **Impact 2: Collision risk**	N/A	N/A	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See **Impact 3: Changes in prey availability**	N/A	N/A	
	Changes in available habitat			
	There is no potential impact pathway between changes in available habitat and this Conservation Objective. See **Impact 4: Changes in available habitat**	N/A	N/A	
Habitat The condition of supporting habitats and processes, and the availability of prey is maintained.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	There is no potential impact pathway between increased underwater noise and this Conservation Objective. See **Impact 1: Increased underwater noise**	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective. See **Impact 2: Collision risk**	N/A	N/A	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Effects due to changes in prey availability are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in prey availability at CWP Project.	
	Changes in available habitat			
	Effects due to changes in available habitat are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in available habitat at CWP Project.	

947. The North Channel SAC (site code 0030399) is located along the eastern coast of Northern Ireland (with 85% of the site lying in Northern Irish inshore waters (0–12 nm from shore) and was designated for the qualifying feature harbour porpoise in February 2019 after its recognition as an important winter area (October to March) for harbour porpoise (DAERA and JNCC, 2017). The site is estimated to support ~1.2% of the Celtic and Irish Sea MU[14] across an area of 1,604 km^2 (DAERA and JNCC, 2017). Although this site is small by comparison to other SACs designated for harbour porpoise, the area has been known to support groups of up to 100 harbour porpoise (DAERA and JNCC, 2017).

2.14.1.1 Conservation Objectives

948. The Conservation Objectives are detailed in (JNCC, 2019a): *'To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:*

- 1) Harbour porpoise is a viable component of the site:
  - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site.
  - Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range.
- 2) There is no significant disturbance of the species:
  - Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.
  - Noise disturbance within an SAC from a plan / project individually or in combination is significant if it excludes harbour porpoises from more than:
    - 1. 20% of the relevant area of the site in any given day; and
    - 2. an average of 10% of the relevant area of the site over a season.
- 3) The condition of supporting habitats and processes, and the availability of prey is maintained:
  - Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.
  - The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site'.

2.14.1.1.1 Impact 1: Increased underwater noise

949. The Conservation Objectives of relevance are to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury) and to ensure that *'there is no significant disturbance of the species'*.

Assessment of the project alone

950. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise produced during construction. Therefore, a detailed assessment has been provided for this impact pathway within **Chapter 11 Marine Mammals**.

951. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

952. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

953. The CWP Project is located approximately 107 km away from the North Channel SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the North Channel SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

954. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance of a 525 kg UXO (+ donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. Therefore, the risk of PTS following mitigation through the UXO MMMP is negligible. There will be no overlap between PTS-onset ranges and the North Channel SAC.

955. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

956. For piling at the onshore substation, PTS impact ranges will not overlap with the Llŷn Peninsula and the Sarnau SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Piling at the onshore substation

957. For piling at the onshore substation, PTS impact ranges will not overlap with the North Channel SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

958. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the North Channel SAC.

959. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

960. For other construction activities, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the North Channel SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

961. For operational noise, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the North Channel SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

962. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

963. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

964. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Disturbance will only cause short-term and / or intermittent and temporary behavioural effects in a limited spatial extent around the source. With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals). Disturbance impact ranges will not overlap with the North Channel SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

965. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). Disturbance impact ranges will not overlap with the North Channel SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

966. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

967. For piling at the onshore substation, disturbance impact ranges will not overlap with the North Channel SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and

short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

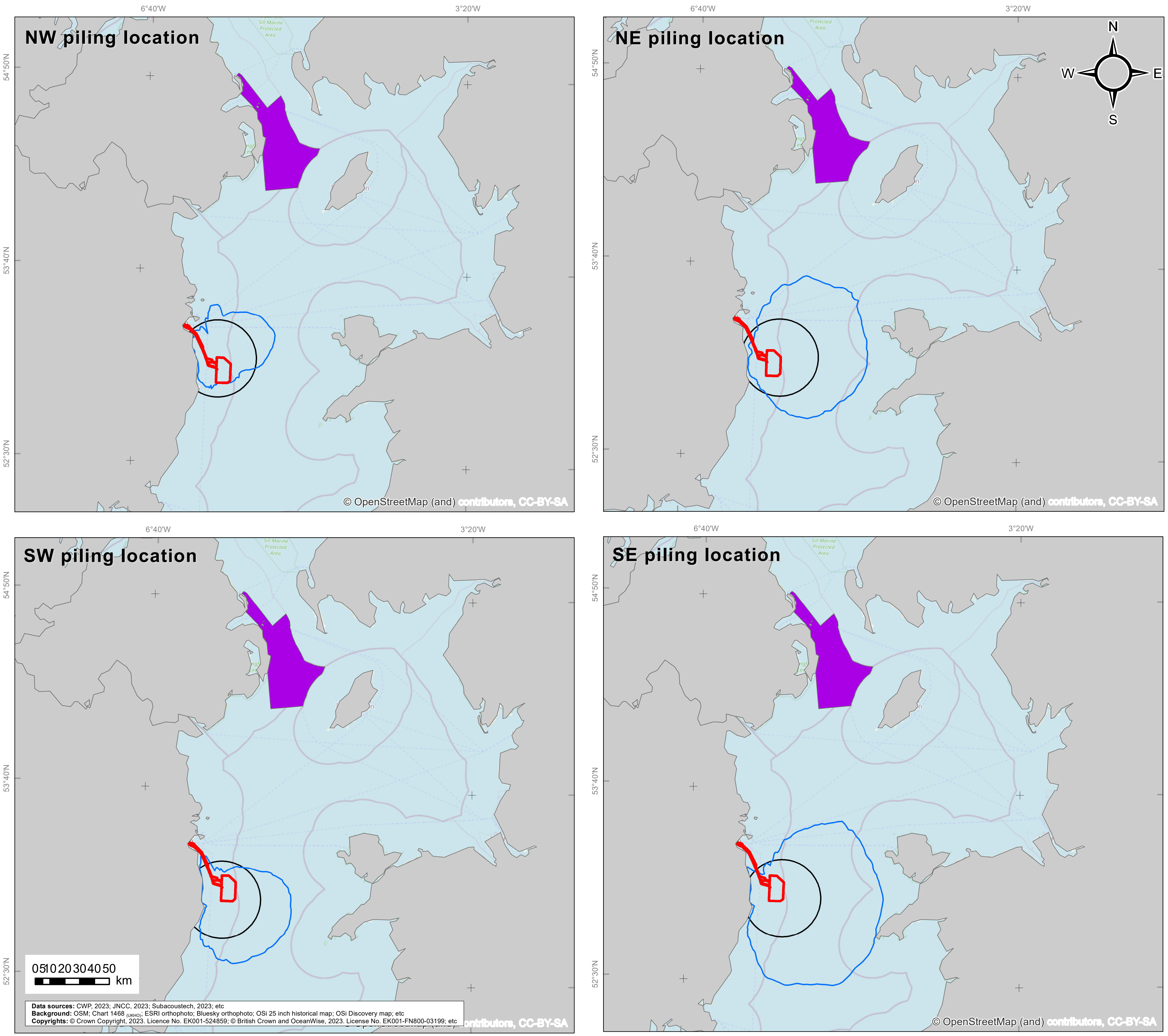
968. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges will not overlap with the North Channel SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

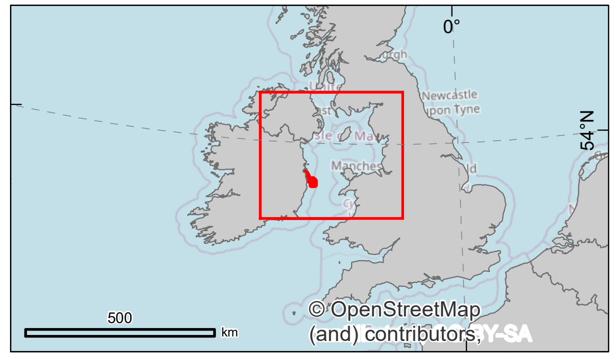
Piling of WTGs

969. For piling of WTGs, the approach presented here is in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023). This involves the use of the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, as well as the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

970. Using either the 145 dB SELss threshold or the 26 km EDR approach, there will be no overlap between the CWP Project and the North Channel SAC, and therefore there is no contribution to the noise disturbance thresholds for the SAC (**Figure 2-14**).





Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^2s threshold
- 26 km EDR
- North Channel SAC

codling wind park

Project: Codling Wind Park

SMRU Consulting
understand • assess • mitigate

Figure 2.14:
Disturbance thresholds for piling at all modelling locations and the North Channel SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1611

Internal descriptive code: IS - PAB..DPNM.THRESH.SEL.26EDR.CONT. WTGs.CORNERS - NORTH.CHANNEL.SAC - (NIS.Vol.04.Ch.02.FIG.19)

Size: A3
Scale: 1:2,500,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

971. For ex situ disturbance from piling of WTGs, the assessment for the North Channel SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

972. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** in the EIAR). Therefore, the introduction of additional vessels associated with the CWP Project is not a novel impact for marine mammals present in the area.

973. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

974. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

975. Vessels associated with the CWP Project are not expected to operate within the North Channel SAC. Disturbance impact ranges will not overlap with the North Channel SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

Conclusion

976. Considering the impact pathways described above, disturbance effects from increased underwater noise are below the thresholds for significant disturbance. Therefore, there is expected to be no potential for AESI to the North Channel SAC from the CWP Project alone.

Exclusion

977. None of the activities associated with the construction, O&M and decommissioning of WTGs at the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their

range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

978. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

979. No additional mitigation is required.

Residual impacts

980. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise associated with the North Channel SAC from increased underwater noise from the CWP Project alone.

2.14.1.1.2 Impact 2: Collision risk

981. The Conservation Objective of relevance is to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury).

Assessment of the project alone

982. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC. Vessels associated with the CWP Project are not expected to operate within the North Channel SAC.

983. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. No harbour porpoise within or outwith the SAC are expected to experience death or injury from collisions with Project vessels. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

984. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

985. No additional mitigation is required.

Residual impacts

986. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise associated with the North Channel SAC from vessel collisions from the CWP Project alone.

2.14.1.1.3 Impact 3: Changes in prey availability

987. The Conservation Objective of relevance is to ensure ‘the condition of supporting habitats and processes, and the availability of prey is maintained’.

Assessment of the project alone

988. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the North Channel SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

989. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition or diversity in situ or ex situ. There is therefore no potential for AESI to the Conservation Objectives of harbour porpoise from changes in prey availability from the CWP Project alone.

Proposed mitigation

990. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the North Channel SAC as a result of changes in prey availability.

Residual impacts

991. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the North Channel SAC as a result of changes to prey availability from the CWP Project alone.

2.14.1.1.4 Impact 4: Changes in available habitat

992. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes […] is maintained. Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat'.

Assessment of the project alone

993. To inform this NIS, **Chapter 6 Marine Geology, Sediments and Coastal processes** and **Chapter 7 Marine Water Quality** of the EIAR prepared for the Project were referred to, for the purposes of establishing whether adverse effects on the integrity of the North Channel SAC could arise as a result of the impacts to the supporting habitats and processes.

994. The EIAR concludes that there will be no significant impact to marine geology, sediments and coastal processes from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations and associated deposition, alteration to seabed morphology or composition and alteration to the hydrodynamic, wave and sediment regimes and coastal processes). Likewise, the EIAR concludes that there will be no significant impact to marine water quality from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations, resuspension of contaminated sediments, or accidental pollution). All impacts are expected to be highly localised and will not affect the supporting habitat within the North Channel SAC.

Proposed mitigation

995. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the North Channel SAC as a result of changes in available supporting habitat.

Residual impacts

996. There is expected to be no change to the FCS, no potential for AESI and no impediment to the Conservation Objectives being achieved for the Conservation Objectives of the harbour porpoise population associated with the North Channel SAC from changes in available supporting habitat from the CWP Project alone.

2.15 Bristol Channel Approaches SAC (UK0030396)

2.15.1 Harbour porpoise

Table 2-33 Assessment summary, Conservation Objectives, Attributes and Targets for harbour porpoise of the Bristol Channel Approaches SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Harbour porpoise is (i.e., remains) a viable component of the site	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to collision risk.	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in prey availability			
	Changes in prey availability is not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in prey availability.	
	Changes in available habitat			
	Changes in habitat are not expected to restrict the survivability and reproductive potential of harbour porpoise using the site to the extent that could adversely affect the FCS. Therefore, harbour porpoise are expected to remain a viable component of the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) as a viable component of the site due to changes in available habitat.	
Population There is no significant disturbance of the species.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to lead to the exclusion of harbour porpoise from a significant proportion of the site for a significant period of time, in line with thresholds set in JNCC (2019c). See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is expected to be no potential for an AESI to the Conservation Objectives of the harbour porpoise population associated	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			with the Bristol Channel Approaches SAC from increased underwater noise from the CWP Project alone.	from the CWP Project.
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective. See **Impact 2: Collision risk**	N/A	N/A	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See **Impact 3: Changes in prey availability**	N/A	N/A	
	Changes in available habitat			
	There is no potential impact pathway between changes in available habitat and this Conservation Objective. See **Impact 4: Changes in available habitat**	N/A	N/A	
Habitat The condition of supporting habitats and processes, and the availability	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising
	There is no potential impact pathway between increased underwater noise and this Conservation Objective. See **Impact 1: Increased underwater noise**	N/A	N/A	
	Collision risk			
	There is no potential impact pathway between collision risk and this Conservation Objective.	N/A	N/A	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
of prey is maintained.	See **Impact 2: Collision risk**			from the CWP Project.
	Changes in prey availability			
	Effects due to changes in prey availability are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in prey availability at CWP Project.	
	Changes in available habitat			
	Effects due to changes in available habitat are not predicted to adversely affect the maintenance of supporting habitats and processes relevant to harbour porpoises and their prey within the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with the supporting habitats and processes relevant to harbour porpoise and their prey within the site due to changes in available habitat at CWP Project.	

997. The Bristol Channel Approaches SAC lies along the southwest coasts of Wales and England. This site straddles the Bristol Channel from Carmarthen Bay in the north to the northern coasts of Devon and Cornwall in the south[12]. The SAC is located within the Irish Sea and thus the Celtic and Irish Sea MU.

998. Covering an area of 5,850 km^2, the Bristol Channel Approaches SAC spans water depths which range from the Mean Low Water (MLW) level down to 70 m below sea level along the western boundary. The whole SAC has been identified as an important winter area for harbour porpoise when densities are particularly high throughout the site (JNCC, 2017). The site is estimated to support ~4.7% of the Celtic and Irish Sea MU (JNCC, 2017).

2.15.1.1 Conservation Objectives

999. The Conservation Objectives are detailed in (JNCC, 2019c): *'To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:*

- 1) Harbour porpoise is a viable component of the site:
    - The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site.
    - Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range.
- 2) There is no significant disturbance of the species:
    - Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.
    - Noise disturbance within an SAC from a plan / project individually or in combination is significant if it excludes harbour porpoises from more than:
        - 1. 20% of the relevant area of the site in any given day; and
        - 2. an average of 10% of the relevant area of the site over a season.
- 3) The condition of supporting habitats and processes, and the availability of prey is maintained:
    - Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.
    - The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site'.

2.15.1.1.1 Impact 1: Increased underwater noise

1000. The Conservation Objectives of relevance are to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury) and to ensure that *'there is no significant disturbance of the species'*.

Assessment of the project alone

1001. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise produced during construction. Therefore, a detailed assessment has been provided for this impact pathway within **Chapter 11 Marine Mammals**.

1002. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

1003. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ or ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

1004. The CWP Project is located approximately 78 km away from the Bristol Channel Approaches SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Bristol Channel Approaches SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1005. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance of a 525 kg UXO (+ donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. There will be no overlap between PTS-onset ranges and the Bristol Channel Approaches SAC.

1006. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

1007. For piling at the onshore substation, PTS impact ranges will not overlap with the Bristol Channel Approaches SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

1008. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Bristol Channel Approaches SAC.

1009. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

1010. For other construction activities, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Bristol Channel Approaches SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

1011. For operational noise, the maximum PTS-onset impact range for harbour porpoise is <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Bristol Channel Approaches SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

1012. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

1013. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

1014. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* Disturbance will only cause short-term and / or intermittent and temporary behavioural effects in a limited spatial extent around the source. With the implementation of embedded primary mitigation (pre-survey monitoring by an MMO / PAM operator to ensure the area is free of marine mammals). Disturbance impact ranges will not overlap with the Bristol Channel Approaches SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1015. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). Disturbance impact ranges will not overlap with the Bristol Channel Approaches SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

1016. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

1017. For piling at the onshore substation, disturbance impact ranges will not overlap with the Bristol Channel Approaches SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

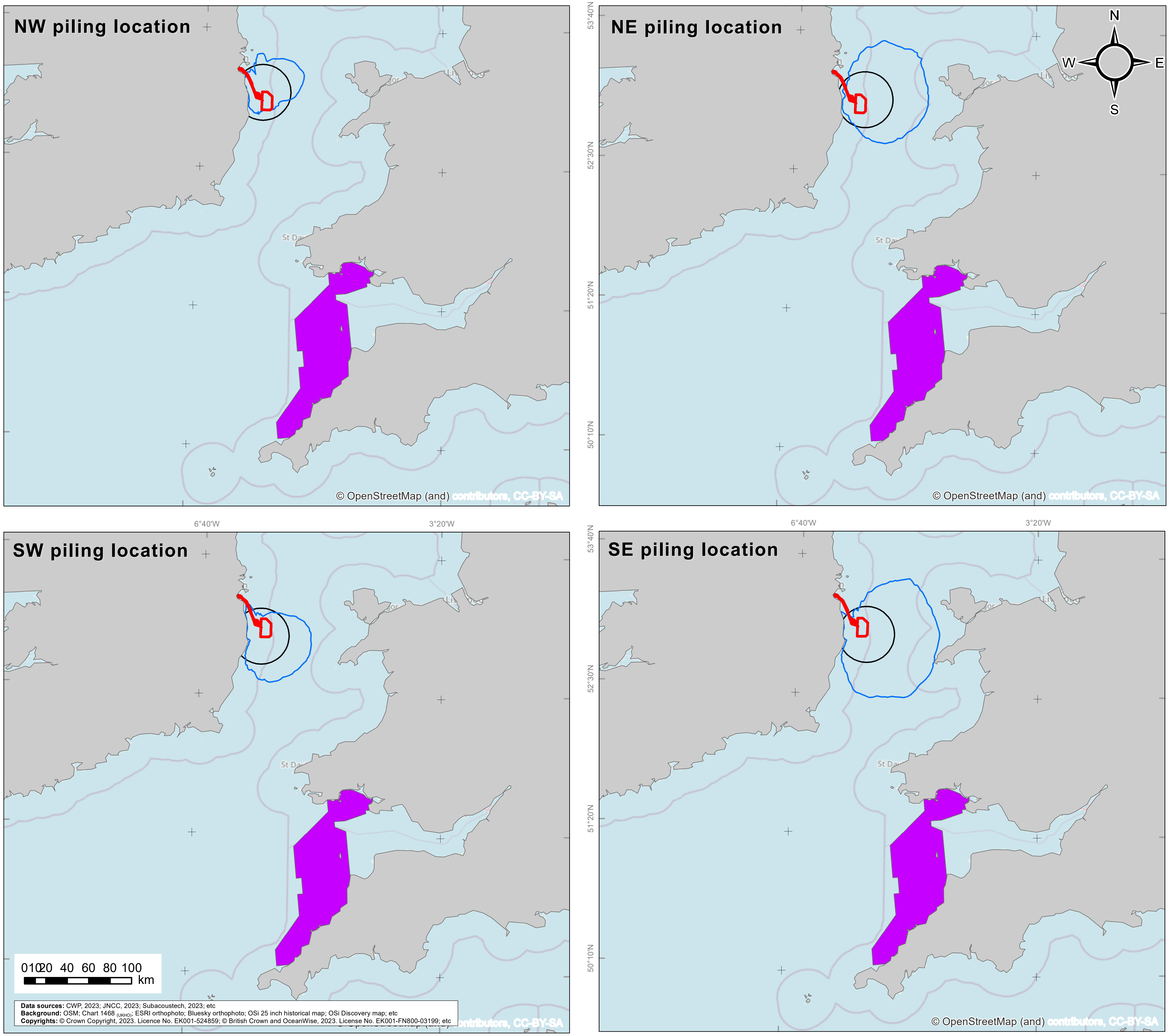
1018. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges will not overlap with the Bristol Channel Approaches SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Piling of WTGs

1019. For piling of WTGs, the approach presented here is in line with the advice from NRW on assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023). This involves the use of the 145 dB SEL_{ss} threshold presented by Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, as well as the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

1020. Using either the 145 dB SEL_{ss} threshold or the 26 km EDR approach, there will be no overlap between the CWP Project and the Bristol Channel Approaches SAC, and therefore there is no contribution to the noise disturbance thresholds for the SAC (**Figure 2-15**).



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc
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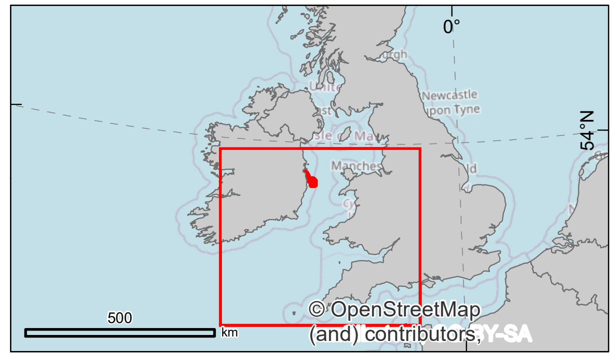

Legend

- Planning application boundary
- SEL_{ss} 145 dB re μPa²s threshold
- 26 km EDR
- Bristol Channel Approaches SAC

Project: Codling Wind Park

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Figure 2.15:
Disturbance thresholds for piling at all modelling locations and the Bristol Channel Approaches SAC

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1612

Internal descriptive code: IS - PAB..DPNM.THRESH.SEL.26EDR.CONT.WTGs.CORNERS - BRISTOL.CHANNEL.APPROACH.SAC - (NIS.Vol.04.Ch.02.FIG.20)

Size: A3
Scale: 1:3,500,000
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

1021. For ex situ disturbance from piling of WTGs, the assessment for the Bristol Channel Approaches SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

1022. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. The area surrounding the CWP Project already experiences high levels of vessel traffic, as outlined in the shipping and navigation baseline (**Appendix 16.3 Navigational Risk Assessment** in the EIAR). Therefore, the introduction of additional vessels associated with the CWP Project is not a novel impact for marine mammals present in the area.

1023. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

1024. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

1025. Vessels associated with the CWP Project are not expected to operate within the Bristol Channel Approaches SAC. Disturbance impact ranges will not overlap with the Bristol Channel Approaches SAC and therefore there is no contribution to the noise disturbance thresholds for the SAC.

Conclusion

1026. Considering the impact pathways described above, disturbance effects from increased underwater noise are below the thresholds for significant disturbance. Therefore, there is expected to be no potential for AESI to the Bristol Channel Approaches SAC from the CWP Project alone.

Exclusion

1027. None of the activities associated with the construction, O&M and decommissioning of WTGs at the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

1028. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

1029. No additional mitigation is required.

Residual impacts

1030. There is expected to be no change to FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the Conservation Objectives of the harbour porpoise associated with the Bristol Channel Approaches SAC from increased underwater noise from the CWP Project alone.

2.15.1.1.2 Impact 2: Collision risk

1031. The Conservation Objective of relevance is to ensure that *'harbour porpoise is a viable component of the site'* (minimise the risk of injury).

Assessment of the project alone

1032. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC. Vessels associated with the CWP Project are not expected to operate within the Bristol Channel Approaches SAC.

1033. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced. No harbour porpoise within or outwith the SAC are expected to experience death or injury from collisions with Project vessels. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

1034. The primary mitigation already includes a EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

1035. No additional mitigation is required.

Residual impacts

1036. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise associated with the Bristol Channel Approaches SAC from vessel collisions from the CWP Project alone.

2.15.1.1.3 Impact 3: Changes in prey availability

1037. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes, and the availability of prey is maintained'.

Assessment of the project alone

1038. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Bristol Channel Approaches SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes: direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

1039. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition or diversity in situ or ex situ. There is therefore no potential for AESI to the Conservation Objectives of harbour porpoise from changes in prey availability from the CWP Project alone.

Proposed mitigation

1040. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Bristol Channel Approaches SAC as a result of changes in prey availability.

Residual impacts

1041. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the Bristol Channel Approaches SAC as a result of changes to prey availability from the CWP Project alone.

2.15.1.1.4 Impact 4: Changes in available habitat

1042. The Conservation Objective of relevance is to ensure 'the condition of supporting habitats and processes […] is maintained. Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat'.

Assessment of the project alone

1043. To inform this NIS, **Chapter 6 Marine Geology, Sediments and Coastal processes** and **Chapter 7 Marine Water Quality** of the EIAR prepared for the Project were referred to, for the purposes of establishing whether adverse effects on the integrity of the Bristol Channel Approaches SAC could arise as a result of the impacts to the supporting habitats and processes.

1044. The EIAR concludes that there will be no significant impact to marine geology, sediments and coastal processes from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations and associated deposition, alteration to seabed morphology or composition and alteration to the hydrodynamic, wave and sediment regimes and coastal processes). Likewise, the EIAR concludes that there will be no significant impact to marine water quality from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (including increases in suspended sediment concentrations, resuspension of contaminated sediments, or accidental pollution). All impacts are expected to be highly localised and will not affect the supporting habitat within the Bristol Channel Approaches SAC.

Proposed mitigation

1045. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Bristol Channel Approaches SAC as a result of changes in available supporting habitat.

Residual impacts

1046. There is expected to be no change to the FCS, no potential for AESI and no impediment to the Conservation Objectives being achieved for the harbour porpoise population associated with the Bristol Channel Approaches SAC from changes in available supporting habitat from the CWP Project alone.

2.16 Roaringwater Bay and Islands SAC (IE000101)

2.16.1 Harbour porpoise

Table 2-34 Assessment summary, Conservation Objectives, Attributes and Targets for harbour porpoise of the Roaringwater Bay and Islands SAC

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See Impact 2: Collision risk	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See Impact 3: Changes in prey availability	N/A	N/A	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See Impact 4: Changes in available habitat	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend. See Impact 1: Increased underwater noise	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site. See Impact 2: Collision risk	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site.	No additional mitigation	There is no potential for an AESI associated with maintaining the species (harbour porpoise)	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	See Impact 3: Changes in prey availability	is required.	population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See Impact 4: Changes in available habitat	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

1047. The Roaringwater Bay and Islands SAC (site code 000101) is designated for harbour porpoise and are located on the southwest coast of Co. Cork, Ireland. The SAC includes the immediate coastline on the mainland from Long Island to Baltimore, together with the whole bay and most of the islands. Some of the larger islands included are Sherkin Island, Cape Clear Island, Heir Island, Horse Island, Castle Island and Long Island (NPWS, 2014b).

1048. In 2015, a visual survey of harbour porpoise within the SAC was undertaken to derive density and abundance estimates for the site. A total of 141 individual porpoise were recorded throughout the survey area, with density estimations ranging from 0.76–3.03 porpoise/km^2, equating to an average density of 2.02 porpoise/km^2 within the site (O'Brien and Berrow, 2015). The density estimate recorded during the 2015 survey was higher than previous estimates in 2008 and 2013, where densities of 1.18 and 1.24 porpoise/km^2 respectively were estimated (O'Brien and Berrow, 2015).

1049. Porpoise group size showed an increasing trend within the site from June to September, and estimates of abundance suggest there are 289±80 (95% CI: 151–541) individuals within the site (O'Brien and Berrow, 2015).

2.16.1.1 Conservation Objectives and Targets

1050. The Conservation Objective is to maintain the favourable conservation condition of harbour porpoise in the Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets (as listed in (NPWS, 2011)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.16.1.1.1 Impact 1: Increased underwater noise

1051. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

1052. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

1053. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

1054. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

1055. The CWP array site is located approximately 346 km away from the Roaringwater Bay and Islands SAC. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and the Roaringwater Bay and Islands SAC. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1056. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. There will be no overlap between PTS-onset ranges and the Roaringwater Bay and Islands SAC.

1057. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity

for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

1058. For piling at the onshore substation, PTS impact ranges will not overlap with the Roaringwater Bay and Islands SAC. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

1059. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and the Roaringwater Bay and Islands SAC.

1060. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

1061. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Roaringwater Bay and Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

1062. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and the Roaringwater Bay and Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

1063. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of

MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

1064. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

1065. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and the Roaringwater Bay and Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1066. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and the Roaringwater Bay and Islands SAC.

1067. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the situ.

Piling at the onshore substation

1068. For piling at the onshore substation, disturbance impact ranges will not overlap with the Roaringwater Bay and Islands SAC. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

1069. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with the Roaringwater Bay and Islands SAC. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

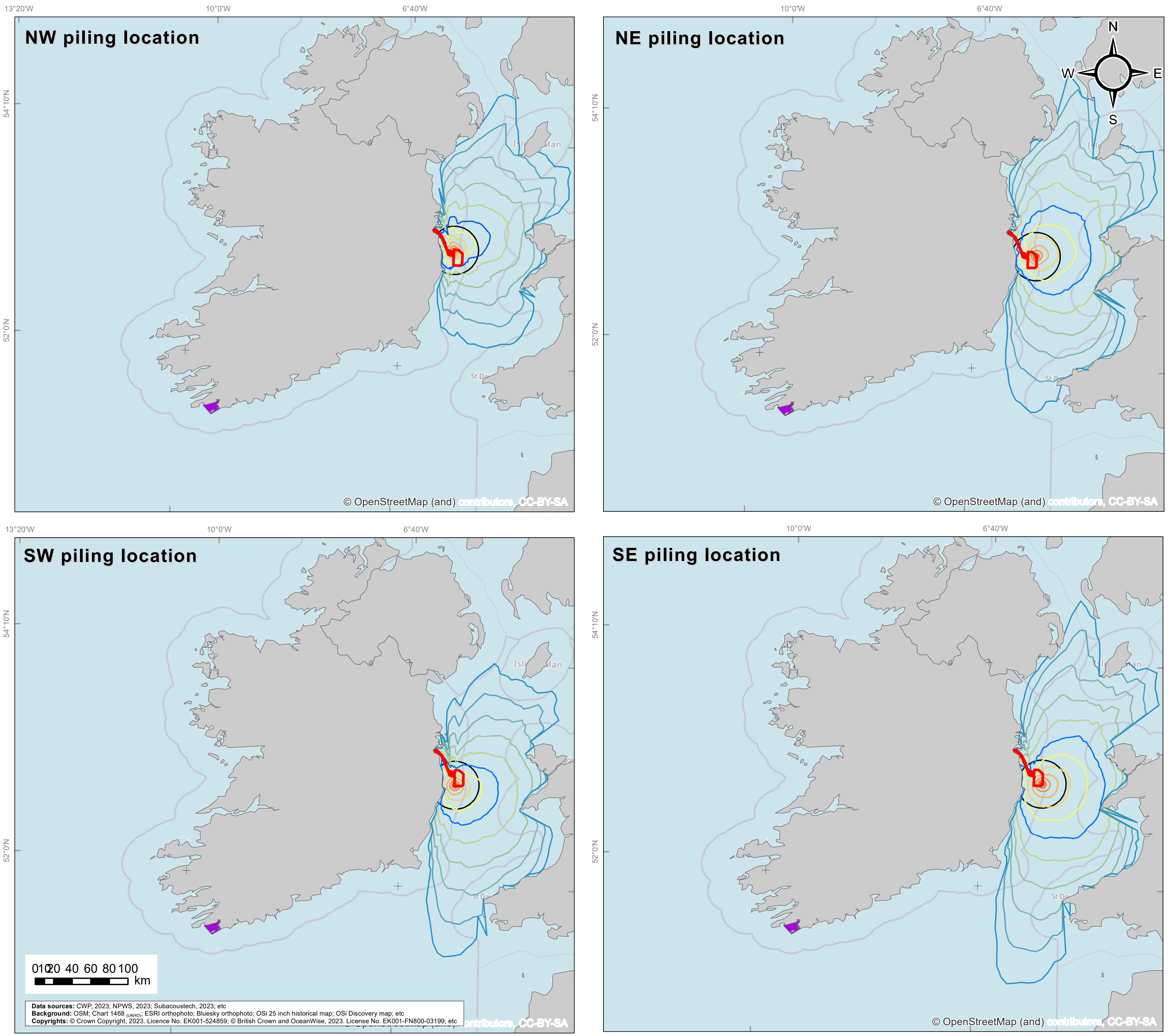
Piling of WTGs

1070. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

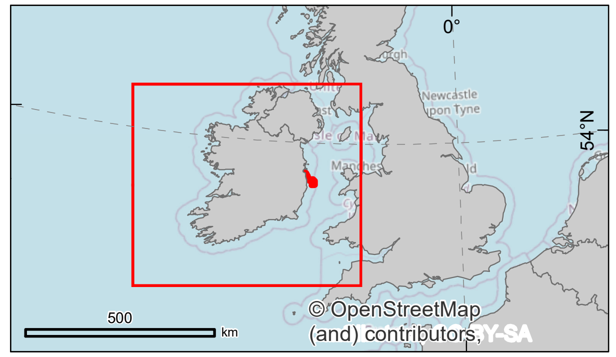
1071. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

1072. None of the disturbance contours overlap with the Roaringwater Bay and Islands SAC (**Figure 2-16**).



Data sources: CWP, 2023; NPWS, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc
Copyrights: © Crown Copyright, 2023. Licence No. EK001-524859; © British Crown and OceanWise, 2023. License No. EK001-FN800-03199; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re μPa^{2}s threshold

SEL_{ss} dB re μPa^{2}s (5dB contours)

- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- 26 km EDR
- Roaringwater Bay and Islands SAC

Project: Codling Wind Park

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Figure 2.16:
Disturbance thresholds for piling at the all modelling locations and the Roaringwater Bay and Islands SACs designated forharbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1613

Internal descriptive code: IRE - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - ROARINGWATER.BAY.and.ISL.SAC - (NIS.Vol.04.Ch.02.FIG.21)

Size: A3
Scale: 1:4,000,000

CRS: EPSG 25830

Rev.	*Updates*	*Date*	*By*	*Chk'd*	*App'd*
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

1073. For ex situ disturbance from piling of WTGs, the assessment for the Roaringwater Bay and Islands SAC is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

1074. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

1075. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

1076. Vessels associated with the CWP Project are not expected to operate within the Roaringwater Bay and Islands SAC. Disturbance impact ranges will not overlap with the Roaringwater Bay and Islands SAC.

Conclusion

1077. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Exclusion

1078. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

1079. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to the SAC from the CWP Project alone.

Proposed mitigation

1080. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from increased underwater noise.

1081. No additional mitigation is required.

Residual impacts

1082. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the Roaringwater Bay and Islands SAC from increased underwater noise from the CWP Project alone.

2.16.1.1.2 Impact 2: Collision risk

1083. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

1084. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

1085. The CWP Project has committed to the implementation of an EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

1086. Vessels associated with the CWP Project are not expected to operate within the Roaringwater Bay and Islands SAC. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at the site. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community from collision risk from the CWP Project alone.

Proposed mitigation

1087. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to the SAC from the CWP Project alone from collision risk.

1088. No additional mitigation is required.

Residual impacts

1089. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the Roaringwater Bay and Islands SAC from vessel collisions from the CWP Project alone.

2.16.1.1.3 Impact 3: Changes in prey availability

1090. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

1091. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9: Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Roaringwater Bay and Islands SAC could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of this SAC. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

1092. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in prey availability from the CWP Project alone.

Proposed mitigation

1093. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Roaringwater Bay and Islands SAC as a result of changes in prey availability.

Residual impacts

1094. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with Roaringwater Bay and Islands SAC as a result of changes to prey availability from the CWP Project alone.

2.16.1.1.4 Impact 4: Changes in available habitat

1095. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

1096. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within the Roaringwater Bay and Islands SAC nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

1097. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community from changes in available habitat from the CWP Project alone.

Proposed mitigation

1098. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of the Roaringwater Bay and Islands SAC as a result of changes in available habitat.

Residual impacts

1099. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the Roaringwater Bay and Islands SAC from changes in available habitat from the CWP Project alone.

2.17 Irish West Coast SACs

2.17.1 Harbour porpoise

Table 2-35 Assessment summary, Conservation Objectives, Attributes and Targets for harbour porpoise of the Irish West Coast SACs

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 2: Collision risk**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	There is no potential impact pathway between changes in prey availability and this Conservation Objective. See **Impact 3: Changes in prey availability**	N/A	N/A	
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site and will not permanently prevent access for the species to suitable habitat. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site or deterioration of key resources upon which harbour porpoise depend. See **Impact 1: Increased underwater noise**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on harbour porpoise population within the site.	No additional mitigation is required.	There is no potential for an AESI associated	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	See **Impact 2: Collision risk**		with maintaining the species (harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See **Impact 3: Changes in prey availability**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site. See **Impact 4: Changes in available habitat**	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

1100. There are an additional seven SACs on the west coast of Ireland that are within the Celtic and Irish Sea MU that list harbour porpoise as a Qualifying Interest. These are:

- Kenmare River SAC (IE002158);
- Belgica Mound Province SAC (IE002327);
- Porcupine Bank Canyon SAC (IE003001);
- South-West Porcupine Bank SAC (IE002329);
- Kilkieran Bay and Islands SAC (IE002111);
- Inishmore Island SAC (IE000213); and
- West Connacht Coast SAC (002998).

1101. Harbour porpoise [1351] were added to these sites as a Qualifying Interest in March 2024. While the Site Synopses were amended in March 2024 to list harbour porpoise, they provide no information on the presence of porpoise within the sites, or the importance of the sites for harbour porpoise.

2.17.1.1 Conservation Objectives and Targets

1102. No Conservation Objectives have been set for harbour porpoise at these sites yet. Therefore, it is assumed that the Conservation Objectives at the Rockabill to Dalkey Island SAC apply here.

1103. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

Attribute 1: Access to suitable habitat
Target 1: Species range within the site should not be restricted by artificial barriers to site use.

- This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
- It does not refer to short-term or temporary restriction of access or range.
- Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.

Attribute 2: Disturbance
Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

- Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
- This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
- Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

2.17.1.1.1 Impact 1: Increased underwater noise

1104. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

1105. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

1106. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

1107. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

1108. The CWP array site is located >400 km away from the nearest Irish West Coast SAC for harbour porpoise. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs for harbour porpoise. Further, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1109. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs for harbour porpoise.

1110. For ex situ UXO clearance, the maximum PTS-onset impact range for harbour porpoise from high-order clearance was 12 km, resulting in up to 127 individuals being impacted in the Celtic and Irish

Sea MU (see **Chapter 11 Marine Mammals** of the EIA). However, as aforementioned, the majority of acoustic energy produced by a high-order detonation is below a few hundred Hz. Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoise (Southall et al., 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of porpoise ex situ.

Piling at the onshore substation

1111. For piling at the onshore substation, PTS impact ranges will not overlap with the Irish West Coast SACs. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

1112. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs for harbour porpoise.

1113. When considering the impacts of piling of WTGs within the Celtic and Irish Sea MU, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location which is predicted to impact up to 11 harbour porpoise (see **Chapter 11 Marine Mammals** of the EIA). There is evidence however, that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Rose et al., 2019, Benhemma-Le Gall et al., 2021, Benhemma-Le Gall et al., 2023). As a result, the number of porpoises potentially impacted is likely to be an overestimate and impacts on porpoise ex situ are unlikely to result in AESI.

Other construction activities

1114. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs for harbour porpoise. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Operational noise

1115. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs for harbour porpoise. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

Primary mitigation

1116. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that will be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMO and PAM to detect marine mammals as well as additional mitigation measures that can be put in place if required (e.g., ADDs, at source mitigation).

Conclusion

1117. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus the proposed activities at the CWP Project will not cause (auditory) injury to individuals at any of the Irish West Coast SACs for harbour porpoise. Therefore, there will be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise feature at any of the Irish West Coast SACs for harbour porpoise from PTS-onset (underwater noise) from the CWP Project alone.

Disturbance

Pre-construction geophysical surveys

1118. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and any of the Irish West Coast SACs for harbour porpoise. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

UXO clearance

1119. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and any of the Irish West Coast SACs for harbour porpoise.

1120. Within the Celtic and Irish Sea MU, high order clearance of a 525 kg UXO (+ donor) will result in 0.95% of the Celtic and Irish Sea MU experiencing disturbance (26 km EDR). For low order clearance 0.04% of the Celtic and Irish Sea MU will experience disturbance (5 km EDR). However, each detonation will be of a short-term duration, resulting in behavioural effects that are temporary and reversible. Therefore, disturbance associated with UXO clearance will not result in the permanent exclusion of harbour porpoise from part of its range within the site and beyond. Additionally, such short-term disturbance is unlikely to be sufficient to result in any changes to the vital rates of individuals and therefore will not adversely affect the harbour porpoise community at the site.

Piling at the onshore substation

1121. For piling at the onshore substation, disturbance impact ranges will not overlap with any of the Irish West Coast SACs for harbour porpoise. Within the Celtic and Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

Operational noise

1122. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with any of the Irish West Coast SACs for harbour porpoise. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

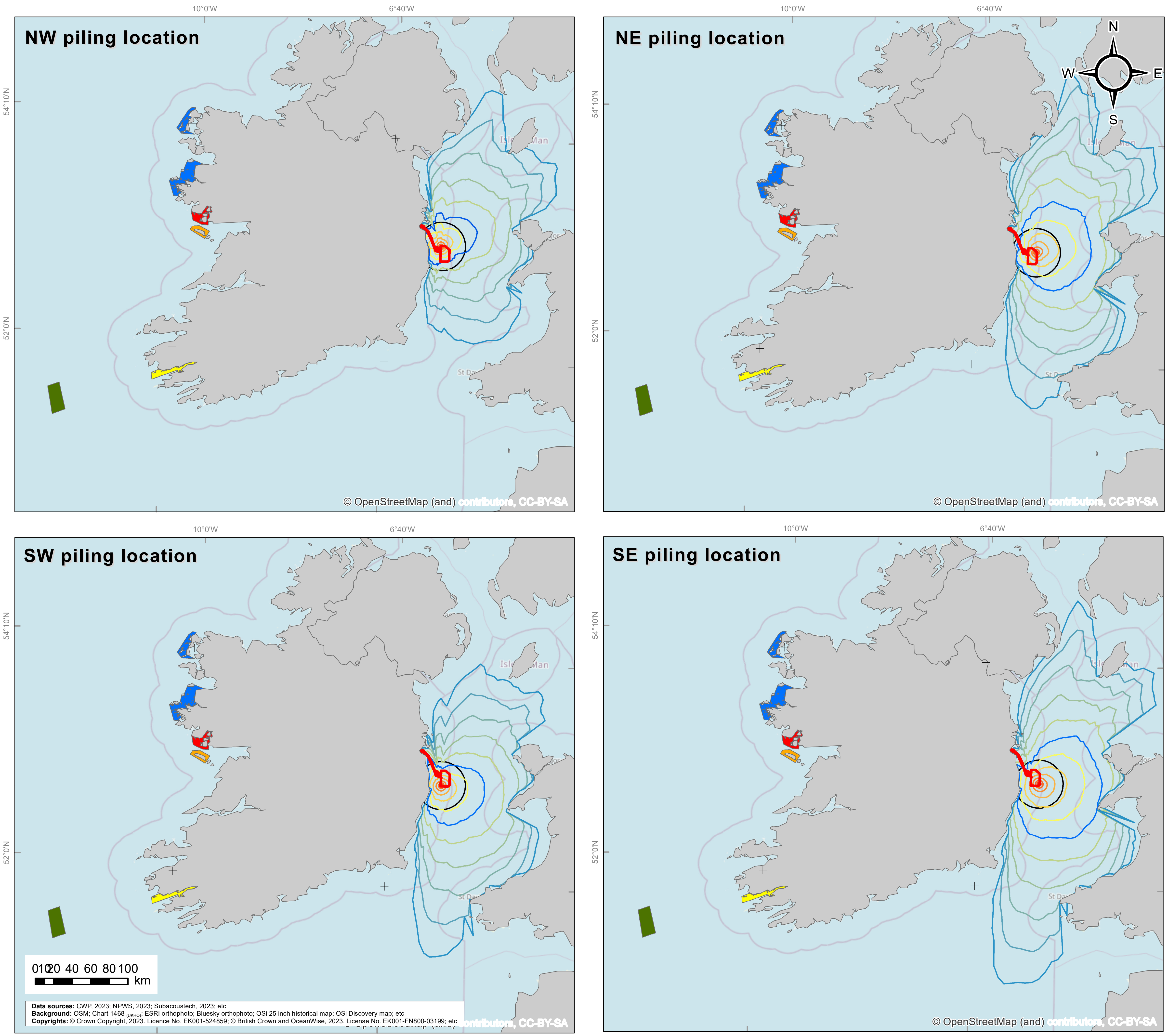
Piling of WTGs

1123. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017).

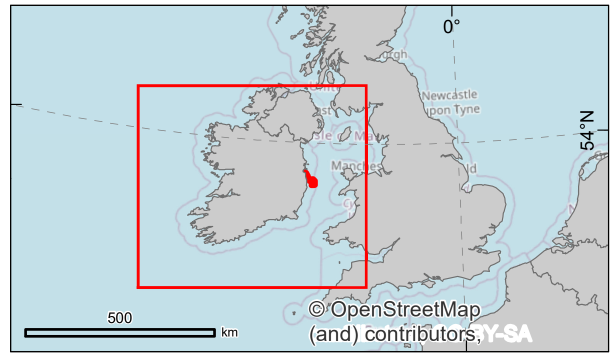
1124. There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

In situ disturbance from piling of WTGs

1125. None of the disturbance contours overlap with any of the Irish West Coast SACs for harbour porpoise (**Figure 2-17**).



Data sources: CWP, 2023; NPWS, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa^2s threshold

SEL_{ss} dB re µPa^2s (5dB contours)

- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB
- 26 km EDR
- West Connacht Coast SAC
- Belgica Mound Province SAC
- Porcupine Bank Canyon SAC
- South-West Porcupine Bank SAC
- Kilkeiran Bay and Islands SAC
- Kenmare River SAC
- Inishmore Island SAC

Project: Codling Wind Park

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Figure 2.17:
Disturbance thresholds for piling at the all modelling locations and the West Irish SACs designated forharbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1614

Internal descriptive code: IRE - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR. CONT.WTGs.CORNERS - WEST.IRISH.SACs - (NIS.Vol.04.Ch.02.FIG.22)

Size: A3
Scale: 1:4,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Ex situ disturbance from piling of WTGs

1126. For ex situ disturbance from piling of WTGs, the assessment for the Irish West Coast SACs is synonymous with that for the Rockabill to Dalkey Island SAC, as they are located within the same MU. Therefore, disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals outwith the site.

Disturbance from vessels

1127. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

1128. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

1129. Vessels associated with the CWP Project are not expected to operate within any of the Irish West Coast SACs. Disturbance impact ranges will not overlap with any of the Irish West Coast SACs.

Conclusion

1130. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at any of the Irish West Coast SACs. Therefore, there is expected to be no potential for AESI to the Irish West Coast SACs from the CWP Project alone.

Exclusion

1131. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

1132. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within any of the Irish West Coast SACs. Therefore, there is expected to be no potential for AESI to any of the Irish West Coast SACs from the CWP Project alone.

Proposed mitigation

1133. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to any of the Irish West Coast SACs from the CWP Project alone from increased underwater noise.

1134. No additional mitigation is required.

Residual impacts

1135. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with any of the Irish West Coast SACs from increased underwater noise from the CWP Project alone.

2.17.1.1.2 Impact 2: Collision risk

1136. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site'.

Assessment of the project alone

1137. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

1138. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

1139. Vessels associated with the CWP Project are not expected to operate within any of the Irish West Coast SACs. No harbour porpoise within or outwith the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at any of the Irish West Coast SACs. Therefore, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community at any of the Irish West Coast SACs from collision risk from the CWP Project alone.

Proposed mitigation

1140. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to any of the Irish West Coast SACs from the CWP Project alone from collision risk.

1141. No additional mitigation is required.

Residual impacts

1142. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with any of the Irish West Coast SACs from vessel collisions from the CWP Project alone.

2.17.1.1.3 Impact 3: Changes in prey availability

1143. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

1144. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of any of the Irish West Coast SACs could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of these SACs. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

1145. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community at any of the Irish West Coast SACs from changes in prey availability from the CWP Project alone.

Proposed mitigation

1146. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the Irish West Coast SACs as a result of changes in prey availability.

Residual impacts

1147. There is expected to be no change to FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with any of the Irish West Coast SACs as a result of changes to prey availability from the CWP Project alone.

2.17.1.1.4 Impact 4: Changes in available habitat

1148. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

1149. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within any of the Irish West Coast SACs nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

1150. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community at any of the Irish West Coast SACs from changes in available habitat from the CWP Project alone.

Proposed mitigation

1151. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the Irish West Coast SACs as a result of changes in available habitat.

Residual impacts

1152. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with any of the Irish West Coast SACs from changes in available habitat from the CWP Project alone.

2.17.2 Bottlenose dolphin

Table 2-36 Assessment summary, Conservation Objectives, Attributes and Targets for bottlenose dolphin of the Irish West Coast SACs

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of bottlenose dolphin from any part of its range within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with the species range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of bottlenose dolphin from any part of its range within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with the species range due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in prey availability and this Conservation Objective.	N/A	N/A	
	Changes in available habitat			

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Changes in available habitat are not expected to adversely affect the access to suitable habitat within the site(s).	No additional mitigation is required.	There is no potential for an AESI the species range due to changes in available habitat.	
Habitat Critical areas, representing habitat used preferentially by bottlenose dolphin, should be conserved in a natural condition.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in significant disturbance to habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to adversely affect critical habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to adversely affect critical habitat used by bottlenose dolphins, or the natural behaviour of dolphins within critical areas.	No additional mitigation is required.	There is no potential for an AESI associated	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			with the critical habitat availability and condition due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to alter the natural behaviour to an extent that may ultimately interfere with key ecological functions.	No additional mitigation is required.	There is no potential for an AESI associated with the critical habitat availability and condition due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of the SAC as a result of impacts on bottlenose dolphins arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on bottlenose dolphin population within the site(s) or deterioration of key resources upon which dolphins depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact (death / injury) on bottlenose dolphin population within the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
			species (bottlenose dolphin) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which bottlenose dolphin depend to the extent that could affect dolphin populations at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which bottlenose dolphin depend to the extent that could affect dolphin populations at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (bottlenose dolphin) population due to changes in available habitat.	

1153. There are nine SACs designated for bottlenose dolphins on the west coast of Ireland:

- Lower River Shannon SAC (IE002165);
- Slyne Head Islands SAC (IE000328);
- Slyne Head Peninsula SAC (IE002074);
- West Connacht Coast SAC (IE002998);
- Duvillaun Islands SAC (IE000495);
- Belgica Mound Province SAC (IE002327);
- Porcupine Bank Canyon SAC (IE003001);
- South-West Porcupine Bank SAC (IE002329); and
- St. Johns Point SAC (IE000191).

1154. Given their large distance from the CWP Project (such that impact contours are not expected to overlap with the SACs), and the fact that they are located in different MUs (West Coast of Ireland MU, Shannon Estuary MU and Oceanic waters MU) and are thus considered to be a different population to that in the Irish Sea MU, the have been assessed together here. For each SAC, a site description is provided in **Table 2-37** and the Conservation Objectives relating to bottlenose dolphins are listed in **Table 2-38**.

Table 2-37 Bottlenose dolphin SACs on the west coast of Ireland

SAC	Site description
Lower River Shannon SAC	The SAC covers 120 km along the Shannon valley from Killaloe in Co. Clare to Loop Head / Kerry Head. In 2018 the SAC population size was estimated at 139 dolphins (95% CI 121–160) and surveys since 1997 indicate this is a stable population (Rogan et al., 2018). Bottlenose dolphins are present year-round and are described as resident within the site, though the Shannon dolphin population are occasionally recorded outside of the site, generally within 25 km of the estuary (NPWS, 2012).
Slyne Head Islands SAC	The SAC includes a long archipelago of islands, islets, rocks and reefs off the west and southwest of the Slyne Head peninsula. The surrounded shallow marine areas are included in the SAC. The SAC supports groups of bottlenose dolphins which are part of the population in the west and north coasts of Connacht (thus the SACs are considered to contain the same population). Group sizes of up to 12 dolphins have been recorded un the SAC, primarily in September (NPWS, 2019b).
Slyne Head Peninsula SAC	The SAC covers the peninsula west of Ballyconneely, Co. Galway and extends northwards to include the Mannin Bay. Waters in Mannin Bay supports groups of bottlenose dolphins which are part of the population in the west and north coasts of Connacht (thus the SACs are considered to contain the same population) (NPWS, 2019c).
West Connacht Coast SAC	The SAC covers the waters off the coasts of Counties Mayo and Galway in the west of Ireland and comprises of two parts – the north and the south component. In 2014 the population estimate was 159 dolphins (95% CI 140–190) with reasonably consistent population estimates since 2009 (NPWS, 2015). The most recent SAC abundance estimate is 228 bottlenose dolphins in 2021 (CV = 0.09, 95% CI 187–270) (Berrow et al., 2021b). The population is described as resident within the SAC, with groups of dolphins also present in the wider Connemara-Mayo region year-round.
Duvillaun Islands SAC	The Duvillaun Islands form part of a larger group of islands, together with the Iniskeas, Inishkeeragh and Inishglora Island. The Duvillaun Islands SAC are estimated to hold at least 177–337 individual dolphins, which are considered to be part of the population in the west and north coasts of Connacht (thus the two SACs are considered to contain the same population). Bottlenose dolphins have only been sighted in the SAC in April, but have been recorded in adjacent waters in the Mullet Peninsula and Inishkea island group year-round (NPWS, 2019a).
Belgica Mound Province SAC	While the Site Synopsis was amended in March 2024 to list bottlenose dolphins, it provides no information on the presence of bottlenose dolphins within the site, or the importance of the site for bottlenose dolphins.
Porcupine Bank Canyon SAC	While the Site Synopsis was amended in March 2024 to list bottlenose dolphins, it provides no information on the presence of bottlenose dolphins within the site, or the importance of the site for bottlenose dolphins.

SAC	Site description
South-West Porcupine Bank SAC	While the Site Synopsis was amended in March 2024 to list bottlenose dolphins, it provides no information on the presence of bottlenose dolphins within the site, or the importance of the site for bottlenose dolphins.
St. Johns Point SAC	While the Site Synopsis was amended in March 2024 to list bottlenose dolphins, it provides no information on the presence of bottlenose dolphins within the site, or the importance of the site for bottlenose dolphins.

Table 2-38 Conservation Objectives for bottlenose dolphin SACs on the west coast of Ireland

SAC	Site description
Lower River Shannon SAC (NPWS, 2012)	To maintain the favourable conservation condition of bottlenose dolphin in the Lower River Shannon SAC which is defined by the following list of attributes and targets: Target 1 Species range within the site should not be restricted by artificial barriers to site use. • This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of bottlenose dolphin from part of its range within the site, or will permanently prevent access for the species to suitable habitat therein. • It does not refer to short-term or temporary restriction of access or range. Target 2 Critical areas, representing habitat used preferentially by bottlenose dolphin, should be conserved in a natural condition. • This target is relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) aquatic habitat used preferentially by bottlenose dolphin during the annual cycle and (b) the natural behaviour of bottlenose dolphin within such critical areas (i.e., preferred habitat). • Operations or activities that cause displacement of individuals from a critical area (i.e., preferred habitat) or alteration of natural behaviour to an extent that may ultimately interfere with key ecological functions would be regarded as significant and should therefore be avoided. Target 3 Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site. • Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of bottlenose dolphin within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species' annual cycle. • This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc) upon which bottlenose dolphins depend. In the absence of complete knowledge on the species' ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis. • Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population at the site.

SAC	Site description
Slyne Head Islands SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. It should be noted that Slyne Head Islands SAC cover the same bottlenose dolphin population as the West Connacht Coast SAC. As such, the Conservation Objectives listed below for the West Connacht Coast SAC were applied in this assessment as proxy Conservation Objectives for the Slyne Head Islands SAC.
Slyne Head Peninsula SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. It should be noted that Slyne Head Peninsula SAC cover the same bottlenose dolphin population as the West Connacht Coast SAC. As such, the Conservation Objectives listed below for the West Connacht Coast SAC were applied in this assessment as proxy Conservation Objectives for the Slyne Head Peninsula SAC.
West Connacht Coast SAC (NPWS, 2015)	To maintain the favourable conservation condition of bottlenose dolphin in West Connacht Coast, which is defined by the following list of attributes and targets: Target 1 Species range within the site should not be restricted by artificial barriers to site use. • This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of bottlenose dolphin from part of its range within the site, or will permanently prevent access for the species to suitable habitat therein. • It does not refer to short-term or temporary restriction of access or range. Target 2 Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site. • Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of bottlenose dolphin within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle. • This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which bottlenose dolphins depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis. • Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population at the site.

SAC	Site description
Duvillaun Islands SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. It should be noted that Duvillaun Islands SAC cover the same bottlenose dolphin population as the West Connacht Coast SAC. As such, the Conservation Objectives listed below for the West Connacht Coast SAC were applied in this assessment as proxy Conservation Objectives for the Duvillaun Islands SAC.
Belgica Mound Province SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. As such, the Conservation Objectives listed for the West Connacht Coast SAC were applied in this assessment as proxy.
Porcupine Bank Canyon SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. As such, the Conservation Objectives listed for the West Connacht Coast SAC were applied in this assessment as proxy.
South-West Porcupine Bank SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. As such, the Conservation Objectives listed for the West Connacht Coast SAC were applied in this assessment as proxy.
St. Johns Point SAC	No Conservation Objectives relating to bottlenose dolphins are currently available. As such, the Conservation Objectives listed for the West Connacht Coast SAC were applied in this assessment as proxy.

2.17.2.1 Impact 1: Increased underwater noise

1155. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of bottlenose dolphins within the site', and 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphins at the site'.

2.17.2.1.1 Assessment of the project alone

1156. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

1157. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

1158. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS) onset) and disturbance, each of which have been assessed below for both in situ and ex situ. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

2.17.2.2 Auditory injury (PTS)

2.17.2.2.1 Pre-construction geophysical surveys

1159. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible on bottlenose dolphins within the Irish Sea MU, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs.

1160. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.2.2 UXO clearance

1161. The underwater noise assessment concluded that for UXO clearance, the maximum PTS-onset impact range for bottlenose dolphins from high-order clearance was 730 m resulting in <1 dolphin in the Irish Sea MU being injured which is of negligible impact. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs.

1162. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.2.3 *Piling of WTGs and onshore substation*

1163. The underwater noise assessment concluded that for piling of WTGs and at the onshore substation, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs.

1164. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.2.4 *Other construction activities*

1165. The underwater noise assessment concluded that for other construction activities, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs.

1166. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.2.5 *Operational noise*

1167. The underwater noise assessment concluded that for operational noise, the maximum PTS-onset impact range for bottlenose dolphins was <100 m resulting in <1 dolphin in the Irish Sea MU being injured, which is of negligible impact. There will be no overlap between PTS-onset ranges and any of the Irish West Coast SACs.

1168. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.2.6 *Primary mitigation*

1169. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**). This is in line with the guidance to manage the risk to marine mammals from man-made sound sources in Irish waters (NPWS, 2014b). Both the piling and UXO MMMPs provide an outline of the primary mitigation measures that could be implemented to reduce the risk of PTS, including variations to the soft-start and ramp-up, and use of MMOs and PAM to detect marine mammals as well as additional mitigation measures that could be put in place if required (e.g., ADDs, at source mitigation).

2.17.2.2.7 *Conclusion*

1170. Considering the above, following the mitigation measures included in the MMMP, the impacts as a result of PTS are expected to be to be reduced to negligible levels. Thus, the proposed activities at the CWP Project will not cause (auditory) injury to individuals at the site. Therefore, there will be no potential for AESI and no impediment to the Conservation Objectives of the bottlenose dolphin feature from PTS-onset (underwater noise) from the CWP Project alone.

2.17.2.3 Disturbance

2.17.2.3.1 Pre-construction geophysical surveys

1171. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and any of the Irish West Coast SACs. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.3.2 UXO clearance

1172. The underwater noise modelling which supports the impact assessment used TTS as a proxy for disturbance for UXO clearance. For the low-order clearance of UXOs the predicted impact range was 100 m for bottlenose dolphins and for high-order detonation of a 525 kg UXO (+ donor) the predicted impact range was 1.3 km for bottlenose dolphins. This results in impact to <1 individual dolphin in the Irish Sea MU, which is of negligible impact. There will be no overlap between disturbance impact ranges and any of the Irish West Coast SACs.

1173. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas (e.g., the Irish Sea MU) and thus could potentially be disturbed by UXO activities at the CWP Project. It is expected that the detonation of a UXO would elicit a startle response and potentially very short duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC, 2020). The duration of impact will be short-term and intermittent throughout a UXO clearance campaign, with animals expected to return to the area once the activity has ceased. The range within the inter-connected areas (Irish Sea MU) will therefore not be constrained or hindered.

1174. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

2.17.2.3.3 Piling at the onshore substation

1175. For piling at the onshore substation, disturbance impact ranges will not overlap with any of the Irish West Coast SACs.

1176. Within the Irish Sea MU, piling at the onshore substation was considered to result in temporary and short-term disturbance impacts occurring over less than a year on a very small proportion of the MU population (see **Chapter 11 Marine Mammals** of the EIA).

2.17.2.3.4 Operational noise

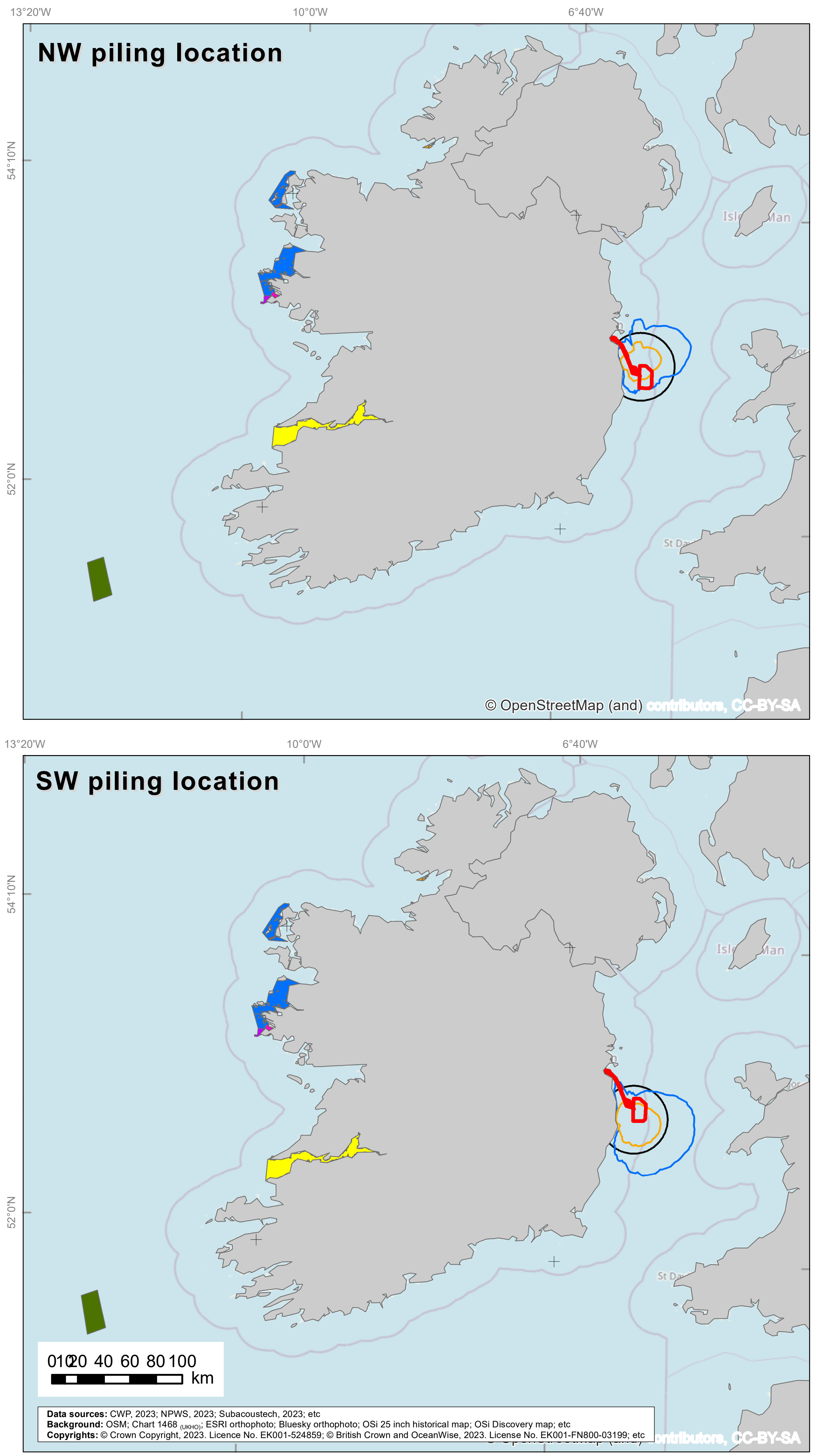
1177. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with any of the Irish West Coast SACs. As such, there are no significant effects on marine mammals at a MU or SAC-level, which can be taken to mean no AESI either in situ or ex situ.

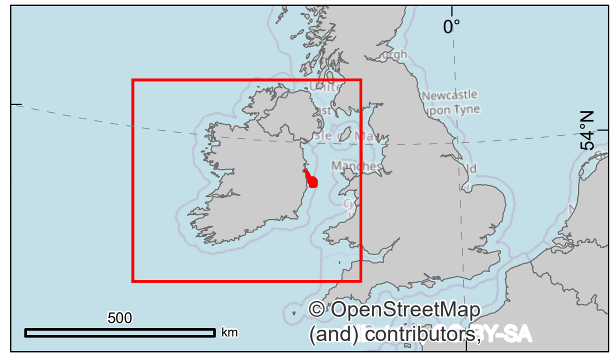
2.17.2.3.5 Piling of WTGs

1178. For piling of WTGs, the disturbance assessment used the harbour porpoise dose-response function presented in Graham et al. (2017) alongside the 160 dB SPL_{rms} Level B harassment threshold (NMFS, 2005). There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the population of bottlenose dolphins within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here, in the absence of advise specific to bottlenose dolphins. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020) alongside the dose-response function and level B threshold.

2.17.2.4 In situ disturbance from piling of WTGs

1179. None of the disturbance contours overlap with any of the Irish West Coast SACs (**Figure 2-18**).





Legend

- Planning application boundary
- Level B threshold 160 dB re µPa (SPL $_{RMS}$)
- SEL_{ss} 145 dB re µPa^{2}s threshold
- 26 km EDR
- Duvillaun Islands SAC
- Lower River Shannon SAC
- Slyne Head Islands SAC
- Slyne Head Peninsula SAC
- West Connacht Coast SAC
- Belgica Mound Province SAC
- Porcupine Bank Canyon SAC
- St Johns Point SAC
- South-West Porcupine Bank SAC

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Figure 2.18:
Disturbance thresholds for piling at the all modelling locations and the West Irish SACs designated for bottlenose dolphin

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1615

Internal descriptive code: IRE - PAB..DPNM.THRESH.B160.SEL.26EDR.CONT. WTGs.CORNERS - WEST.IRISH.SACs - (NIS.Vol.04.Ch.02.FIG.23)

Size: A3
Scale: 1:4,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Data sources: CWP, 2023; NPWS, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc

2.17.2.5 Ex situ disturbance from piling of WTGs

1180. It is recognised that bottlenose dolphins are mobile individuals and could be present outside of the boundary of the SAC in inter-connected areas where they could potentially be disturbed by piling activities at the CWP Project. It is recognised however that the Irish West Coast SACs are situated within the West Coast Ireland and Offshore Waters MUs and not the Irish Sea MU, although these MUs may be interconnected.

1181. The underwater noise assessment used the harbour porpoise dose-response curve (Graham et al., 2017) to assess potential impacts of disturbance from piling in the absence of species-specific information for bottlenose dolphins. Population modelling for the Irish Sea MU however indicated that disturbance may cause temporary changes in behaviour resulting in potential reductions to lifetime reproductive success and survival to some individuals, although not enough to affect the population trajectory over a generational scale. Therefore, it is assumed that disturbance associated with underwater noise from piling is not predicted to result in any significant negative impacts on individuals out with the site Irish Coast SACs and associated with the Oceanic Waters and West Coast Ireland MUs.

2.17.2.5.1 Disturbance from vessels

1182. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. Vessels within 400 m of a bottlenose dolphin group have been found to result in short-term changes to bottlenose dolphin behaviour through both targeted and non-targeted approaches (Clarkson et al., 2020, Bas et al., 2017, Puszka et al., 2021). This will result in a negligible impact to the Irish Sea MU. Disturbance impact ranges will not overlap with any of the Irish West Coast SACs.

1183. The project has committed to the adoption of an EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals.

1184. Vessels associated with the CWP Project are not expected to operate within the Irish West Coast SACs. Disturbance impact ranges will not overlap with any of the Irish West Coast SACs.

2.17.2.6 Conclusion

1185. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the bottlenose dolphin population at the site. Therefore, there is expected to be no potential for AESI to any of the Irish West Coast SACs from the CWP Project alone.

2.17.2.7 Exclusion

1186. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within any of the Irish West Coast SACs. Therefore, there is expected to be no potential for AESI to any of the Irish West Coast SACs from the CWP Project alone.

2.17.2.8 Proposed mitigation

1187. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. With these primary mitigation measures in place, the assessment has concluded no AESI to any of the Irish West Coast SACs from the CWP Project alone from increased underwater noise.

1188. No additional mitigation is required.

2.17.2.9 Residual impacts

1189. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the bottlenose dolphin population associated with any of the Irish West Coast SACs from increased underwater noise from the CWP Project alone.

2.17.2.10 Impact 2: Collision risk

1190. Target 2 of the Conservation Objectives states that 'proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population at the site'.

2.17.2.10.1 Assessment of the project alone

1191. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

1192. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 'Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters', the already low risk of vessel collisions will be further reduced.

1193. Vessels associated with the CWP Project are not expected to operate within any of the Irish West Coast SACs. No bottlenose dolphins within or out with the SAC are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the bottlenose dolphin population at the site. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins from collision risk from the CWP Project alone.

2.17.2.10.2 Proposed mitigation

1194. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. With these primary mitigation measures in place, the assessment has concluded no AESI to any of the Irish West Coast SACs from the CWP Project alone from collision risk.

1195. No additional mitigation is required.

2.17.2.10.3 Residual impacts

1196. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved at any of the Irish West Coast SACs. Therefore, there is no potential for an AESI, and no impediment to the Conservation Objectives of the bottlenose dolphins associated with any of the Irish West Coast SACs from vessel collisions from the CWP Project alone.

2.17.2.11 Impact 3: Changes in prey availability

1197. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which bottlenose dolphins depend'.

2.17.2.11.1 Assessment of the project alone

1198. Given that bottlenose dolphins are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. Stomach contents analysis from stranded bottlenose dolphins in Irish waters has shown that their diet is diverse, with a preference for whiting / blue whiting and pelagic squid (Hernandez-Milian et al., 2011). To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of the Irish West Coast SACs could arise as a result of the impacts of changes in prey availability on bottlenose dolphins as a qualifying feature of the Irish West Coast SACs. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of CWP Project alone (this includes: direct damage, disturbance, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of bottlenose dolphins (e.g., whiting).

1199. Considering the above, there is expected to be no change to bottlenose dolphin prey species presence, abundance, condition, or diversity in situ or ex situ; as such, there will be no deterioration of key resources (feeding) upon which bottlenose dolphins depend. There is therefore no potential for AESI to the Conservation Objectives of the bottlenose dolphin at any of the Irish West Coast SACs from changes in prey availability from the CWP Project alone.

2.17.2.11.2 Proposed mitigation

1200. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the Irish West Coast SACs as a result of changes in prey availability.

2.17.2.11.3 Residual impacts

1201. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the bottlenose dolphins associated with any of the Irish West Coast SACs as a result of changes to prey availability from the CWP Project alone.

2.17.2.12 Impact 4: Changes in available habitat

1202. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of bottlenose dolphins from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

2.17.2.12.1 Assessment of the project alone

1203. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of bottlenose dolphins from part of their range within any of the Irish West Coast SACs nor will they permanently remove, or prevent access for bottlenose dolphins to, suitable habitat therein.

1204. Considering the above, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the bottlenose dolphin feature any of the Irish West Coast SACs from changes in available habitat from the CWP Project alone.

2.17.2.12.2 Proposed mitigation

1205. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the Irish West Coast SACs as a result of changes in available habitat.

2.17.2.12.3 Residual impacts

1206. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the bottlenose dolphins associated with any of the Irish West Coast SACs from changes in available habitat from the CWP Project alone.

2.18 Slaney River Valley SAC (IE0000781)

1207. This SAC is 80 km from the offshore development area and onshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Atlantic salmon.

Table 2-39 Assessment summary, Conservation Objectives, Attributes and Targets for Slaney River Valley SAC and summary of associated assessment (NPWS, 2011a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Juvenile density at least 1 m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.1**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds. Improved dispersal of spawning beds into areas upstream of barriers	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution: extent of anadromy. Greater than 75% of main stem and major tributaries down to second order	No impact on river morphology, and as such no impact on this attribute and target.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
accessible from estuary				
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1103] Twaite shad (*Alosa fallax*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure- age classes. More than one age class present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitat Presence of structures and predator aggregation. See **Section 2.18.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning habitats	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality- oxygen levels. No lower than 5 mg/l	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Spawning habitat quality: Filamentous algae; macrophytes; sediment. Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
second order accessible from estuary				adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.18.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.18.1 Sea lamprey [1095] and River lamprey [1099]

1208. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

1209. The following Conservation Objective attributes and targets are considered to have potential impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 m².

1210. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m².

2.18.1.1 Increase in underwater noise and vibration

1211. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014)). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1212. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

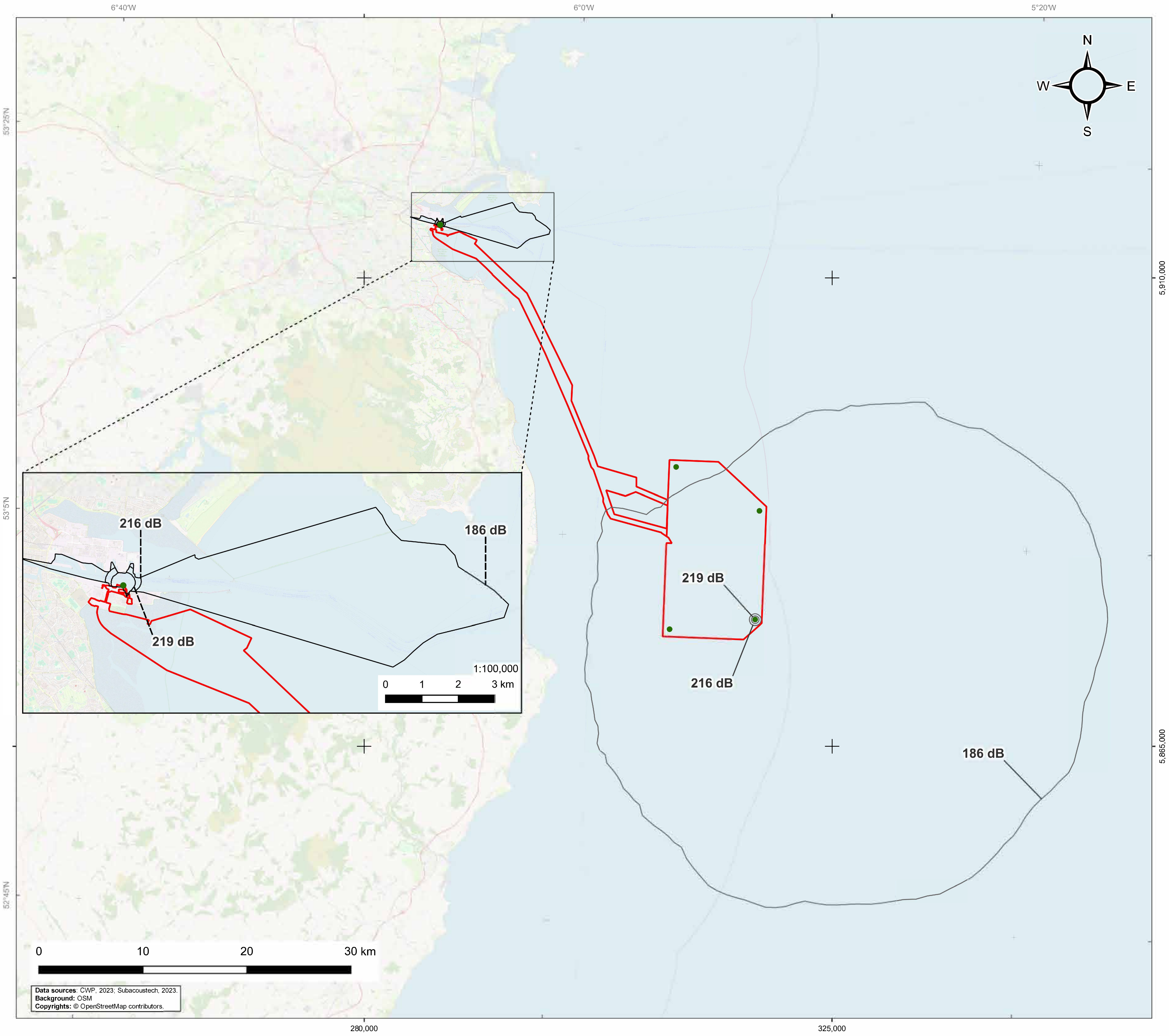
1213. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

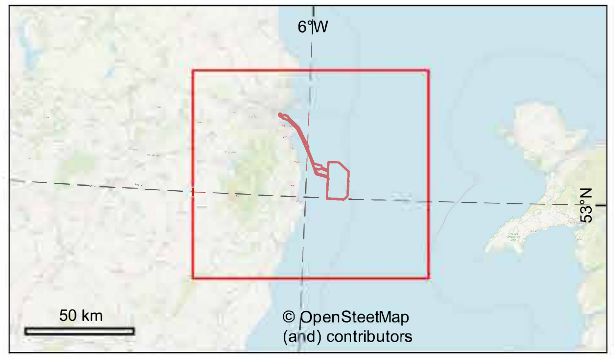
1214. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[25], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1215. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

[25] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf





Legend

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

Project: Codling Wind Park

Contractor: www.naturalpower.com

Figure 2.19
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 - (NIS Vol 04.02.19)	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

2.18.1.1.1 Mortality

1216. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1217. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1218. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.18.1.1.2 Recoverable injury

1219. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1220. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.18.1.1.3 Temporary threshold shift and behavioural responses

1221. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1222. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1223. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1224. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1225. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*.130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.18.1.1.4 Conclusions relating to underwater noise impacts

1226. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1227. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects and lack of any barrier to migration, underwater noise impacts arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.18.1.2 Presence of EMF

1228. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric

fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1229. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1230. There is a maximum of approximately 145.8 km of offshore export 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1231. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-11**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-12**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-13**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-11, Plate 2-12**).

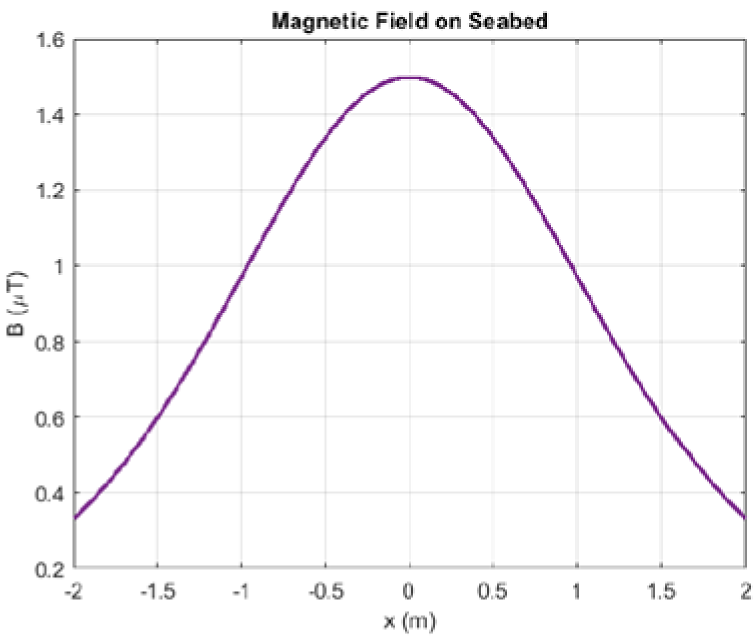


Plate 2-11 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

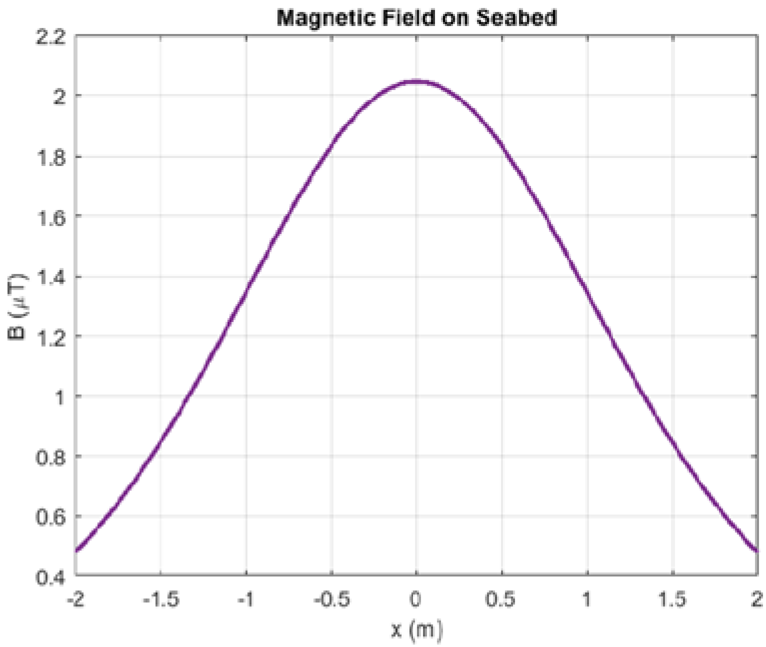


Plate 2-12 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

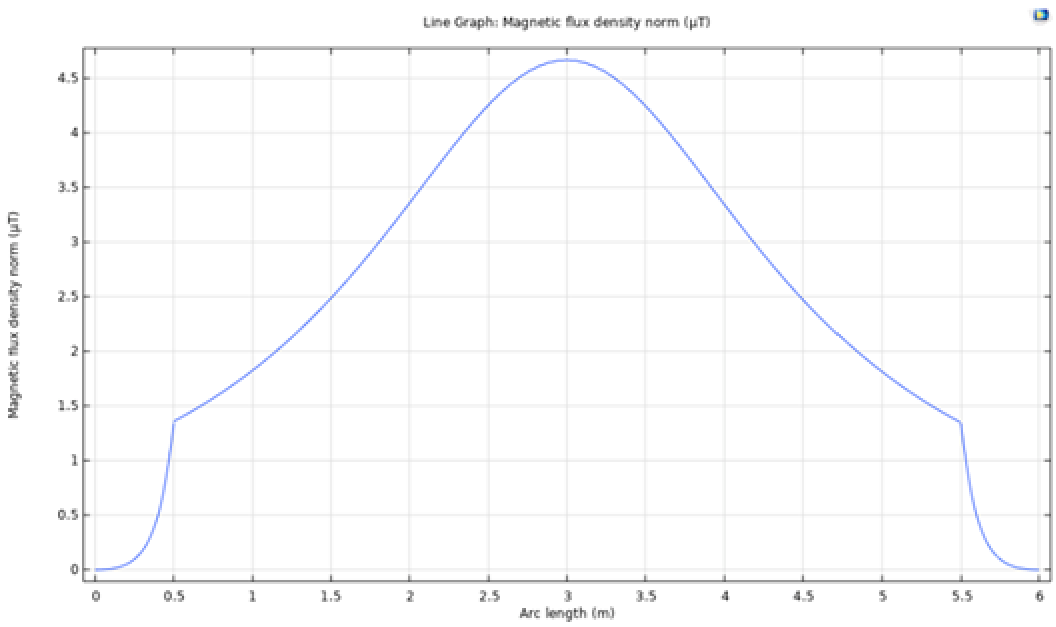


Plate 2-13 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1232. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1233. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1234. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1235. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, EMF impacts arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.18.1.3 Temporary increase in SSC and contaminated sediments

1236. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1237. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle and will not form any barrier to migration.

1238. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1239. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.18.1.3.1 Dredging and dredge disposal

1240. 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).

1241. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1242. 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.

2.18.1.3.2 Trenching

1243. 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.

1244. Based upon the representative scenario, the modelled 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.

1245. 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.

1246. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1247. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1248. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, temporary increases in SSC and contaminated sediments arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.18.1.4 Direct impacts on habitats

1249. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small ex situ ex situ area of offshore habitat that may be used during the marine phase of this species life cycle only.

1250. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1251. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1252. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1253. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to lamprey species that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, direct impacts on habitat arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.18.1.5 Presence of structures and predator aggregation

1254. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1255. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1256. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1257. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1258. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, presence of structures and predator aggregation arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these considerations it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.18.2 Twaite shad [1103]

1259. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Population structure – age classes. More than one age class present.

2.18.2.1 Increase in underwater noise and vibration

1260. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought

to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

1261. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

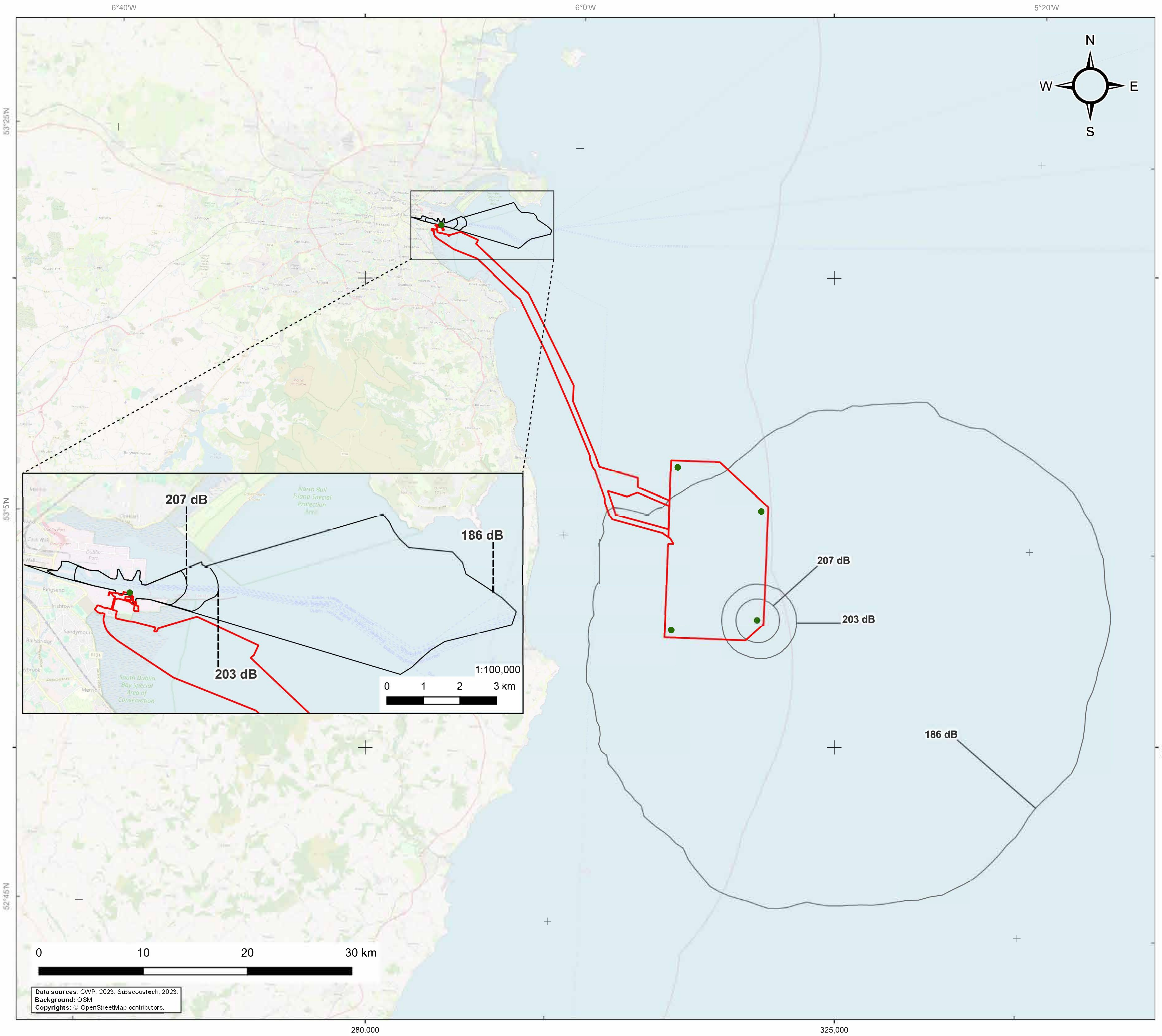
1262. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

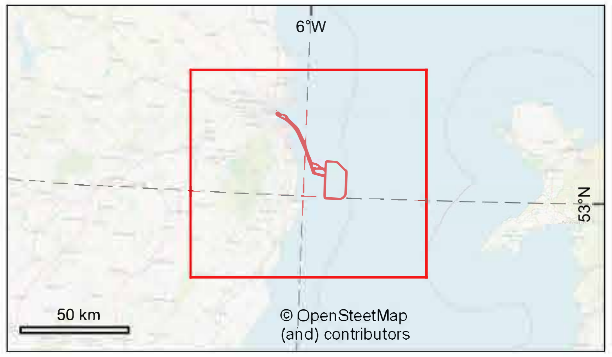
1263. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[26], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1264. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

1265. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

[26] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf





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 2.20
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

2.18.2.1.1 Mortality

1266. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

1267. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

1268. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.18.2.1.2 Recoverable injury

1269. Recoverable injury effects 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 more realistic fleeing model is used.

1270. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.18.2.1.3 Temporary threshold shift and behavioural responses

1271. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

1272. 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 more realistic fleeing model is used.

1273. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1274. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1275. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*.130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.18.2.1.4 Conclusions relating to underwater noise impacts

1276. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

1277. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that increases in underwater noise and vibration arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.18.2.2 Presence of EMF

1278. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1279. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1280. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1281. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-14**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-15**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-16**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-14, Plate 2-15, Plate 2-16**).

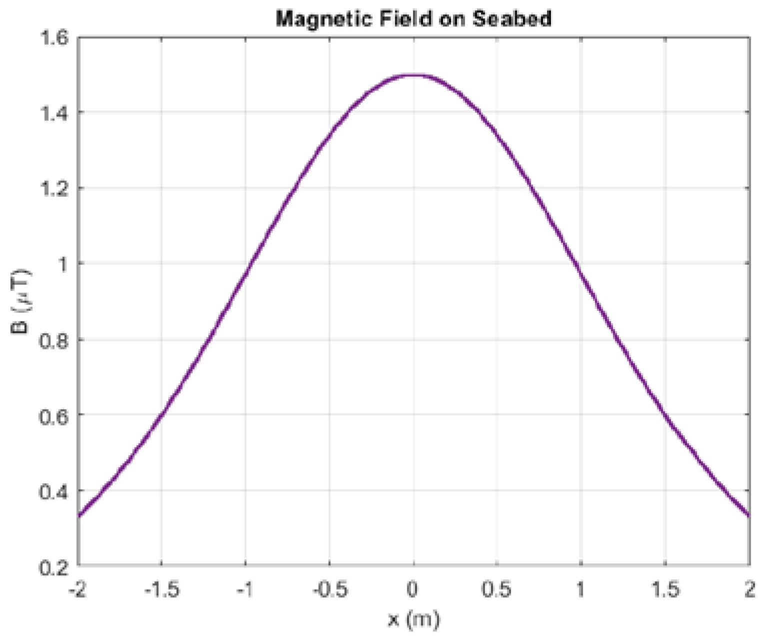


Plate 2-14 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

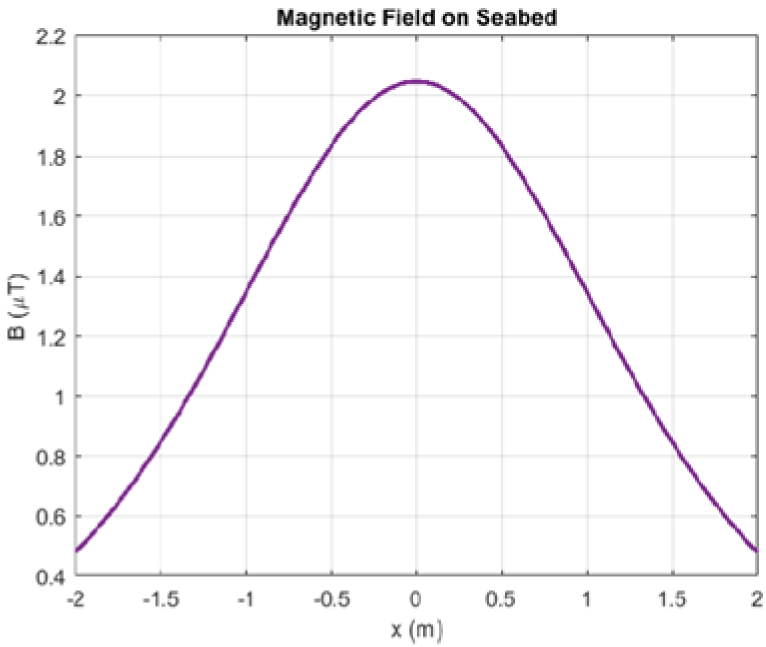


Plate 2-15 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

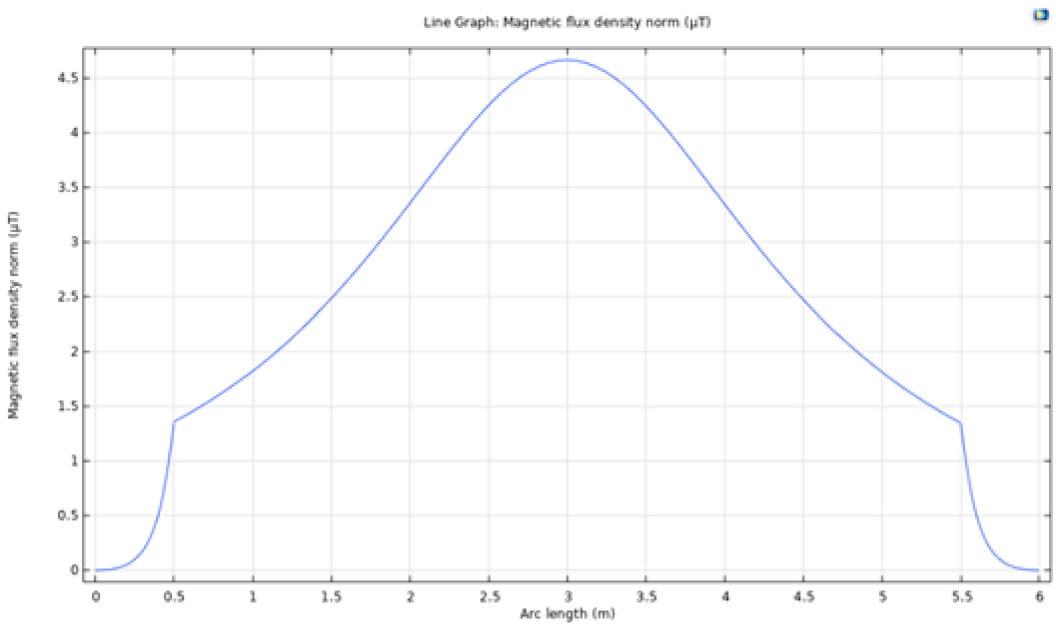


Plate 2-16 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1282. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

1283. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1284. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

1285. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that presence of EMF arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.18.2.3 Temporary increase in SSC and contaminated sediments

1286. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

1287. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1288. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area.

However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1289. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.18.2.3.1 Dredging and dredge disposal

1290. 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).

1291. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1292. 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.

2.18.2.3.2 Trenching

1293. 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.

1294. Based upon the representative scenario, the modelled 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.

1295. 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.

1296. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1297. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

1298. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that temporary increases in SSC and contaminated sediment arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.18.2.4 Direct impacts on habitats

1299. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1300. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1301. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1302. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to

950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

1303. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that direct impacts on habitat arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.18.2.5 Presence of structures and predator aggregation

1304. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1305. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1306. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1307. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1308. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that presence of structures and predator aggregation arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.18.3 Atlantic salmon [1106][27]

1309. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling; and
- Out-migrating smolt abundance. No significant decline.

2.18.3.1 Increase in underwater noise and vibration

1310. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1311. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1312. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1313. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[28], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into

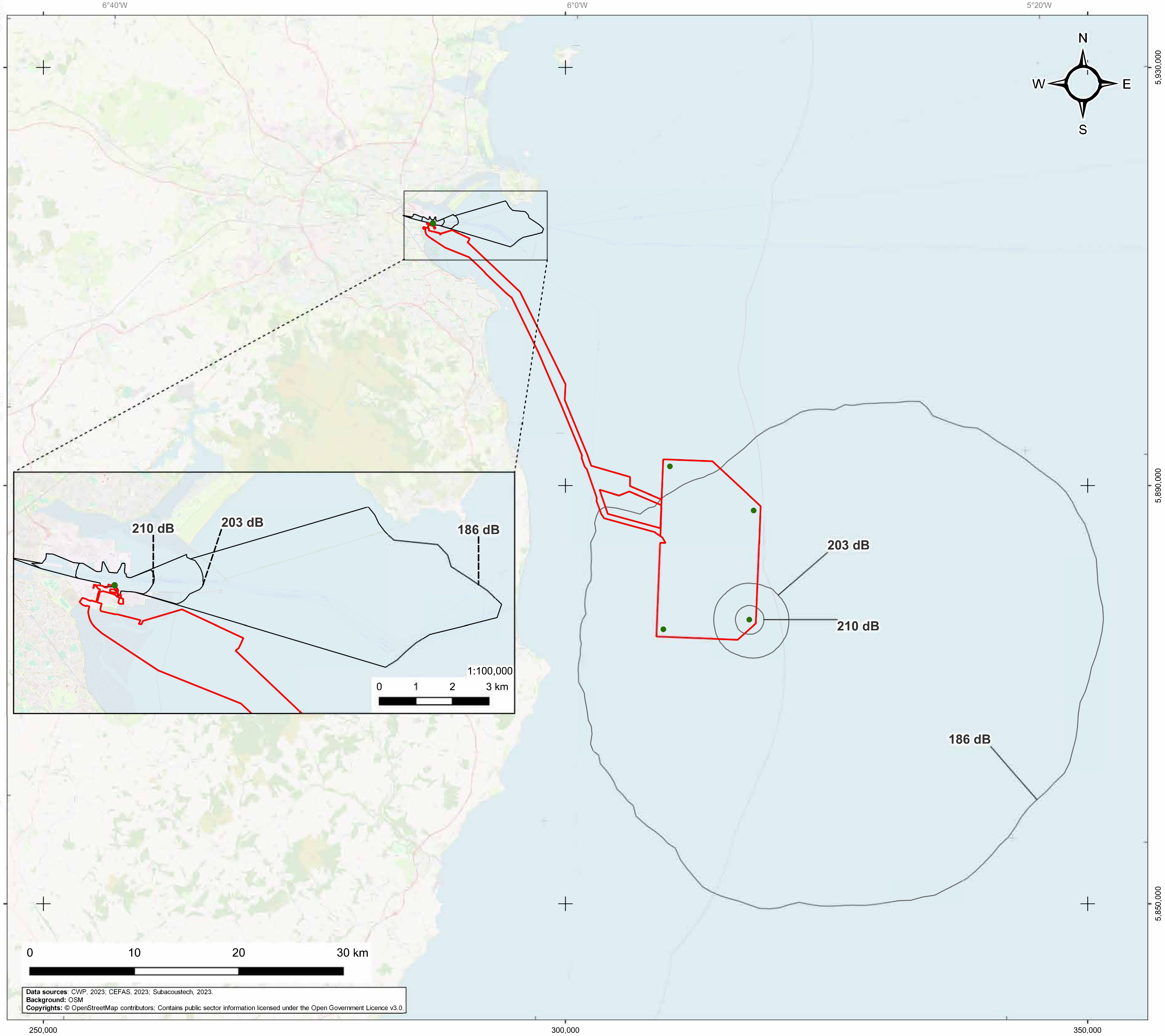
[27] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

[28] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1314. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1315. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.



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.

Legend

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

Project: Codling Wind Park

Contractor: natural power — www.naturalpower.com

Figure 2.21
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:
	Scale: 1:350,000	EPSG 25830

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

2.18.3.1.1 Mortality

1316. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1317. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1318. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.18.3.1.2 Recoverable injury

1319. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1320. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.18.3.1.3 Temporary threshold shift and behavioural responses

1321. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1322. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1323. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1324. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1325. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.18.3.1.4 Conclusions relating to underwater noise impacts

1326. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1327. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that increases in underwater noise and vibration arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC., it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.18.3.2 Presence of EMF

1328. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1329. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1330. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1331. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-17**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-18**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-19**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-17, Plate 2-18**).

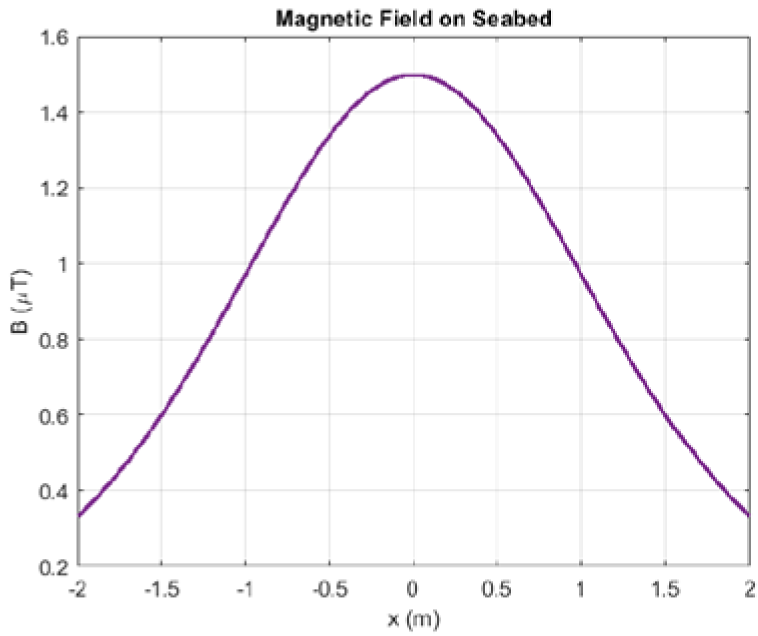


Plate 2-17 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

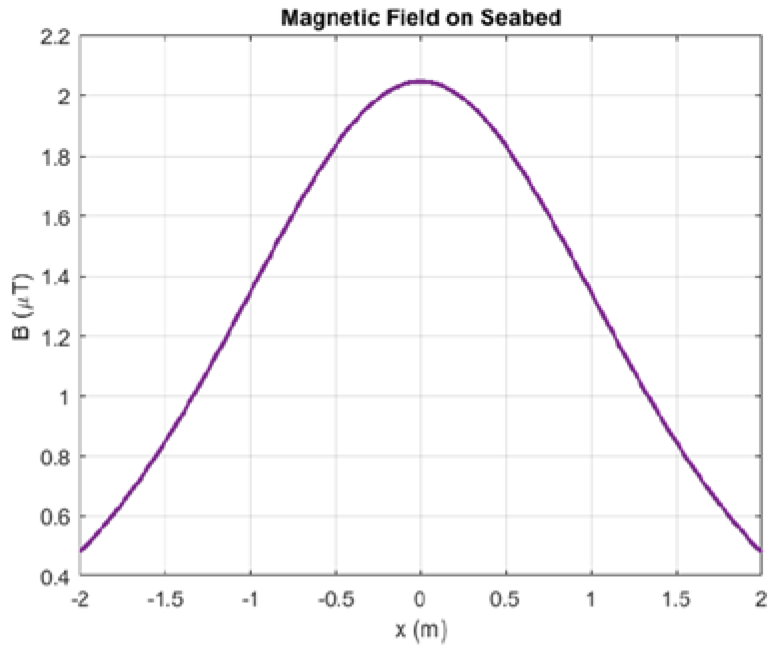


Plate 2-18 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

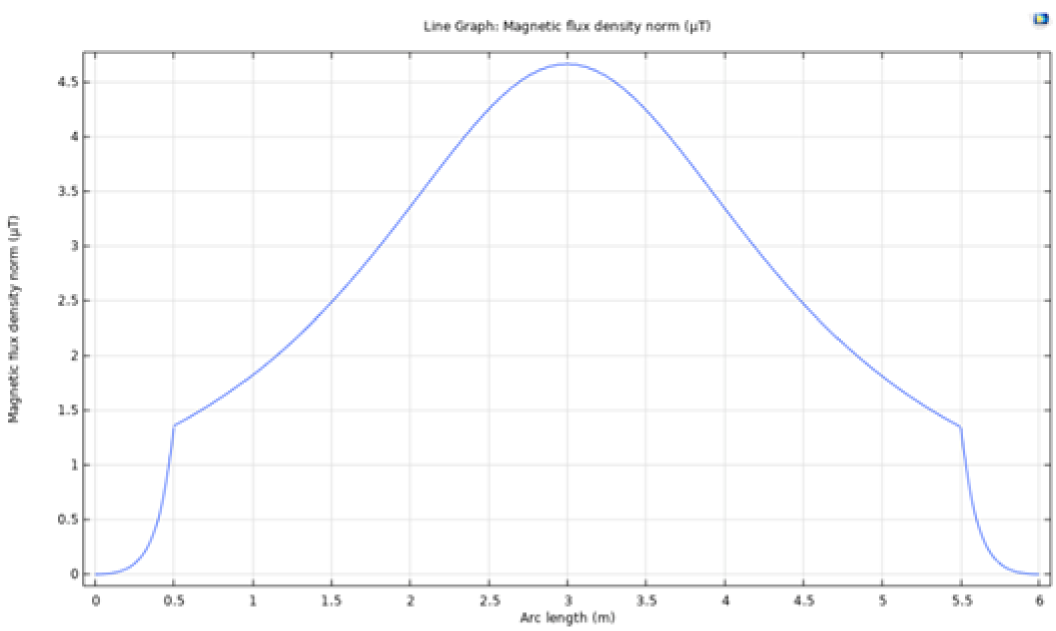


Plate 2-19 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1332. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1333. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1334. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1335. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that presence of EMF arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.18.3.3 Temporary increase in SSC and contaminated sediments

1336. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1337. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1338. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1339. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.18.3.3.1 Dredging and dredge disposal

1340. 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).

1341. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1342. 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.

2.18.3.3.2 Trenching

1343. 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.

1344. Based upon the representative scenario, the modelled 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.

1345. 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.

1346. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1347. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[29]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1348. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that temporary increases in SSCs and contaminated sediments arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.18.3.4 Direct impacts on habitats

1349. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1350. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the

[29]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1351. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1352. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1353. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that direct impacts on habitat arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, as such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.18.3.5 Presence of structures and predator aggregation

1354. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1355. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1356. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1357. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1358. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that presence of structures and predator aggregation arising as a result of the CWP Project will not impede the Conservation Objectives for the SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.19 River Barrow and River Nore SAC (IE0002162)

1359. This SAC is 147 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Atlantic salmon.

Table 2-40 Conservation Objectives, Attributes and Targets for River Barrow and River Nore SAC and summary of associated assessment (NPWS, 2011b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.19.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.19.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution. Access to all water courses	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
down to first order streams				site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.19.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.19.1**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1103] Twaite shad (*Alosa fallax*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure: age classes. More than one age class present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.19.2**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning habitats	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality: oxygen levels. No lower than 5 mg/l	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Spawning habitat quality: Filamentous algae; macrophytes; sediment. Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
river channels down to second order accessible from estuary				met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.19.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.19.3**			
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.19.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact on possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.19.1 Sea lamprey [1095] and River lamprey [1099]

1360. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

1361. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m².

1362. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m².

2.19.1.1 Increase in underwater noise and vibration

1363. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1364. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1365. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1366. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[30], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.**4 of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1367. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.19.1.1.1 Mortality

1368. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1369. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1370. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.19.1.1.2 Recoverable injury

1371. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1372. Recoverable injury in proximity to the Liffey piling operations 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

[30] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.19.1.1.3 Temporary threshold shift and behavioural responses

1373. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1374. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1375. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1376. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1377. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*.130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.19.1.1.4 Conclusions relating to underwater noise impacts

1378. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1379. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.19.1.2 Presence of EMF

1380. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1381. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1382. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1383. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-20**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-21**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-22**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-20, Plate 2-21**).

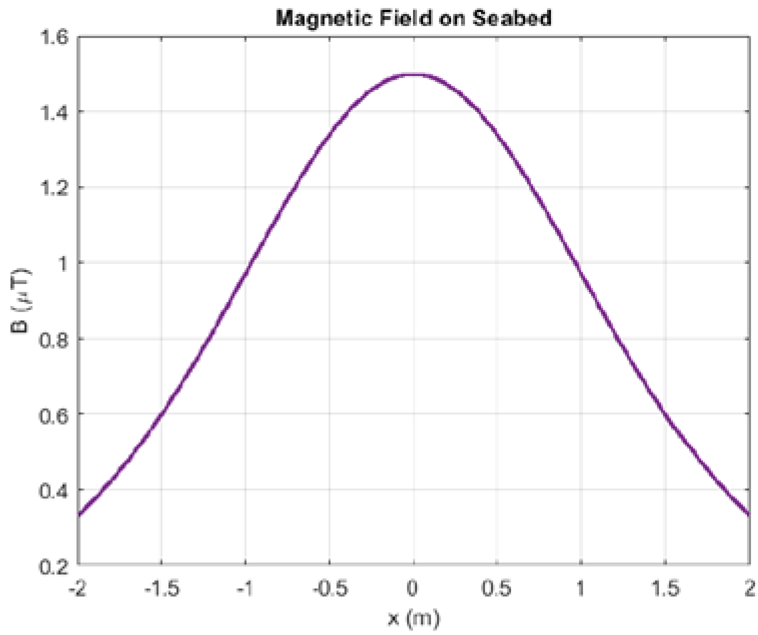


Plate 2-20 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

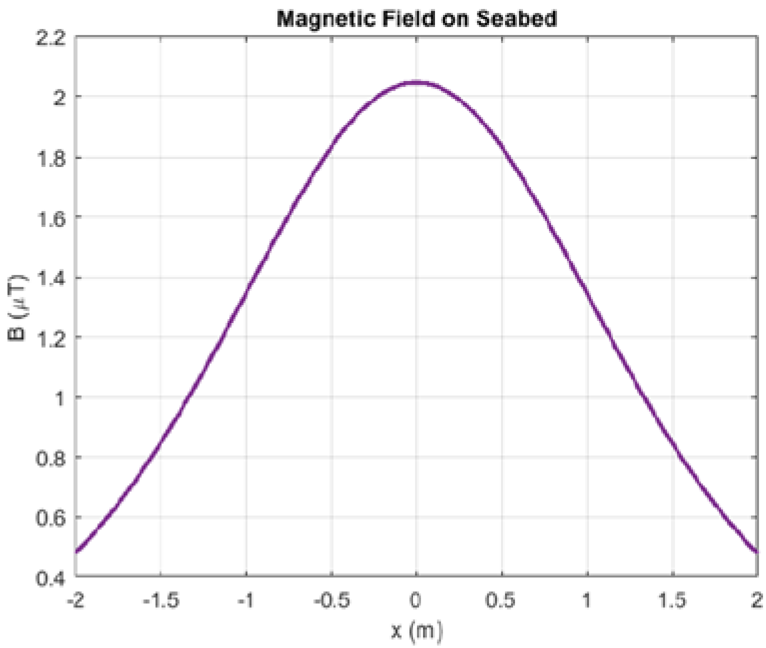


Plate 2-21 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

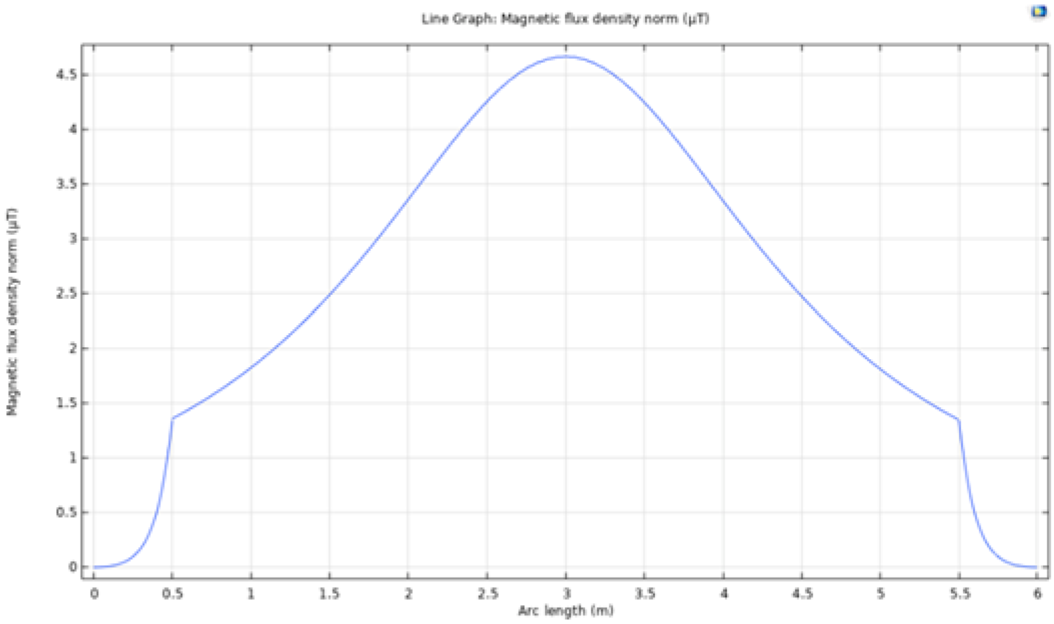


Plate 2-22 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1384. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1385. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1386. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1387. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.19.1.3 Temporary increase in SSC and contaminated sediments

1388. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1389. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1390. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1391. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.19.1.3.1 Dredging and dredge disposal

1392. 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).

1393. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1394. 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.

2.19.1.3.2 Trenching

1395. 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.

1396. Based upon the representative scenario, the modelled 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.

1397. 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.

1398. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1399. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1400. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.19.1.4 Direct impacts on habitats

1401. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1402. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1403. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1404. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1405. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.19.1.5 Presence of structures and predator aggregation

1406. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1407. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1408. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1409. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1410. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered such that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.19.2 Twaite shad [1103]

1411. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Population structure: age classes. More than one age class present.

2.19.2.1 Increase in underwater noise and vibration

1412. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

1413. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1414. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1415. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[31], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment - **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1416. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

1417. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.19.2.1.1 Mortality

1418. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

1419. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

1420. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.19.2.1.2 Recoverable injury

1421. Recoverable injury effects 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

[31] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

1422. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.19.2.1.3 Temporary threshold shift and behavioural responses

1423. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

1424. 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 more realistic fleeing model is used.

1425. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1426. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1427. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.19.2.1.4 Conclusions relating to underwater noise impacts

1428. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

1429. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.19.2.2 Presence of EMF

1430. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1431. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1432. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1433. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-23**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-24**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-25**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-23, Plate 2-24**).

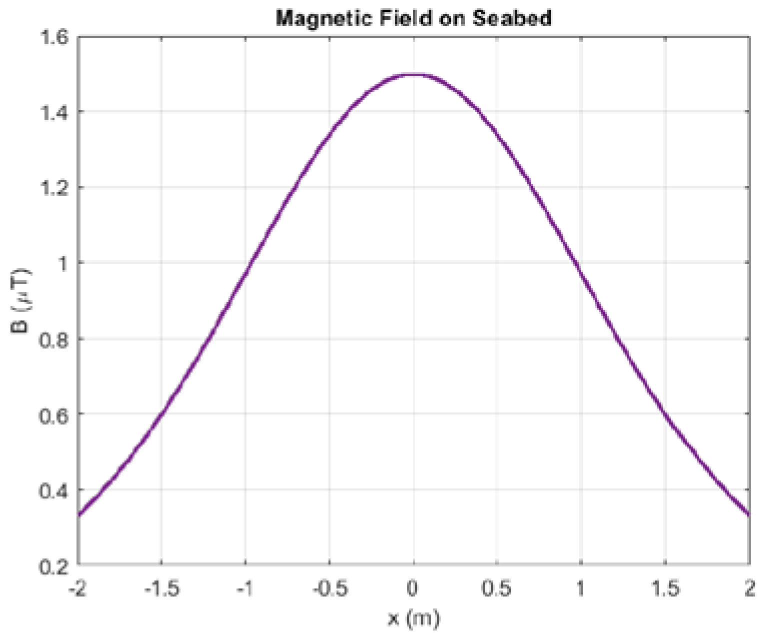


Plate 2-23 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

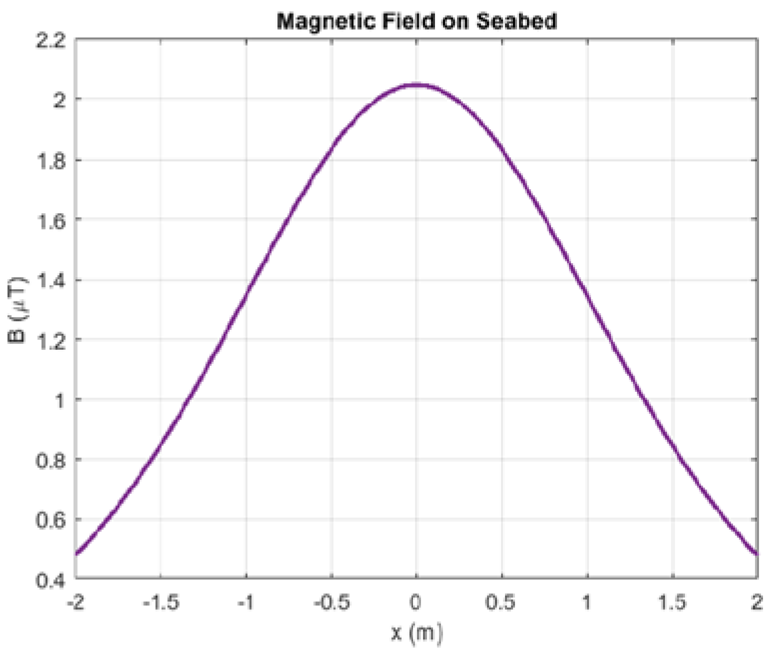


Plate 2-24 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

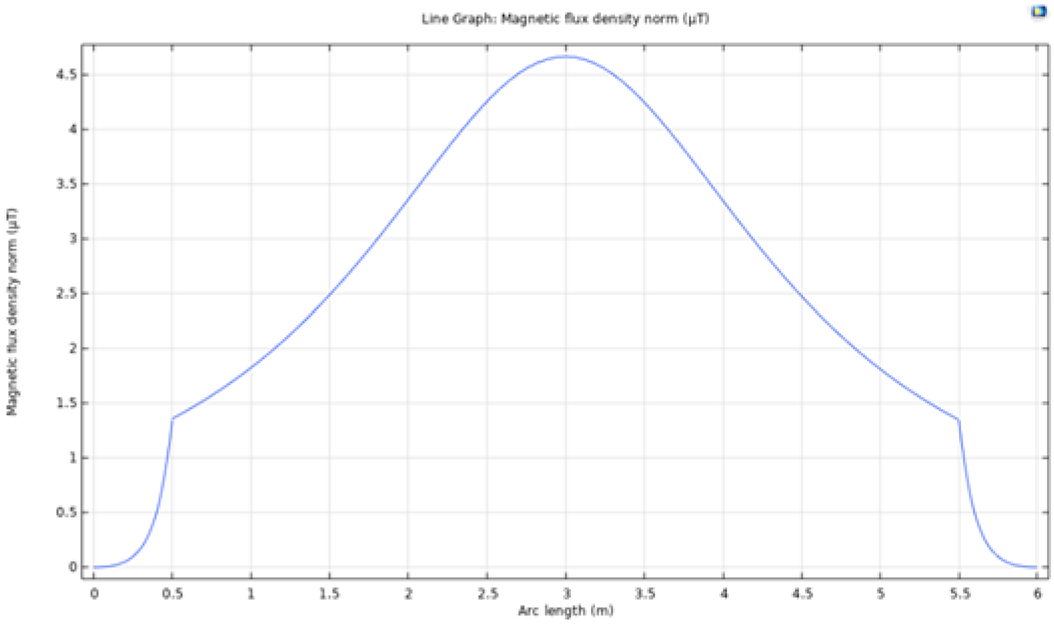


Plate 2-25 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1434. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

1435. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1436. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

1437. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.19.2.3 Temporary increase in SSC and contaminated sediments

1438. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

1439. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1440. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1441. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.19.2.3.1 Dredging and dredge disposal

1442. 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).

1443. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1444. 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.

2.19.2.3.2 Trenching

1445. 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.

1446. Based upon the representative scenario, the modelled 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.

1447. 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.

1448. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1449. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

1450. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It can therefore be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.19.2.4 Direct impacts on habitats

1451. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1452. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1453. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1454. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

1455. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.19.2.5 Presence of structures and predator aggregation

1456. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1457. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1458. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected

that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1459. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1460. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It can therefore be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.19.3 Atlantic salmon [1106][32]

1461. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI.

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling;
- Out-migrating smolt abundance. No significant decline; and

2.19.3.1 Increase in underwater noise and vibration

1462. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1463. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and

[32] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1464. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1465. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[33], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1466. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1467. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.19.3.1.1 Mortality

1468. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1469. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1470. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood

[33] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.19.3.1.2 Recoverable injury

1471. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1472. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.19.3.1.3 Temporary threshold shift and behavioural responses

1473. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1474. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1475. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1476. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1477. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160 - 170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are

predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.19.3.1.4 Conclusions relating to underwater noise impacts

1478. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1479. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.19.3.2 Presence of EMF

1480. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1481. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1482. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1483. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-26**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-27**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-28**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-26, Plate 2-27**).

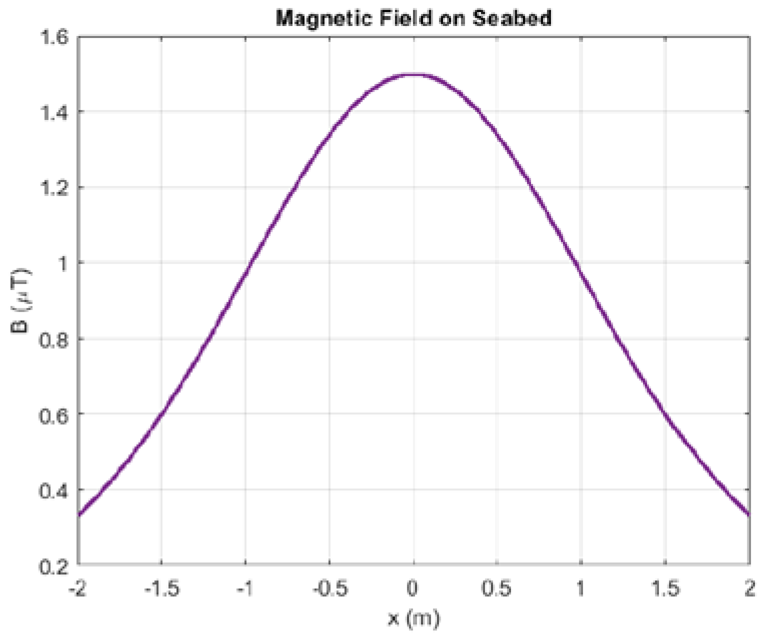


Plate 2-26 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

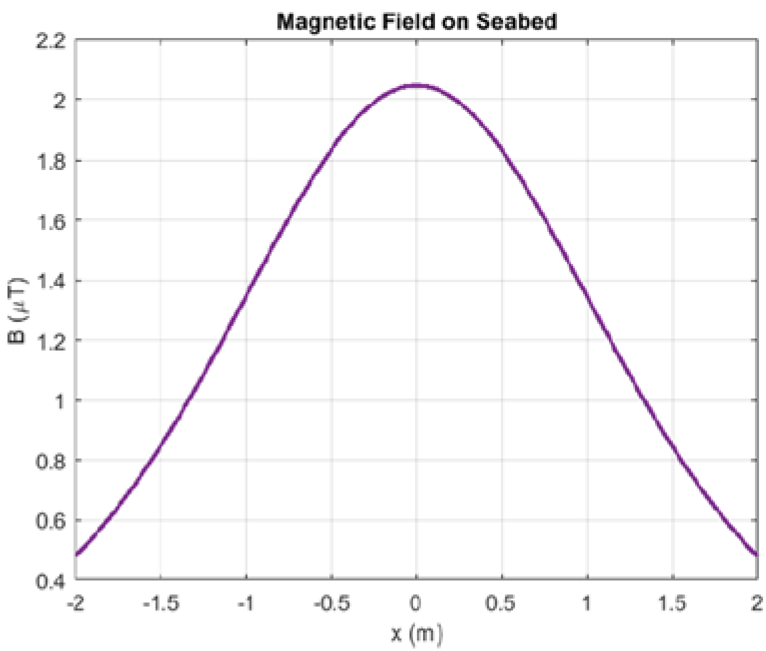


Plate 2-27 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

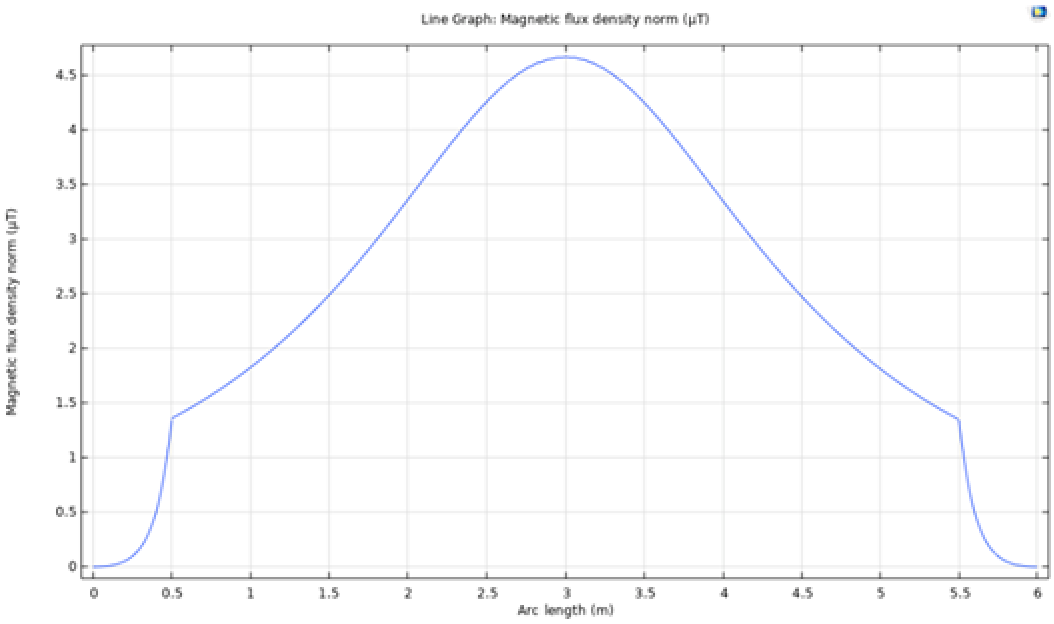


Plate 2-28 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1484. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1485. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1486. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1487. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.19.3.3 Temporary increase in SSC and contaminated sediments

1488. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1489. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1490. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1491. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.19.3.3.1 Dredging and dredge disposal

1492. 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).

1493. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1494. 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.

2.19.3.3.2 Trenching

1495. 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.

1496. Based upon the representative scenario, the modelled 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.

1497. 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.

1498. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1499. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[34]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1500. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high

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[34] In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It can therefore be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.19.3.4 Direct impacts on habitats

1501. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1502. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1503. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1504. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1505. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.19.3.5 Presence of structures and predator aggregation

1506. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1507. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1508. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1509. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1510. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It can therefore be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.20 Lower River Suir SAC (IE0002137)

1511. This SAC is 164 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Atlantic salmon.

Table 2-41 Conservation Objectives, Attributes and Targets for Lower River Suir SAC and summary of associated assessment (NPWS, 2017a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.1**			predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and therefore no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatili*)				
Distribution. Access to all water courses down to first order streams	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
				predicted from the project alone
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 /m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
decline in extent and distribution of spawning beds				Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1103] Twaite shad (*Alosa fallax*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure: age classes. More than one age class present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.20.2**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning habitats	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality: oxygen levels. No lower than 5 mg/l	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Spawning habitat quality: Filamentous algae; macrophytes; sediment. Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plants) growth	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met,

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
second order accessible from estuary				and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.20.3**			
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.20.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.20.1 Sea lamprey [1095] and River lamprey [1099]

1512. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

1513. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m².

1514. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey.

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m².

2.20.1.1 Increase in underwater noise and vibration

1515. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1516. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1517. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1518. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[35], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1519. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.20.1.1.1 Mortality

1520. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1521. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1522. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.20.1.1.2 Recoverable injury

1523. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1524. Recoverable injury in proximity to the Liffey piling operations 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

[35] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.20.1.1.3 Temporary threshold shift and behavioural responses

1525. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1526. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1527. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1528. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1529. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.20.1.1.4 Conclusions relating to underwater noise impacts

1530. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project, therefore in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1531. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.20.1.2 Presence of EMF

1532. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1533. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1534. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1535. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-29**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-30**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-31**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-29, Plate 2-30, Plate 2-31**).

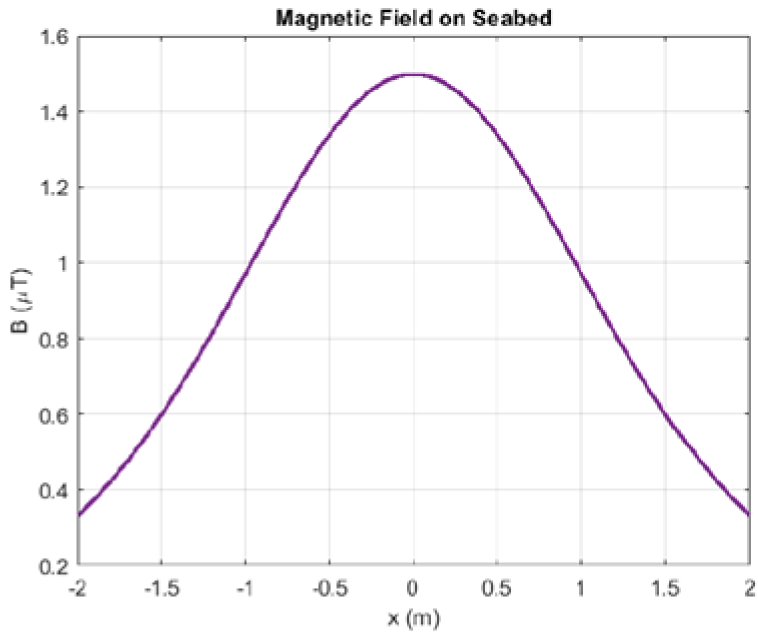

Plate 2-29 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

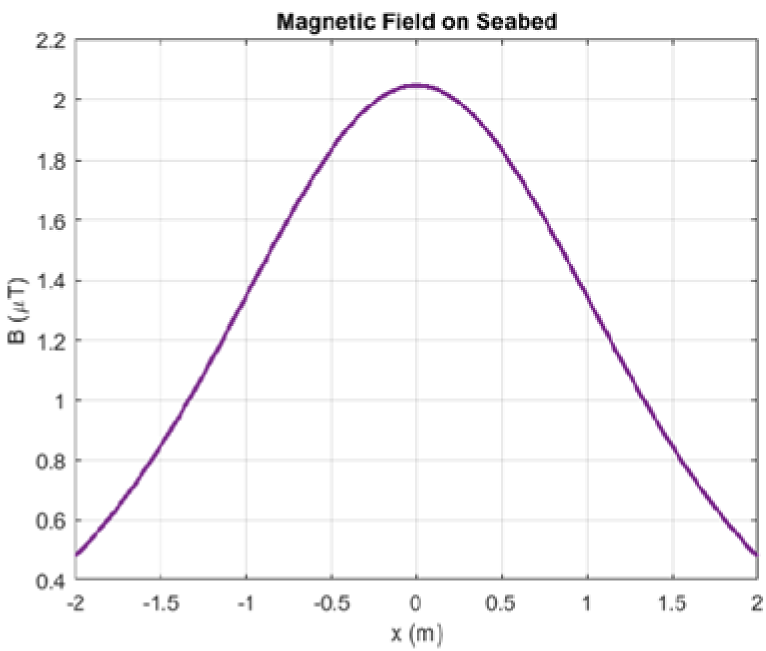

Plate 2-30 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

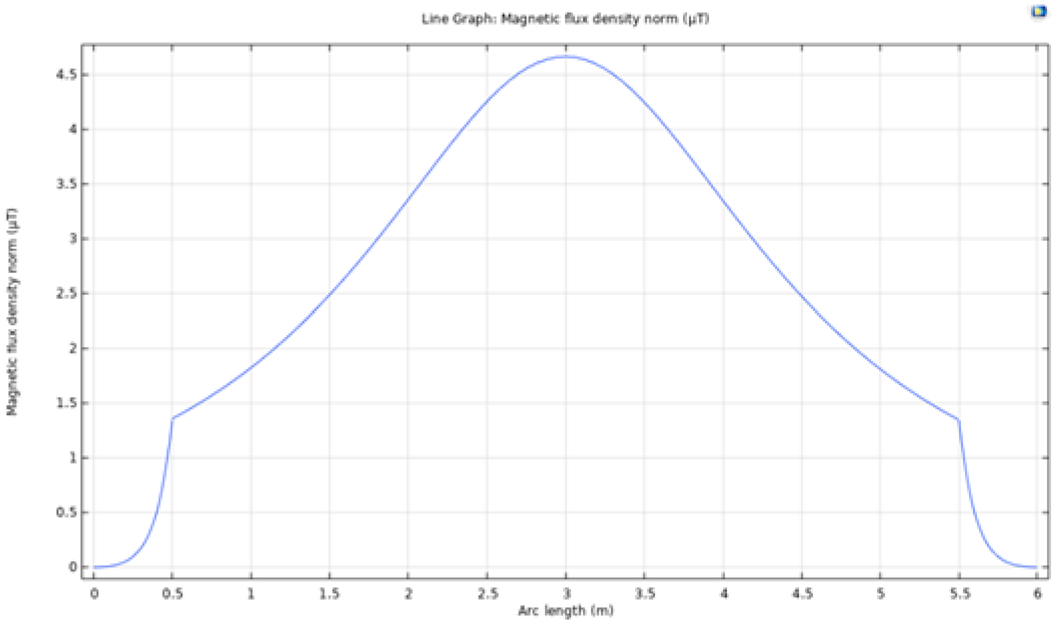

Plate 2-31 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1536. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1537. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1538. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1539. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.20.1.3 Temporary increase in SSC and contaminated sediments

1540. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1541. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1542. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1543. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.20.1.3.1 Dredging and dredge disposal

1544. 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).

1545. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1546. 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.

2.20.1.3.2 Trenching

1547. 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.

1548. Based upon the representative scenario, the modelled 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.

1549. 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.

1550. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1551. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1552. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.20.1.4 Direct impacts on habitats

1553. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1554. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1555. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1556. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1557. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.20.1.5 Presence of structures and predator aggregation

1558. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1559. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1560. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1561. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1562. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.20.2 Twaite shad [1103]

1563. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Population structure: age classes. More than one age class present.

2.20.2.1 Increase in underwater noise and vibration

1564. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

1565. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1566. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1567. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[36], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1568. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

1569. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.20.2.1.1 Mortality

1570. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

1571. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

1572. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.20.2.1.2 Recoverable injury

1573. Recoverable injury effects 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

[36] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

1574. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.20.2.1.3 Temporary threshold shift and behavioural responses

1575. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

1576. 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 more realistic fleeing model is used.

1577. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1578. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1579. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.20.2.1.4 Conclusions relating to underwater noise impacts

1580. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

1581. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.20.2.2 Presence of EMF

1582. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1583. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1584. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1585. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-32**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-33**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-34**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-32, Plate 2-33**).

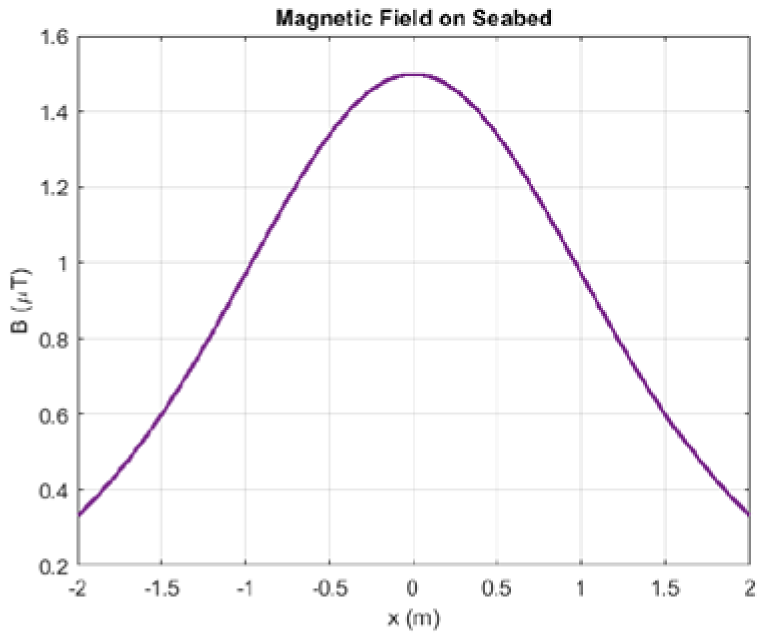

Plate 2-32 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

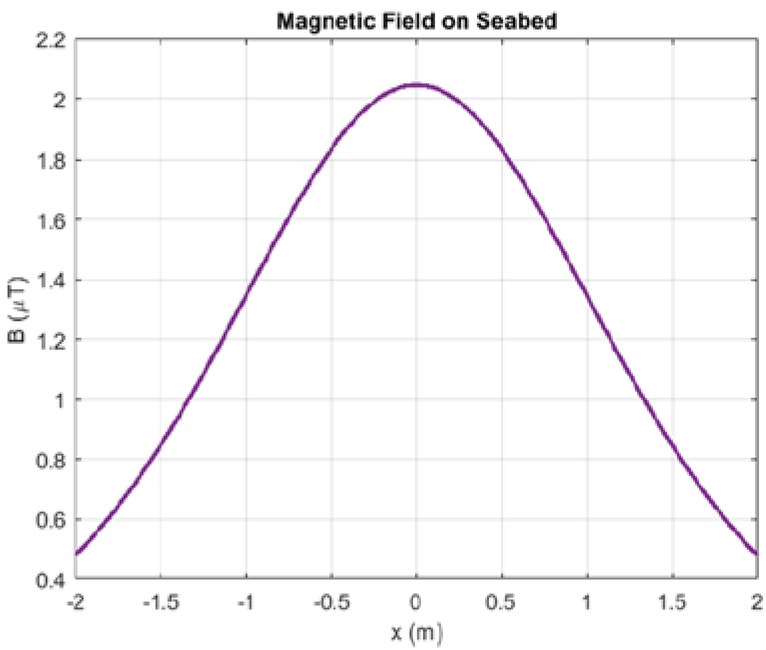

Plate 2-33 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

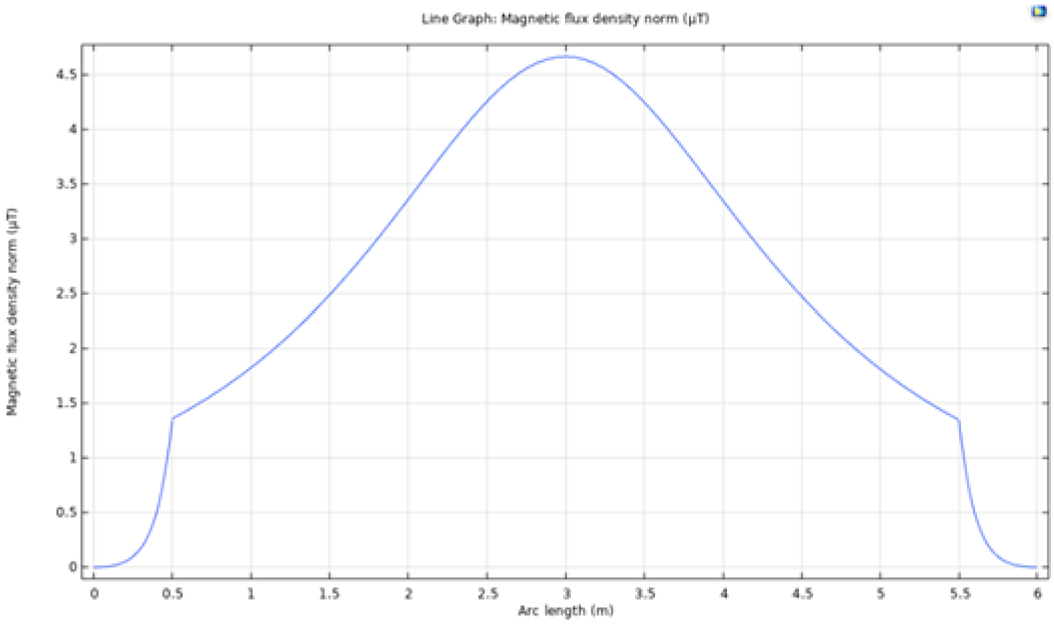

Plate 2-34 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1586. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

1587. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1588. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

1589. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. It is therefore concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.20.2.3 Temporary increase in SSC and contaminated sediments

1590. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

1591. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1592. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1593. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.20.2.3.1 Dredging and dredge disposal

1594. 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).

1595. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1596. 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.

2.20.2.3.2 Trenching

1597. 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.

1598. Based upon the representative scenario, the modelled 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.

1599. 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.

1600. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1601. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

1602. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.20.2.4 Direct impacts on habitats

1603. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small ex situ ex situ area of offshore habitat that may be used during the marine phase of this species life cycle only.

1604. Within the offshore development area, up to approximately 11,931,840 m² of habitat will be disturbed by construction related activities with up to 157,000 m² potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m². However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1605. For longer term loss within the array site, approximately 0.49 km² of currently available habitat will be lost by operation related activities, with 0.11 km² potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km². It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1606. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

1607. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Therefore, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.20.2.5 Presence of structures and predator aggregation

1608. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1609. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1610. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected

that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1611. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1612. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.20.3 Atlantic salmon [1106][37]

1613. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0+ fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.20.3.1 Increase in underwater noise and vibration

1614. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1615. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and

[37] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1616. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1617. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[38], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1618. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1619. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.20.3.1.1 Mortality

1620. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1621. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1622. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood

[38] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.20.3.1.2 Recoverable injury

1623. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1624. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.20.3.1.3 Temporary threshold shift and behavioural responses

1625. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1626. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1627. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1628. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1629. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are

predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.20.3.1.4 Conclusions relating to underwater noise impacts

1630. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1631. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.20.3.2 Presence of EMF

1632. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1633. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1634. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1635. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-35**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-36**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-37**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-35, Plate 2-36, Plate 2-37**).

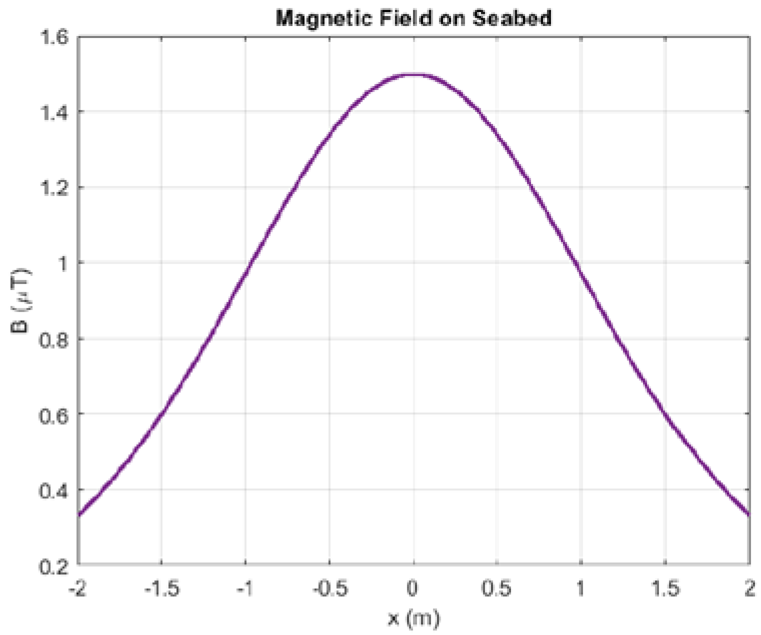

Plate 2-35 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

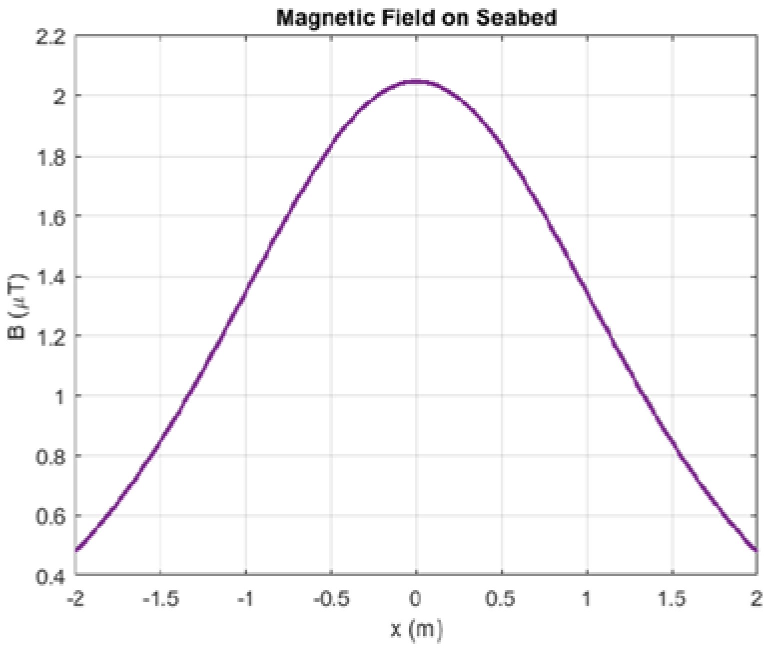

Plate 2-36 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

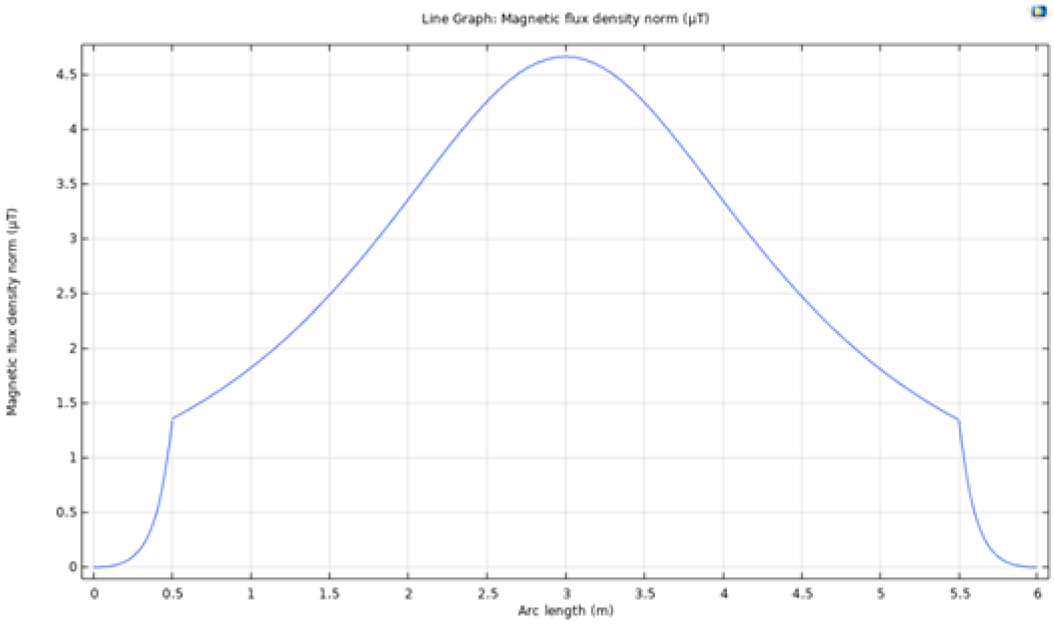

Plate 2-37 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1636. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1637. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1638. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1639. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.20.3.3 Temporary increase in SSC and contaminated sediments

1640. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1641. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1642. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1643. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.20.3.3.1 Dredging and dredge disposal

1644. 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).

1645. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1646. 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.

2.20.3.3.2 Trenching

1647. 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.

1648. Based upon the representative scenario, the modelled 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.

1649. 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.

1650. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1651. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[39]). This is considerably higher than the predicted levels of

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[39]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1652. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.20.3.4 Direct impacts on habitats

1653. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small ex situ ex situ area of offshore habitat that may be used during the marine phase of this species life cycle only.

1654. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1655. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1656. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1657. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.20.3.5 Presence of structures and predator aggregation

1658. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1659. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1660. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1661. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1662. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.21 Blackwater River (Cork / Waterford) SAC (IE0002170)

1663. This SAC is 204 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Atlantic salmon.

Table 2-42 Conservation Objectives, Attributes and Targets for Blackwater River (Cork / Waterford) SAC and summary of associated assessment (NPWS, 2012a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and therefore no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.1**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Availability of juvenile habitat. More than 50% of sample sites positive. See map 10 for recorded locations	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution. Access to all water courses down to first order streams	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m^2	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Extent and distribution of spawning habitat. No	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
decline in extent and distribution of spawning beds.				being met, and no adverse effect on site integrity predicted from the project alone.
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1103] Twaite shad (*Alosa fallax*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Population structure: age classes. More than one age class present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.21.2**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning habitats	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Water quality: oxygen levels. No lower than 5 mg/l	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Spawning habitat quality: Filamentous algae; macrophytes; sediment. Maintain stable gravel substrate with very little fine material, free of filamentous algal (macroalgae) growth and macrophyte (rooted higher plant) growth	No impact on freshwater spawning habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1106] Atlantic salmon (*Salmo salar*) (only in fresh water)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
				integrity predicted from the project alone.
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.21.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

2.21.1 Sea lamprey [1095] and River lamprey [1099]

1664. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

1665. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey.

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m².

1666. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m².

2.21.1.1 Increase in underwater noise and vibration

1667. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1668. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1669. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1670. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[40], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1671. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.21.1.1.1 Mortality

1672. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1673. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1674. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.21.1.1.2 Recoverable injury

1675. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1676. Recoverable injury in proximity to the Liffey piling operations 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

[40] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.21.1.1.3 Temporary threshold shift and behavioural responses

1677. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1678. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1679. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1680. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1681. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.21.1.1.4 Conclusions relating to underwater noise impacts

1682. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project, therefore in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1683. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.21.1.2 Presence of EMF

1684. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1685. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1686. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1687. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-38**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-39**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-40**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-38, Plate 2-39, Plate 2-40**).

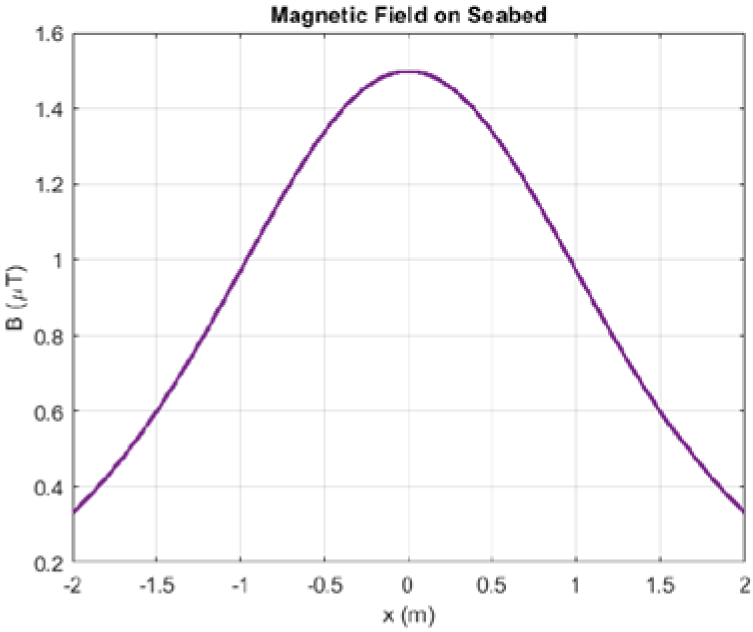

Plate 2-38 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

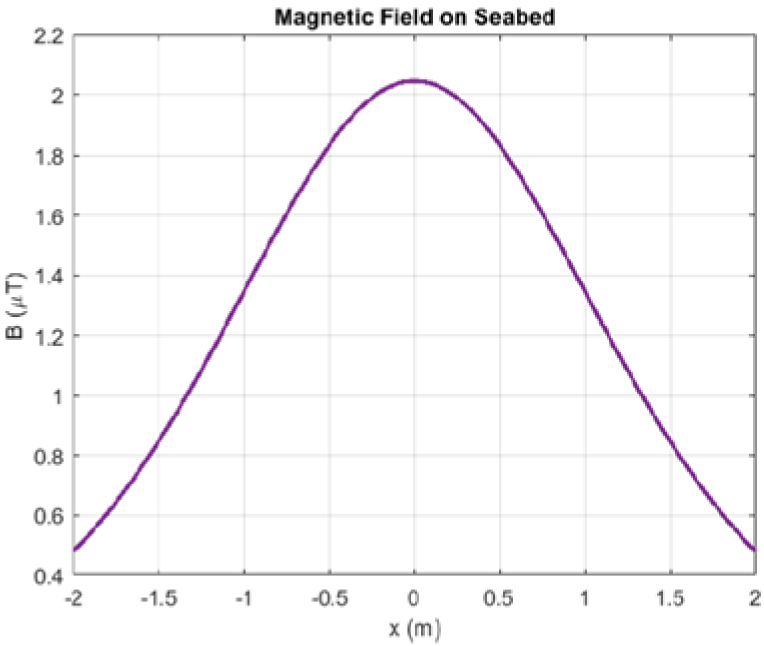

Plate 2-39 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

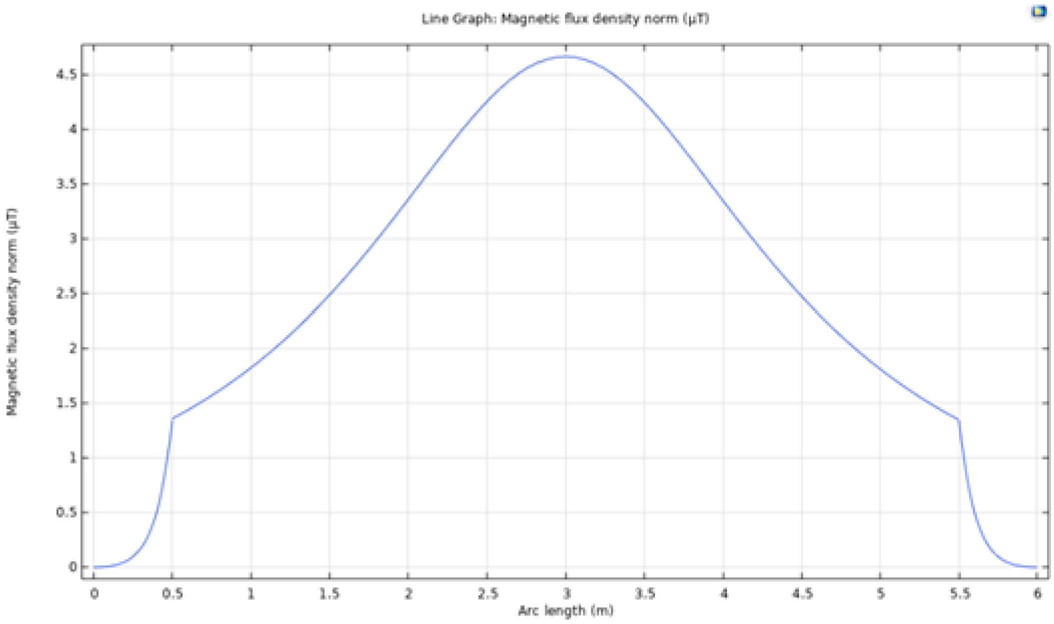

Plate 2-40 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1688. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1689. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1690. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1691. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.21.1.3 Temporary increase in SSC and contaminated sediments

1692. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1693. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1694. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1695. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.21.1.3.1 Dredging and dredge disposal

1696. 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).

1697. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1698. 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.

2.21.1.3.2 Trenching

1699. 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.

1700. Based upon the representative scenario, the modelled 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.

1701. 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.

1702. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1703. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1704. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.21.1.4 Direct impacts on habitats

1705. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1706. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1707. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1708. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1709. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.21.1.5 Presence of structures and predator aggregation

1710. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1711. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1712. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1713. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1714. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.21.2 Twaite shad [1103]

1715. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Population structure: age classes. More than one age class present.

2.21.2.1 Increase in underwater noise and vibration

1716. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

1717. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area.

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1718. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1719. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[41], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1720. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

1721. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.21.2.1.1 Mortality

1722. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

1723. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

1724. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.21.2.1.2 Recoverable injury

1725. Recoverable injury effects 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

[41]https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

1726. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.21.2.1.3 Temporary threshold shift and behavioural responses

1727. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

1728. 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 more realistic fleeing model is used.

1729. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1730. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1731. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.21.2.1.4 Conclusions relating to underwater noise impacts

1732. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

1733. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.21.2.2 Presence of EMF

1734. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1735. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1736. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1737. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-41**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-42**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-43**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-41, Plate 2-42, Plate 2-43**).

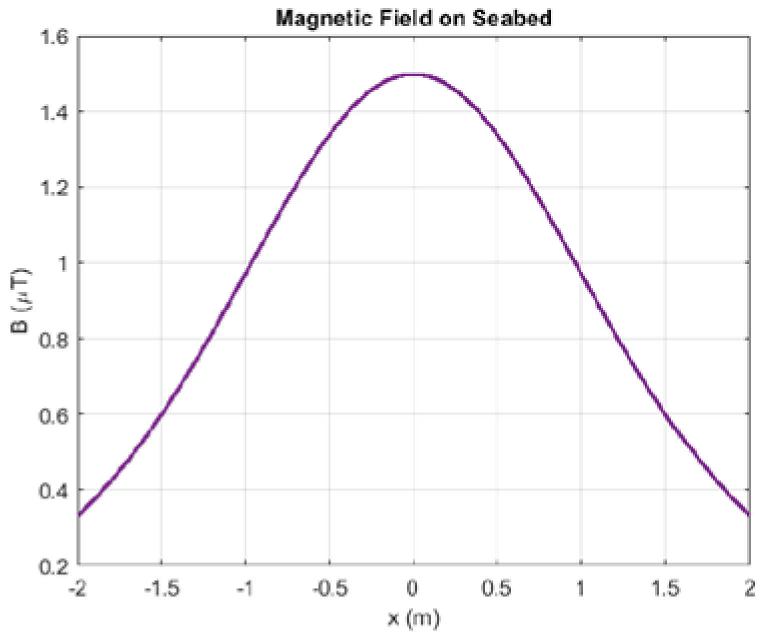

Plate 2-41 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

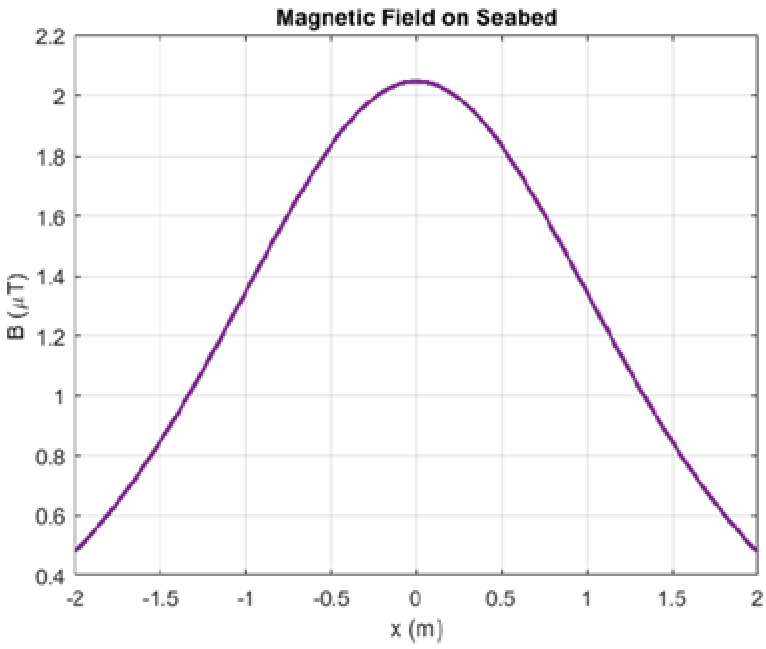

Plate 2-42 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

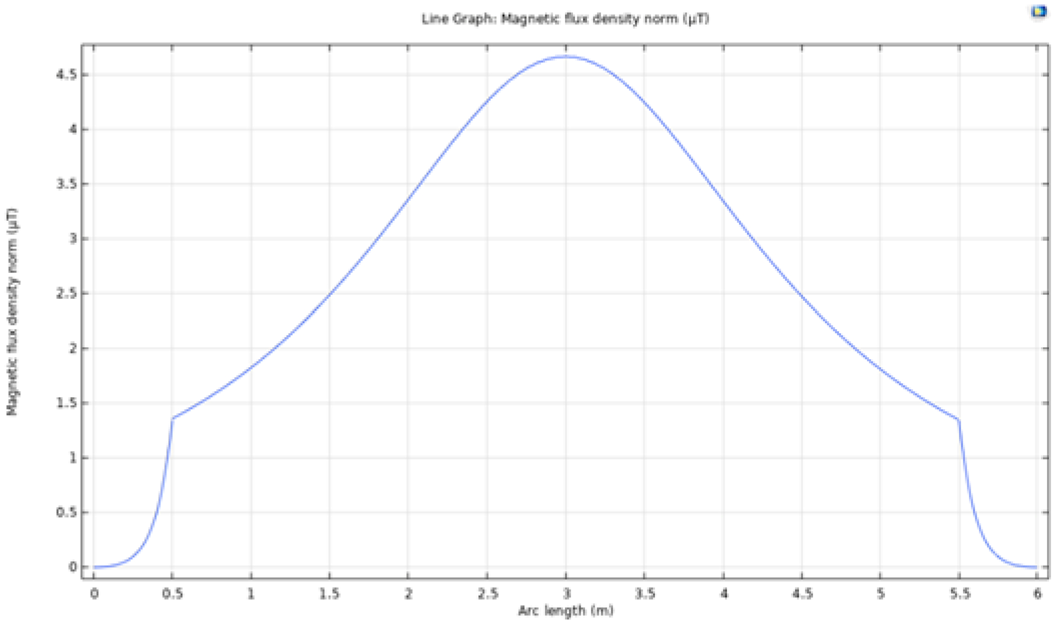

Plate 2-43 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1738. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

1739. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1740. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

1741. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.21.2.3 Temporary increase in SSC and contaminated sediments

1742. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

1743. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1744. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1745. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.21.2.3.1 Dredging and dredge disposal

1746. 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).

1747. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1748. 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.

2.21.2.3.2 Trenching

1749. 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.

1750. Based upon the representative scenario, the modelled 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.

1751. 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.

1752. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1753. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

1754. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.21.2.4 Direct impacts on habitats

1755. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1756. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1757. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1758. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

1759. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.21.2.5 Presence of structures and predator aggregation

1760. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1761. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1762. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected

that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1763. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1764. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.21.3 Atlantic salmon [1106][42]

1765. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI.

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry / 5 min sampling; and
- Out-migrating smolt abundance. No significant decline.

2.21.3.1 Increase in underwater noise and vibration

1766. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1767. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;

[42] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1768. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1769. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[43], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1770. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1771. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.21.3.1.1 Mortality

1772. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1773. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1774. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood

[43] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.21.3.1.2 Recoverable injury

1775. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1776. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.21.3.1.3 Temporary threshold shift and behavioural responses

1777. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1778. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1779. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1780. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1781. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are

predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.21.3.1.4 Conclusions relating to underwater noise impacts

1782. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1783. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.21.3.2 Presence of EMF

1784. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1785. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1786. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1787. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-44**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-45**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-46**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-44, Plate 2-45**).

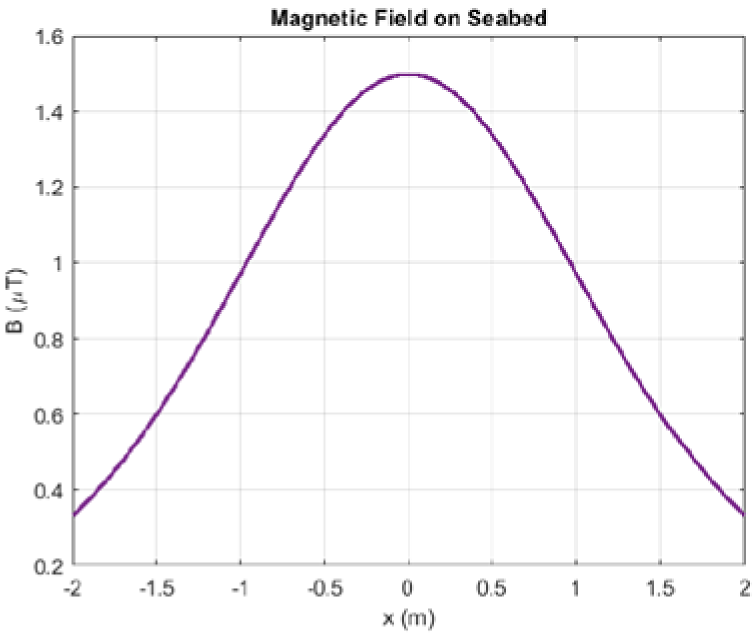

Plate 2-44 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

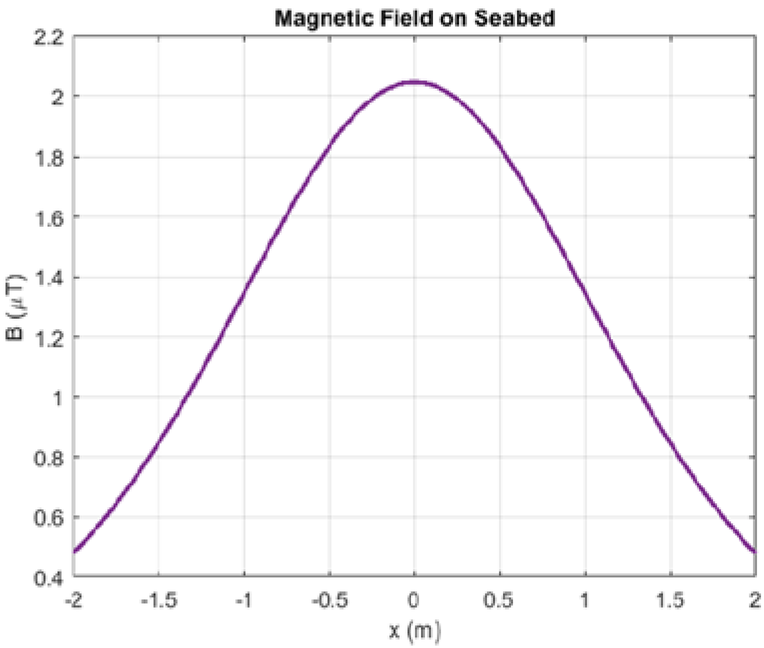

Plate 2-45 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

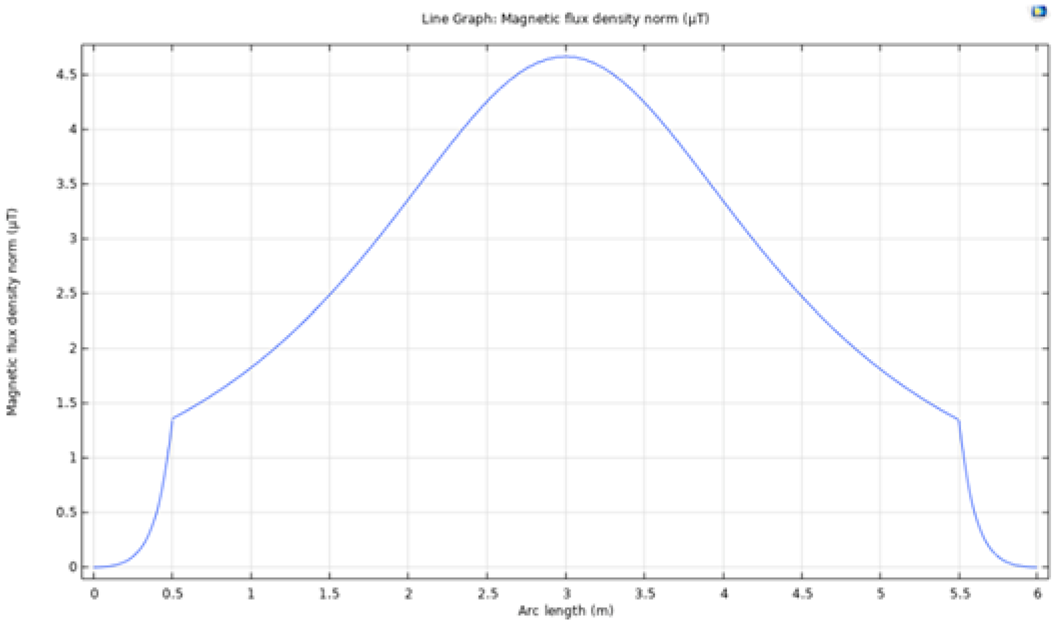

Plate 2-46 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1788. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1789. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1790. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1791. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.21.3.3 Temporary increase in SSC and contaminated sediments

1792. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 **(Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1793. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1794. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1795. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.21.3.3.1 Dredging and dredge disposal

1796. 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).

1797. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1798. 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.

2.21.3.3.2 Trenching

1799. 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.

1800. Based upon the representative scenario, the modelled 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.

1801. 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.

1802. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1803. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[44]). This is considerably higher than the predicted levels of

[44]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1804. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.21.3.4 Direct impacts on habitats

1805. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1806. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1807. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1808. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1809. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. It is therefore considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.21.3.5 Presence of structures and predator aggregation

1810. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1811. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1812. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1813. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1814. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.22 River Boyne and River Blackwater SAC (IE0002299)

1815. This SAC is 56 km from the offshore development area and is screened in for River lamprey and Atlantic salmon.

Table 2-43 Conservation Objectives, Attributes and Targets for River Boyne and River Blackwater SAC and summary of associated assessment (NPWS, 2012a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution. Restore access to all water courses down to first order streams	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Distribution of larvae. Not less than 50% of sample sites with suitable habitat positive for larval brook / river lamprey	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of larvae. At least three age / size classes of larval brook / river lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.22.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Larval lamprey density in fine sediment. Mean density of brook / river larval lamprey in sites with suitable habitat more than 5 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.22.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning nursery habitat. No decline in extent and distribution of spawning and nursery beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation limit (CL)	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
for each system consistently exceeded	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.22.2**			site integrity predicted from the project alone
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.22.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.22.2**			
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.22.1 River lamprey [1099]

1816. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of larvae. At least three age / size classes of larval brook / river lamprey present; and
- Larval lamprey density in fine sediment. Mean density of brook / river larval lamprey in sites with suitable habitat more than 5 / m^2.

2.22.1.1 Increase in underwater noise and vibration

1817. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1818. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area.

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1819. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1820. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[45], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into

[45] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1821. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.22.1.1.1 Mortality

1822. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1823. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1824. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.22.1.1.2 Recoverable injury

1825. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1826. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.22.1.1.3 Temporary threshold shift and behavioural responses

1827. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1828. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1829. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1830. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1831. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.22.1.1.4 Conclusions relating to underwater noise impacts

1832. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1833. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.22.1.2 Presence of EMF

1834. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1835. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1836. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1837. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-47**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-48**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-49**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-47, Plate 2-48**).

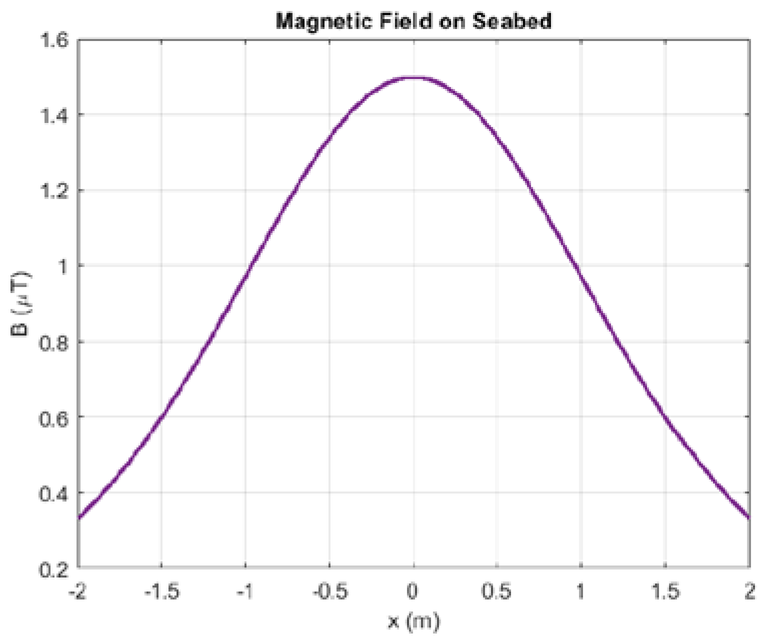

Plate 2-47 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

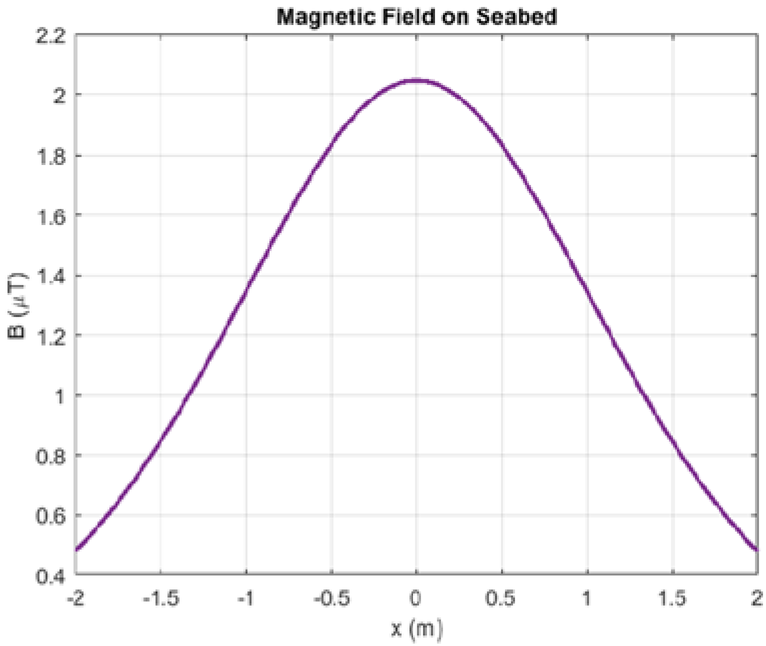

Plate 2-48 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

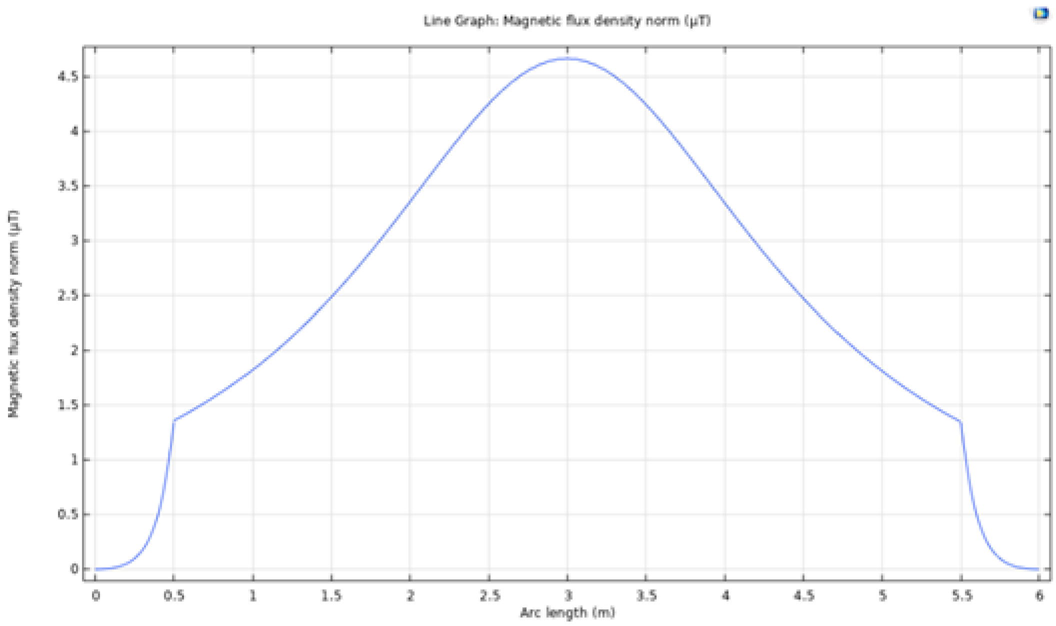

Plate 2-49 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1838. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1839. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1840. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1841. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF and heat emissions.

2.22.1.3 Temporary increase in SSC and contaminated sediments

1842. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1843. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1844. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1845. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.22.1.3.1 Dredging and dredge disposal

1846. 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).

1847. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1848. 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.

2.22.1.3.2 Trenching

1849. 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.

1850. Based upon the representative scenario, the modelled 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.

1851. 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.

1852. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1853. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1854. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.22.1.4 Direct impacts on habitats

1855. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1856. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1857. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1858. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1859. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea,

and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.22.1.5 Presence of structures and predator aggregation

1860. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1861. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1862. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1863. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1864. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.22.2 Atlantic salmon [1106]

1865. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.22.2.1 Increase in underwater noise and vibration

1866. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1867. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1868. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1869. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[46], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1870. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1871. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

[46] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.22.2.1.1 Mortality

1872. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1873. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1874. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.22.2.1.2 Recoverable injury

1875. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1876. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.22.2.1.3 Temporary threshold shift and behavioural responses

1877. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1878. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1879. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1880. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1881. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160 - 170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.22.2.1.4 Conclusions relating to underwater noise impacts

1882. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1883. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.22.2.2 Presence of EMF

1884. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric

fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1885. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1886. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1887. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-50**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-51**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-52**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-50, Plate 2-51**).

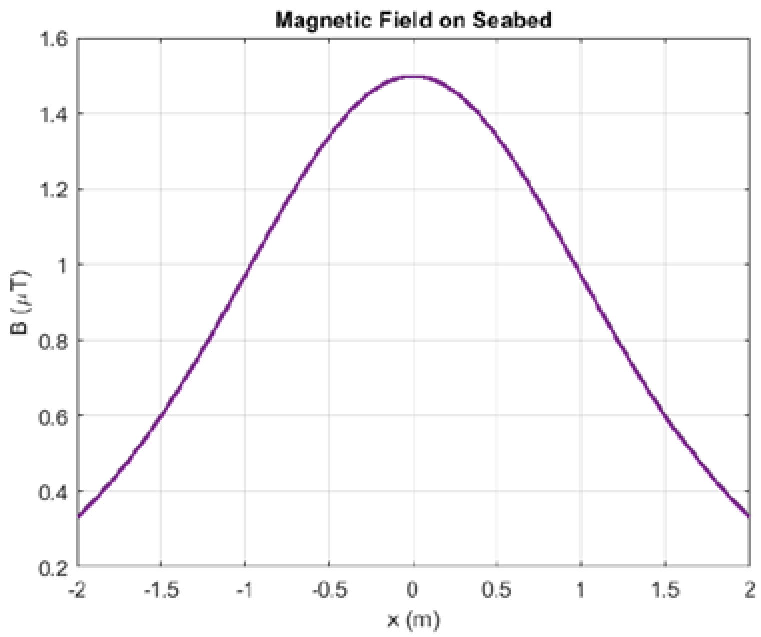

Plate 2-50 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

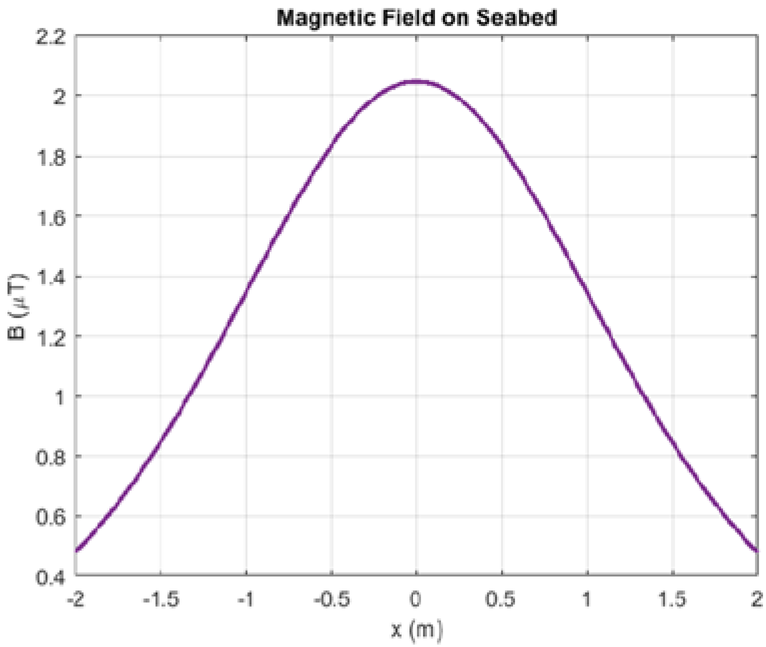

Plate 2-51 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

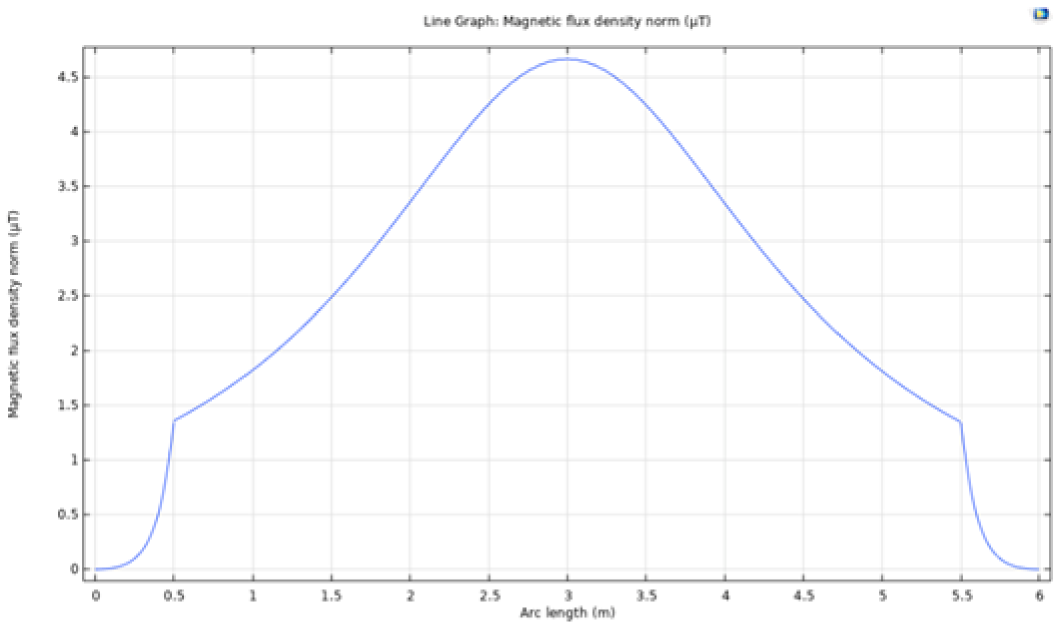

Plate 2-52 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1888. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1889. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1890. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1891. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.22.2.3 Temporary increase in SSC and contaminated sediments

1892. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1893. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1894. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1895. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.22.2.3.1 Dredging and dredge disposal

1896. 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).

1897. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1898. 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.

2.22.2.3.2 Trenching

1899. 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.

1900. Based upon the representative scenario, the modelled 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.

1901. 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.

1902. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1903. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[47]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1904. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.22.2.4 Direct impacts on habitats

1905. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1906. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the

[47]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1907. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1908. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

1909. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.22.2.5 Presence of structures and predator aggregation

1910. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1911. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1912. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1913. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1914. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.23 Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC (IE0000627)

1915. This SAC is 501 km from the offshore development area and is screened in for Sea lamprey and River lamprey. However, the Conservation Objectives for this site are such that there can be no impediment to any Conservation Objective or target from the proposed works as there will be no impact on any riverine habitat, and thus it can be concluded beyond scientific doubt that there will be no adverse effects on site integrity.

Table 2-44 Conservation Objectives, Attributes and Targets for Cummeen Strand / Drumcliff Bay (Sligo Bay) SAC and associated assessment (NPWS, 2024)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. No barriers for migratory life stages of lamprey moving from freshwater to marine habitats and vice versa	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution: extent of anadromy. No barriers for migratory life stages of lamprey moving from freshwater to marine habitats and vice versa	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.24 Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC (IE0000365)

1916. This SAC is 413 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-45 Conservation Objectives, Attributes and Targets for Kilarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC and summary of associated assessment (NPWS, 2017b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.1**			on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 10% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution. Access to all water courses down to first order streams	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
				predicted from the project alone
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Juvenile density in fine sediment. Mean catchment juvenile density of river / brook lamprey at least 5 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.24.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.24.2**			
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

codling wind park

2.24.1 Sea lamprey [1095] and River lamprey [1099]

1917. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

1918. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m².

1919. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of river / brook lamprey at least 5 / m².

2.24.1.1 Increase in underwater noise and vibration

1920. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1921. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1922. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1923. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[48], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1924. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.24.1.1.1 Mortality

1925. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

1926. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

1927. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.24.1.1.2 Recoverable injury

1928. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

1929. Recoverable injury in proximity to the Liffey piling operations 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

[48] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.24.1.1.3 Temporary threshold shift and behavioural responses

1930. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1931. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1932. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1933. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1934. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.24.1.1.4 Conclusions relating to underwater noise impacts

1935. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1936. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.24.1.2 Presence of EMF

1937. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1938. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1939. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1940. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-53**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-54**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-55**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-53, Plate 2-54**).

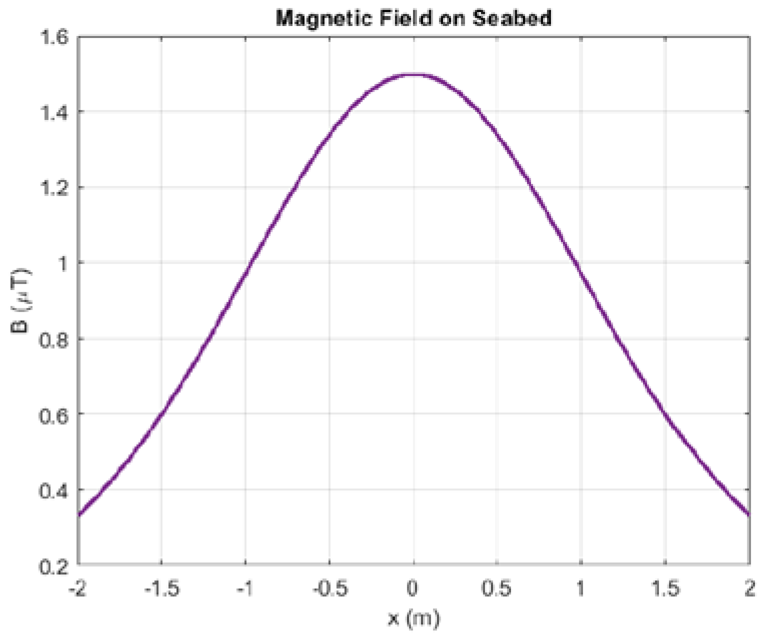

Plate 2-53 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

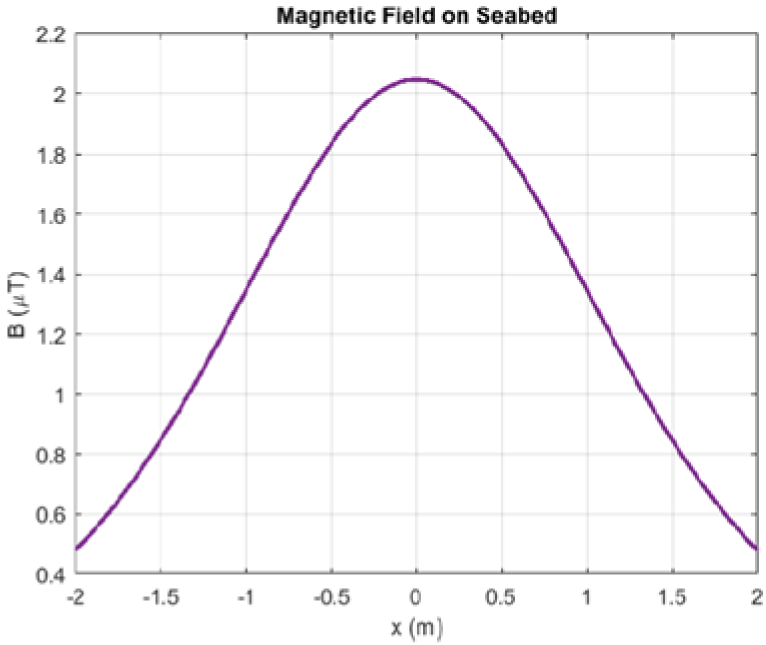

Plate 2-54 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

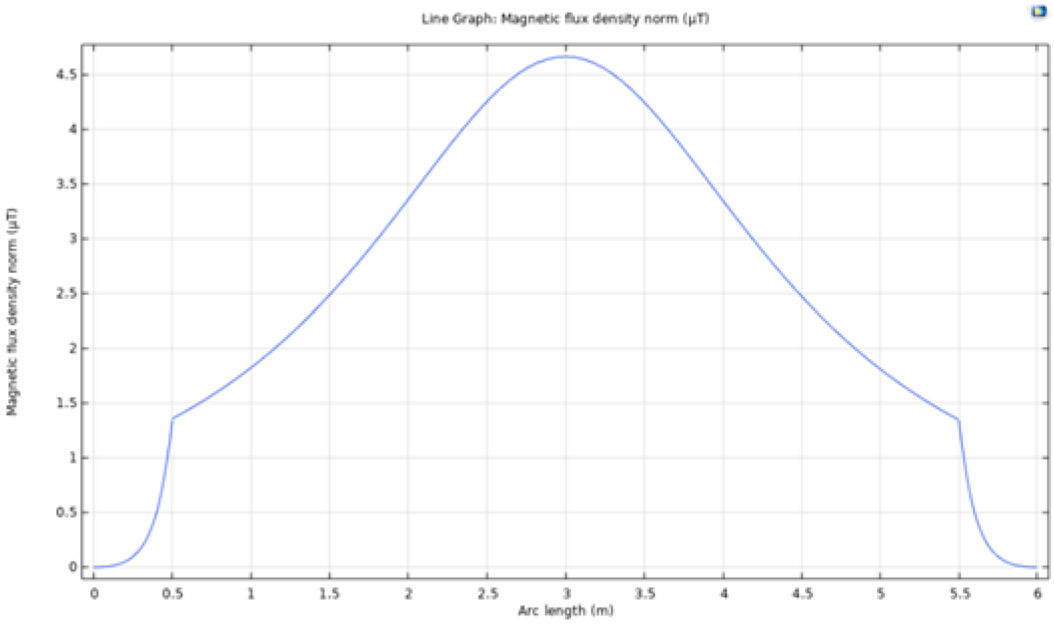

Plate 2-55 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1941. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

1942. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1943. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1944. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.24.1.3 Temporary increase in SSC and contaminated sediments

1945. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in suspended sediment concentration (SSC). Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1946. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1947. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

1948. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.24.1.3.1 Dredging and dredge disposal

1949. 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).

1950. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

1951. 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.

2.24.1.3.2 Trenching

1952. 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.

1953. Based upon the representative scenario, the modelled 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.

1954. 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.

1955. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

1956. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

1957. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.24.1.4 Direct impacts on habitats

1958. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

1959. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

1960. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

1961. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

1962. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.24.1.5 Presence of structures and predator aggregation

1963. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

1964. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

1965. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

1966. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

1967. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.24.2 Atlantic salmon [1106][49]

1968. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI.

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.24.2.1 Increase in underwater noise and vibration

1969. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

1970. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and

[49] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

- Other construction activities such as cable installation or seabed preparation, including vessel activity.

1971. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

1972. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[50], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

1973. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

1974. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.24.2.1.1 Mortality

1975. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

1976. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

1977. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood

[50] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.24.2.1.2 Recoverable injury

1978. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

1979. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.24.2.1.3 Temporary threshold shift and behavioural responses

1980. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

1981. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

1982. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

1983. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

1984. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are

predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.24.2.1.4 Conclusions relating to underwater noise impacts

1985. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

1986. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.24.2.2 Presence of EMF

1987. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

1988. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

1989. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

1990. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-56**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-57**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-58**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-56, Plate 2-57**).

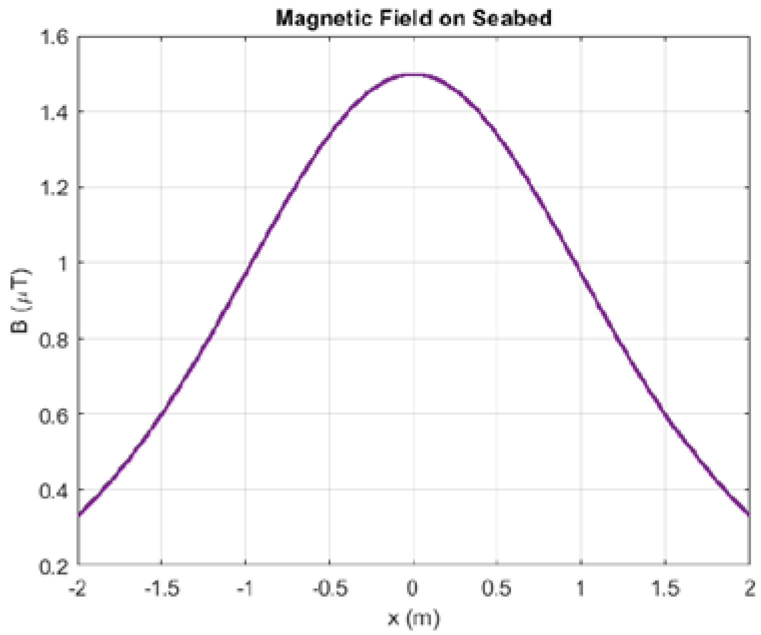

Plate 2-56 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

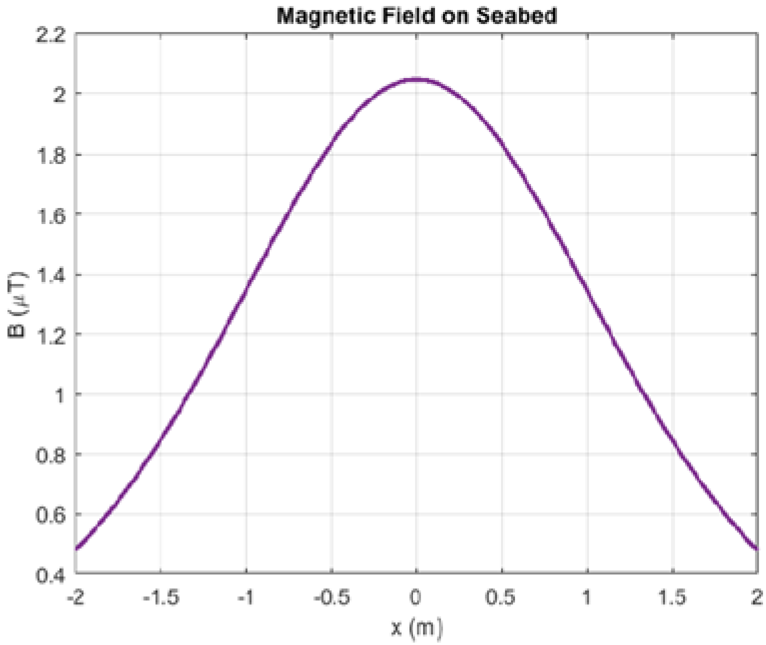

Plate 2-57 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

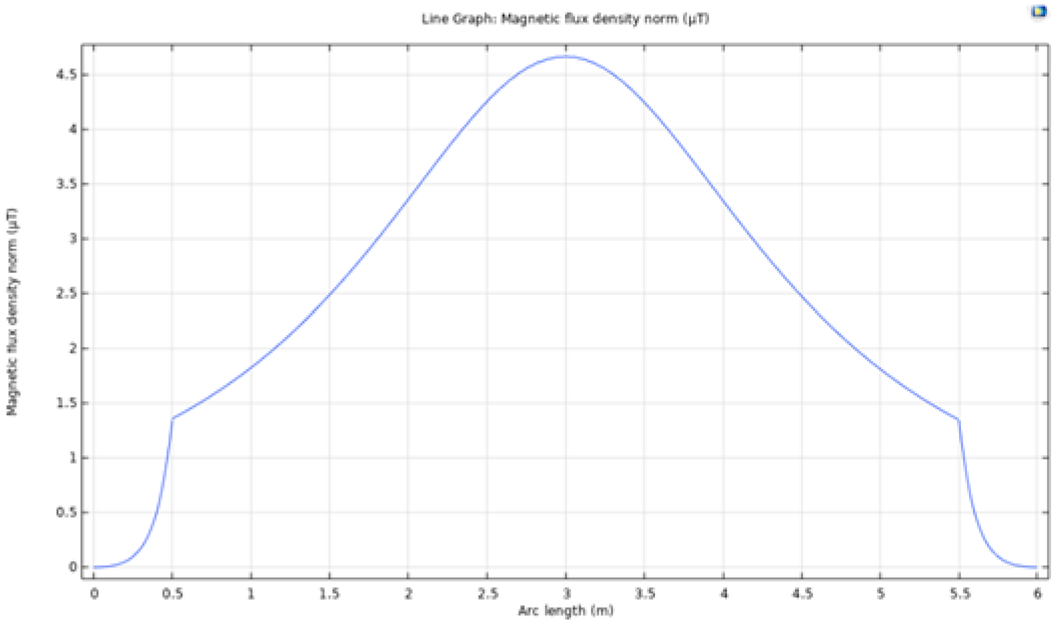

Plate 2-58 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

1991. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

1992. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

1993. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

1994. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.24.2.3 Temporary increase in SSC and contaminated sediments

1995. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in suspended sediment concentration (SSC). Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

1996. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

1997. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

1998. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.24.2.3.1 Dredging and dredge disposal

1999. 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).

2000. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2001. 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.

2.24.2.3.2 Trenching

2002. 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.

2003. Based upon the representative scenario, the modelled 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.

2004. 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.

2005. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2006. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[51]). This is considerably higher than the predicted levels of

[51]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2007. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.24.2.4 Direct impacts on habitats

2008. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2009. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2010. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2011. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2012. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.24.2.5 Presence of structures and predator aggregation

2013. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2014. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2015. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2016. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2017. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.25 Killala Bay / Moy Estuary SAC (IE0000458)

2018. This SAC is 508 km from the offshore development area and is screened in for Sea lamprey.

Table 2-46 Conservation Objectives, Attributes and Targets for Kilala Bay / Moy Estuary SAC and summary of associated assessment (NPWS, 2012b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. No barriers for migratory life stages of lamprey moving from freshwater to marine habitats and vice versa	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.25.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.25.1**			

2.25.1 Sea lamprey [1095]

2019. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m^2.

2.25.1.1 Increase in underwater noise and vibration

2020. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2021. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2022. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2023. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[52], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

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[52] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2024. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.25.1.1.1 Mortality

2025. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2026. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2027. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.25.1.1.2 Recoverable injury

2028. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2029. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.25.1.1.3 Temporary threshold shift and behavioural responses

2030. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2031. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2032. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2033. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2034. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.25.1.1.4 Conclusions relating to underwater noise impacts

2035. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project, therefore in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2036. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.25.1.2 Presence of EMF

2037. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2038. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2039. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2040. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-59**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-60**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-61**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-59, Plate 2-60**).

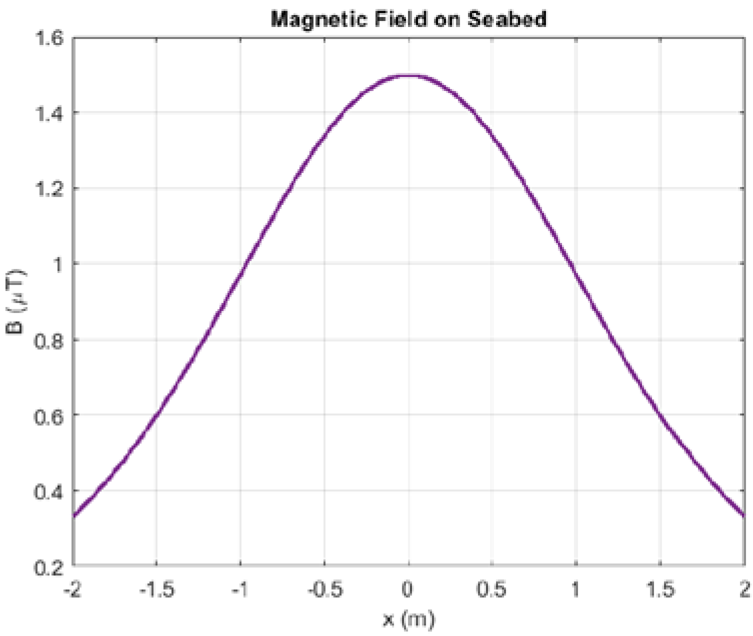

Plate 2-59 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

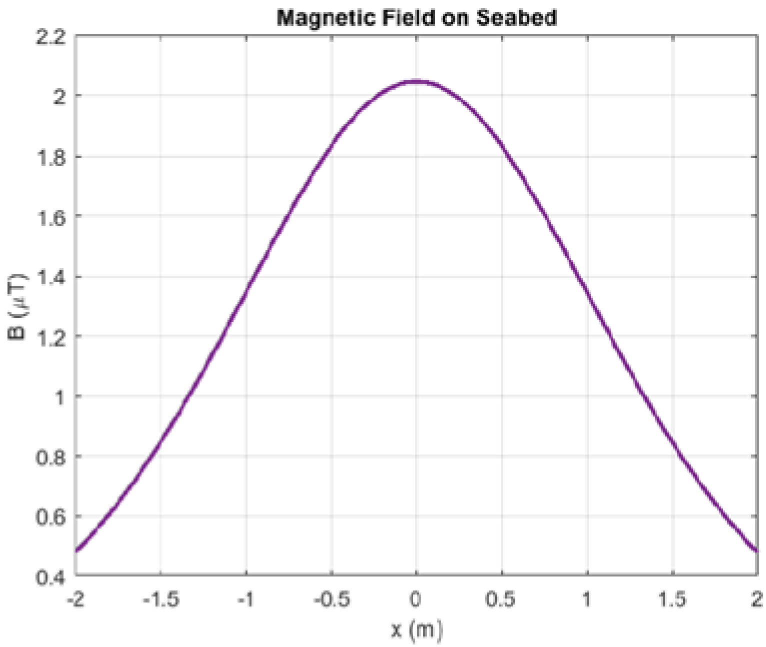

Plate 2-60 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

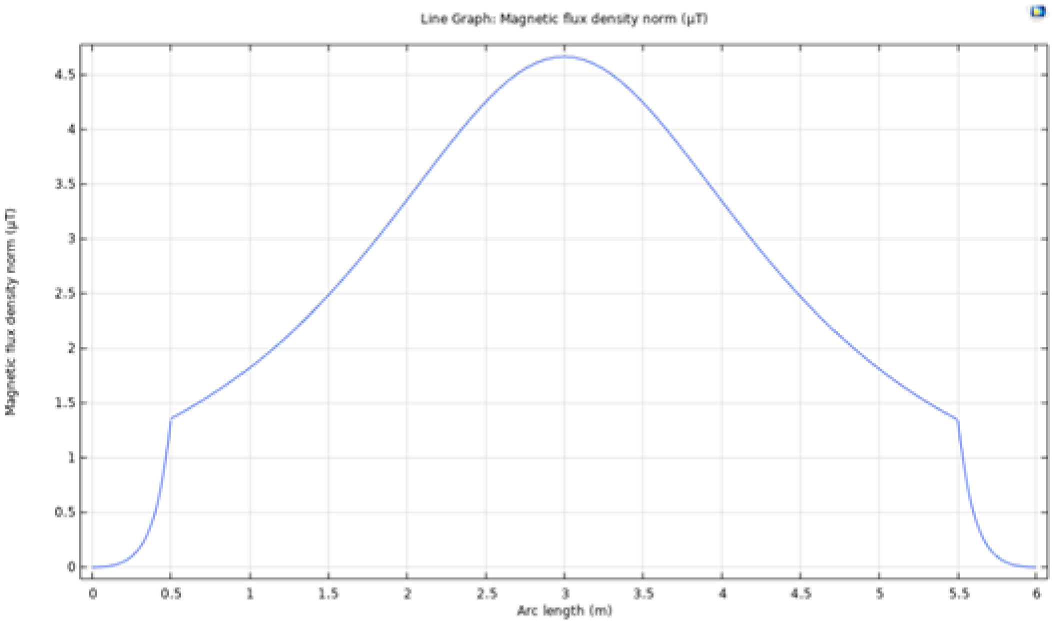

Plate 2-61 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2041. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2042. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2043. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2044. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.25.1.3 Temporary increase in SSC and contaminated sediments

2045. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2046. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2047. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2048. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.25.1.3.1 Dredging and dredge disposal

2049. 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).

2050. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2051. 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.

2.25.1.3.2 Trenching

2052. 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.

2053. Based upon the representative scenario, the modelled 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.

2054. 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.

2055. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2056. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2057. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.25.1.4 Direct impacts on habitats

2058. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2059. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2060. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2061. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2062. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea,

and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.25.1.5 Presence of structures and predator aggregation

2063. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2064. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2065. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2066. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2067. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.26 Lough Gill SAC (IE0001976)

2068. This SAC is 500 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-47 Conservation Objectives, Attributes and Targets for Lough Gill SAC and summary of associated assessment (NPWS, 2021b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Annual run size. Annual run size should reflect that expected under near-natural conditions	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Larval lamprey in fine sediment. Larval lamprey present in SAC catchment	Increase in underwater noise and vibration	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.1**			site integrity predicted from the project alone
Extent and distribution of spawning and nursery habitat. No decline in extent and distribution of spawning and nursery beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				
Distribution. Access to all water courses down to first order streams	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Distribution in suitable habitat. Not less than 50% of sample	No impact on river morphology, and as	None required	N/A	No impediment to the Conservation Objective being

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
sites with suitable habitat positive for larval brook / river lamprey	such no impact on this attribute and target			met, and no adverse effect on site integrity predicted from the project alone
Population structure of larvae. At least three age / size classes of larval brook / river lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Larval lamprey density in fine sediment. Mean density of brook / river larval lamprey in sites with suitable habitat at least 5 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.1**			
Extent and distribution of spawning and nursery habitat. No decline in extent and distribution of spawning and nursery beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration	None required	N/A	No impediment to the Conservation Objective being

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.26.2**			met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.26.1 Sea lamprey [1095] and River lamprey [1099]

2069. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2070. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Annual run size. Annual run size should reflect that expected under near-natural conditions; and
- Larval lamprey in fine sediment. Larval lamprey present in SAC catchment.

2071. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of larvae. At least three age / size classes of larval brook / river lamprey present; and
- Larval lamprey density in fine sediment. Mean density of brook / river larval lamprey in sites with suitable habitat at least 5 / m².

2.26.1.1 Increase in underwater noise and vibration

2072. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2073. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2074. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2075. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[53], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2076. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.26.1.1.1 Mortality

2077. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2078. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2079. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.26.1.1.2 Recoverable injury

2080. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2081. Recoverable injury in proximity to the Liffey piling operations 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

[53] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.26.1.1.3 Temporary threshold shift and behavioural responses

2082. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2083. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2084. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2085. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2086. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.26.1.1.4 Conclusions relating to underwater noise impacts

2087. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2088. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.26.1.2 Presence of EMF

2089. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2090. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2091. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2092. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-62**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-63**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-64**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-62, Plate 2-63**).

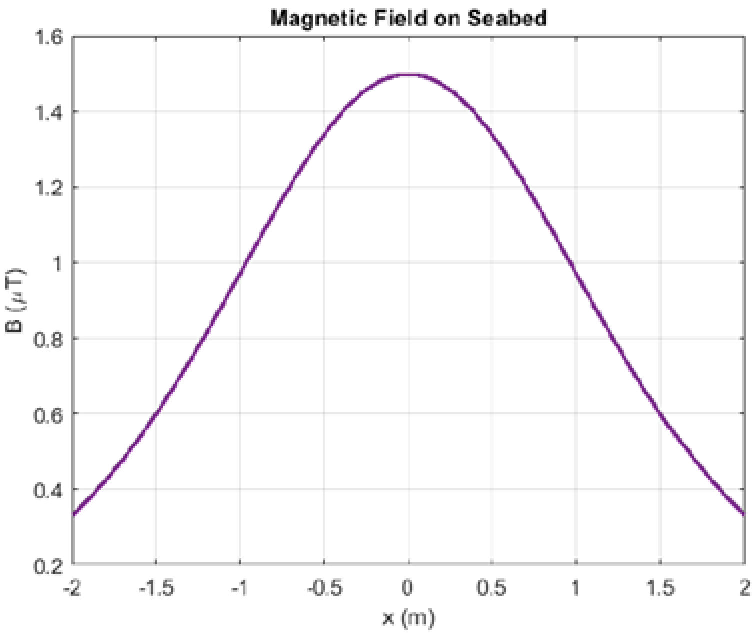

Plate 2-62 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

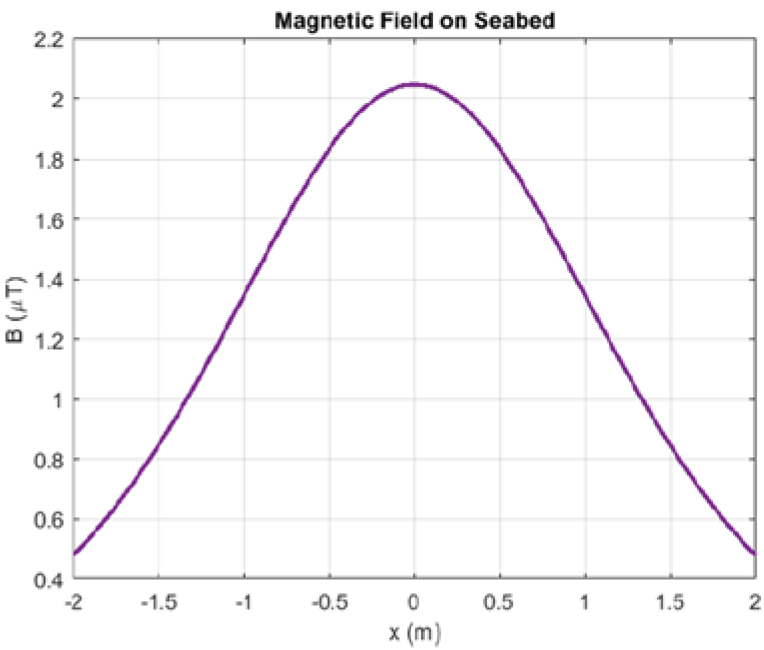

Plate 2-63 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

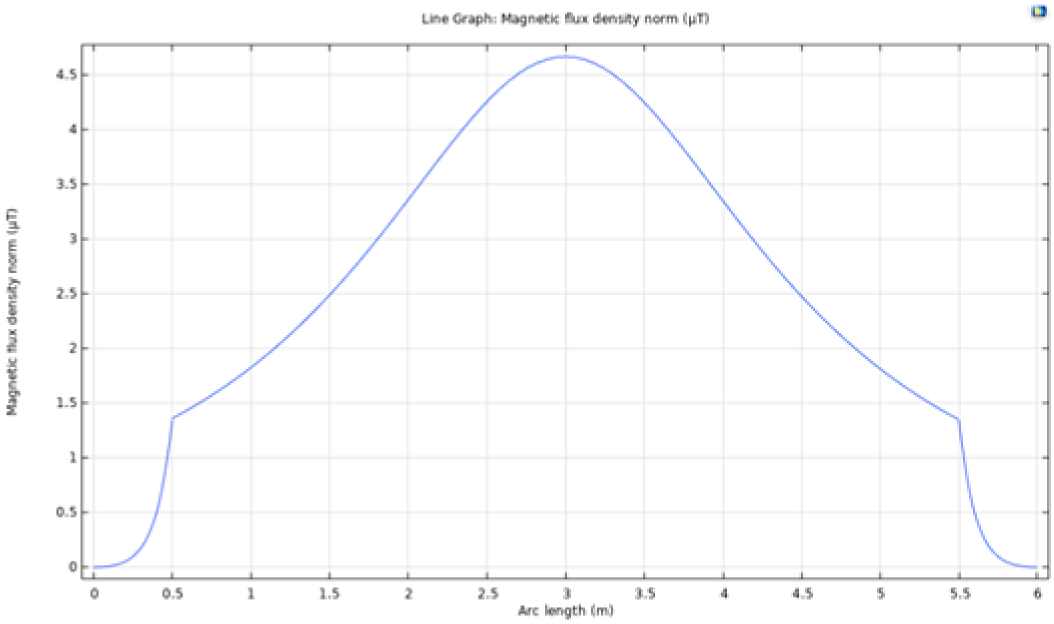

Plate 2-64 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2093. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2094. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2095. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2096. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.26.1.3 Temporary increase in SSC and contaminated sediments

2097. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in suspended sediment concentration (SSC). Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2098. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2099. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2100. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.26.1.3.1 Dredging and dredge disposal

2101. 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).

2102. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2103. 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.

2.26.1.3.2 Trenching

2104. 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.

2105. Based upon the representative scenario, the modelled 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.

2106. 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.

2107. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2108. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2109. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.26.1.4 Direct impacts on habitats

2110. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2111. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2112. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2113. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2114. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.26.1.5 Presence of structures and predator aggregation

2115. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2116. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2117. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2118. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2119. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.26.2 Atlantic salmon [1106]

2120. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.26.2.1 Increase in underwater noise and vibration

2121. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

2122. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2123. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2124. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[54], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2125. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2126. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.26.2.1.1 Mortality

2127. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

2128. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

2129. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.26.2.1.2 Recoverable injury

2130. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 m from the source for cumulative level

[54] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the more realistic fleeing model is used.

2131. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.26.2.1.3 Temporary threshold shift and behavioural responses

2132. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2133. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2134. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2135. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2136. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.26.2.1.4 *Conclusions relating to Underwater Noise Impacts*

2137. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2138. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.26.2.2 Presence of EMF

2139. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2140. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2141. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2142. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-65**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-66**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-67**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-65, Plate 2-66**).

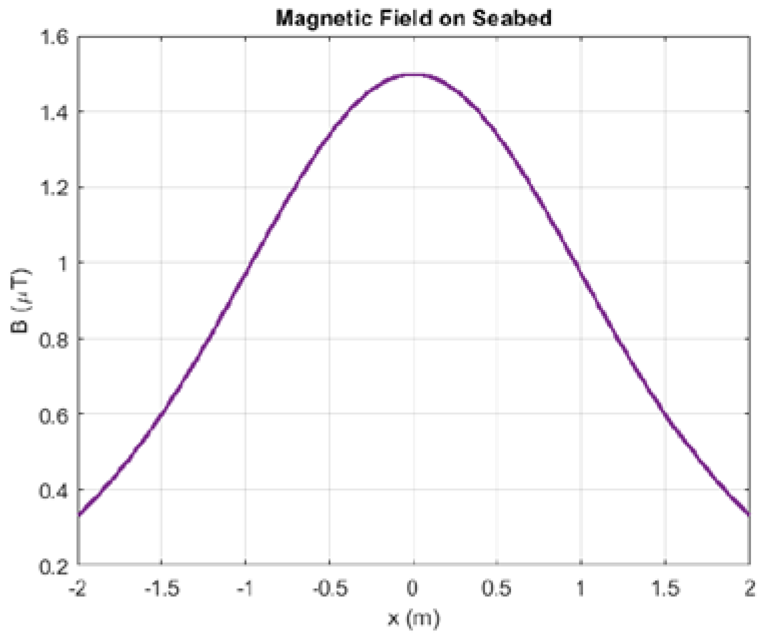

Plate 2-65 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

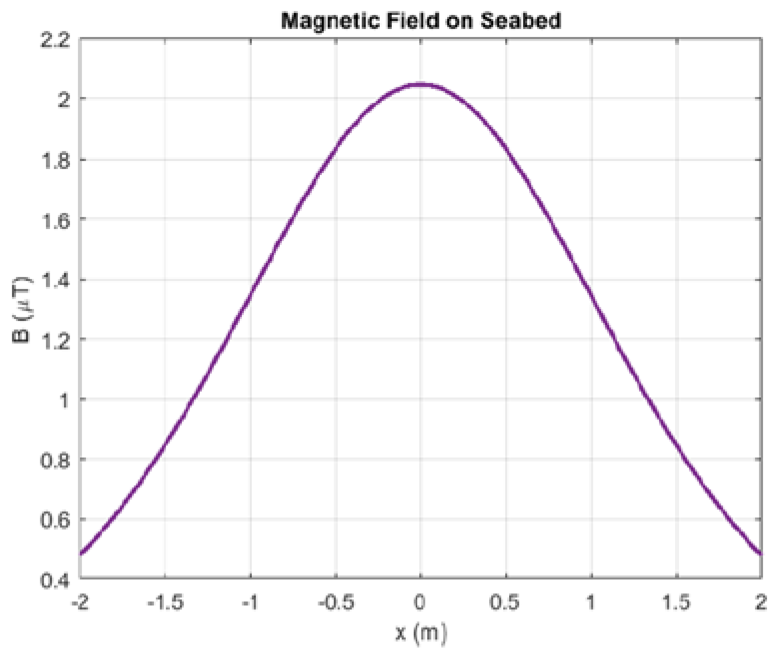

Plate 2-66 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

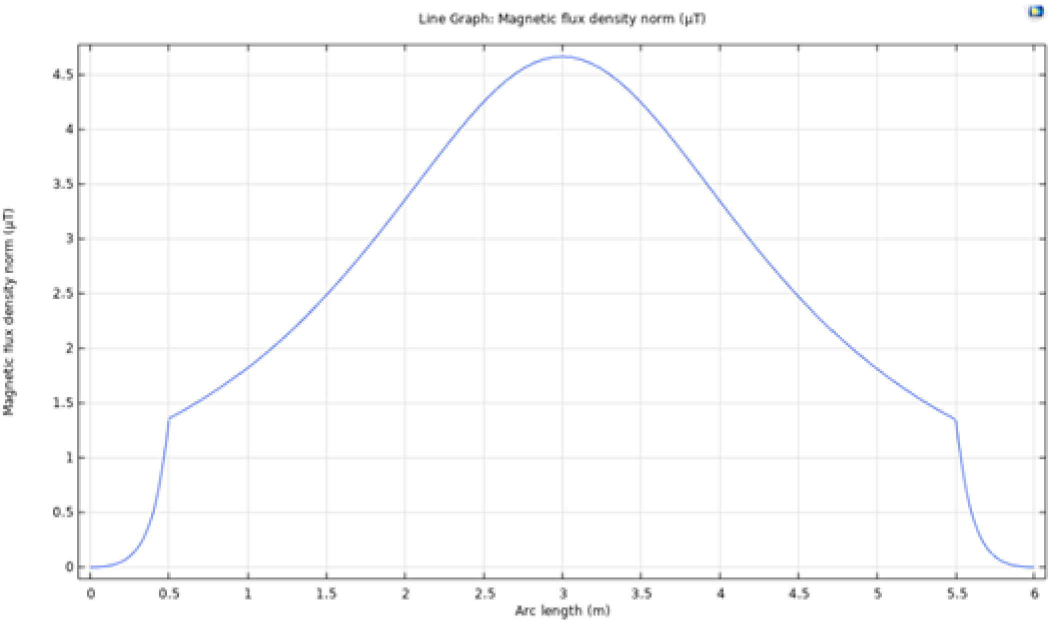

Plate 2-67 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2143. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

2144. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2145. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

2146. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.26.2.3 Temporary increase in SSC and contaminated sediments

2147. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR**).** Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2148. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2149. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

2150. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.26.2.3.1 Dredging and dredge disposal

2151. 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).

2152. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2153. 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.

2.26.2.3.2 Trenching

2154. 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.

2155. Based upon the representative scenario, the modelled 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.

2156. 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.

2157. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2158. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[55]). This is considerably higher than the predicted levels of

[55] https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2159. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.26.2.4 Direct impacts on habitats

2160. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2161. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2162. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2163. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2164. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.26.2.5 Presence of structures and predator aggregation

2165. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2166. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2167. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2168. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2169. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.27 River Moy SAC (IE0002298)

2170. This SAC is 508 km from the offshore development area and is screened in for Sea lamprey and Atlantic salmon.

Table 2-48 Conservation Objectives, Attributes and Targets for River Moy SAC and summary of associated assessment (NPWS, 2016)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Population structure of juvenile. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.27.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Juvenile density in fine sediment. Mean catchment juvenile density at least 1 / m^2	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.27.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.27.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.27.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.27.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA	No direct connectivity with the SAC and as	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	such no impact on water quality possible			site integrity predicted from the project alone

2.27.1 Sea lamprey [1095]

2171. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea Lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Mean catchment juvenile density at least 1 / m².

2.27.1.1 Increase in underwater noise and vibration

2172. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2173. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2174. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2175. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[56], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

[56] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2176. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.27.1.1.1 Mortality

2177. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2178. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2179. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.27.1.1.2 Recoverable injury

2180. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2181. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.27.1.1.3 Temporary threshold shift and behavioural responses

2182. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2183. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2184. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2185. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2186. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.27.1.1.4 Conclusions relating to underwater noise impacts

2187. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2188. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.27.1.2 Presence of EMF

2189. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2190. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2191. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2192. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-68**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-69**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-70**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-68, Plate 2-69**).

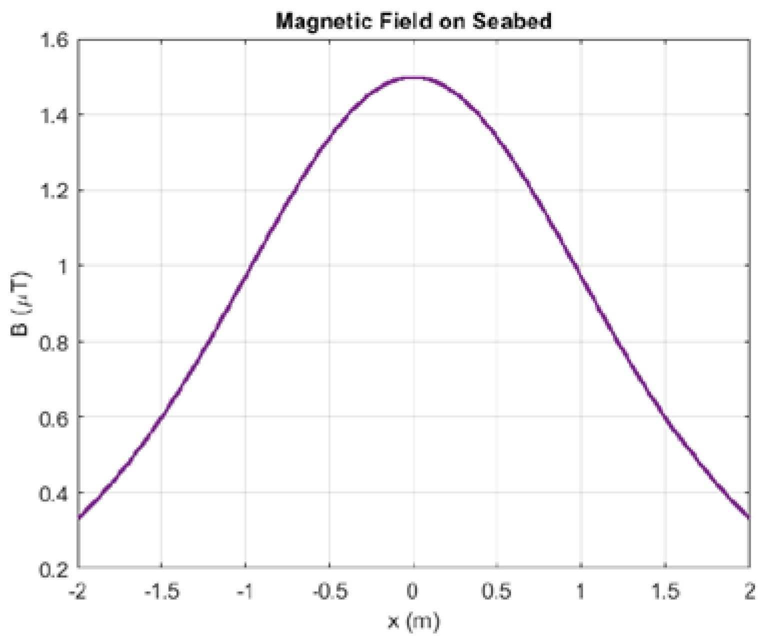

Plate 2-68 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

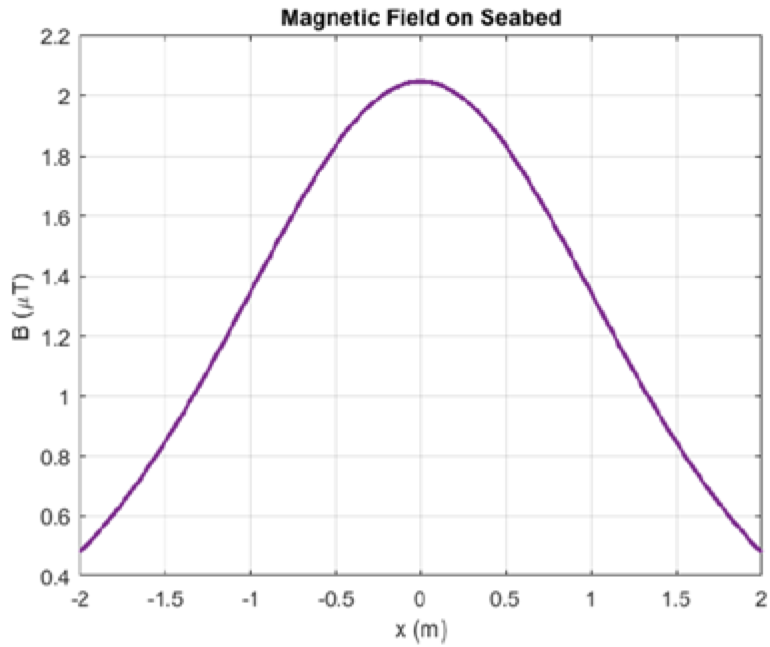

Plate 2-69 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

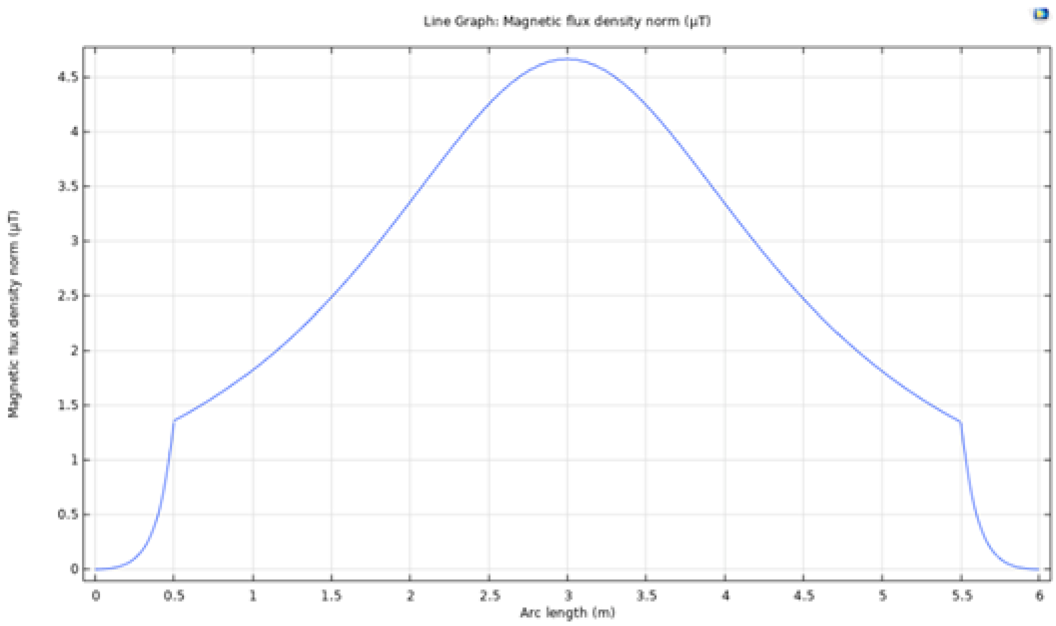

Plate 2-70 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2193. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2194. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2195. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2196. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.27.1.3 Temporary increase in SSC and contaminated sediments

2197. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2198. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2199. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2200. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.27.1.3.1 Dredging and dredge disposal

2201. 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).

2202. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2203. 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.

2.27.1.3.2 Trenching

2204. 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.

2205. Based upon the representative scenario, the modelled 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.

2206. 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.

2207. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2208. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2209. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.27.1.4 Direct impacts on habitats

2210. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2211. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2212. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2213. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2214. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea,

and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.27.1.5 Presence of structures and predator aggregation

2215. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2216. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2217. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2218. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2219. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.27.2 Atlantic salmon [1106]

2220. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.27.2.1 Increase in underwater noise and vibration

2221. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

2222. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2223. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2224. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[57], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2225. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2226. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

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[57] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.27.2.1.1 Mortality

2227. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

2228. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

2229. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.27.2.1.2 Recoverable injury

2230. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

2231. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.27.2.1.3 Temporary threshold shift and behavioural responses

2232. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2233. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2234. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2235. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2236. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.27.2.1.4 Conclusions relating to underwater noise impacts

2237. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2238. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.27.2.2 Presence of EMF

2239. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric

fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2240. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2241. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2242. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-71**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-72**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-73**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-71, Plate 2-72**).

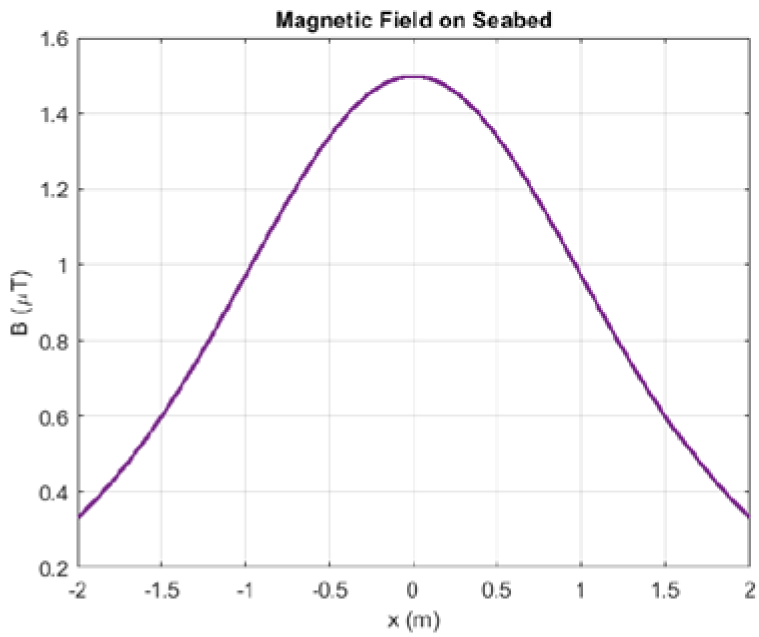

Plate 2-71 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

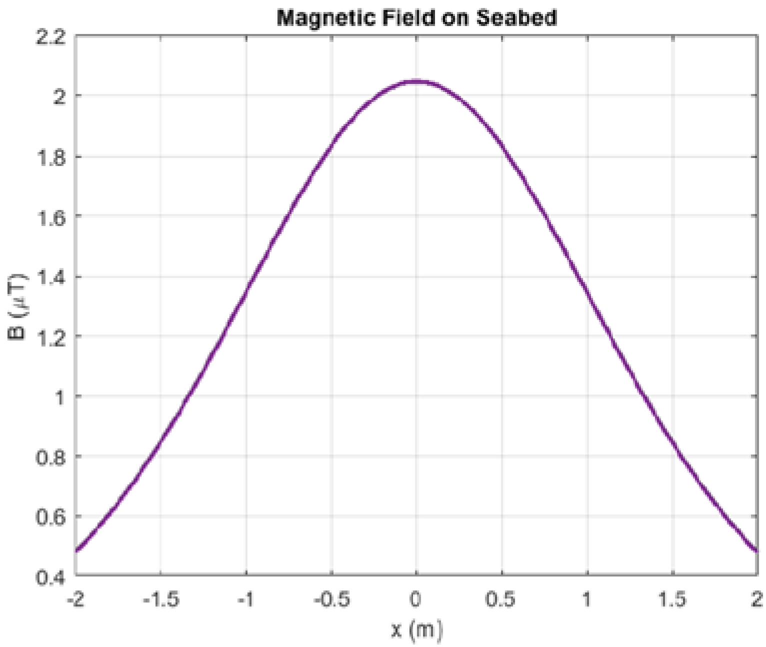

Plate 2-72 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

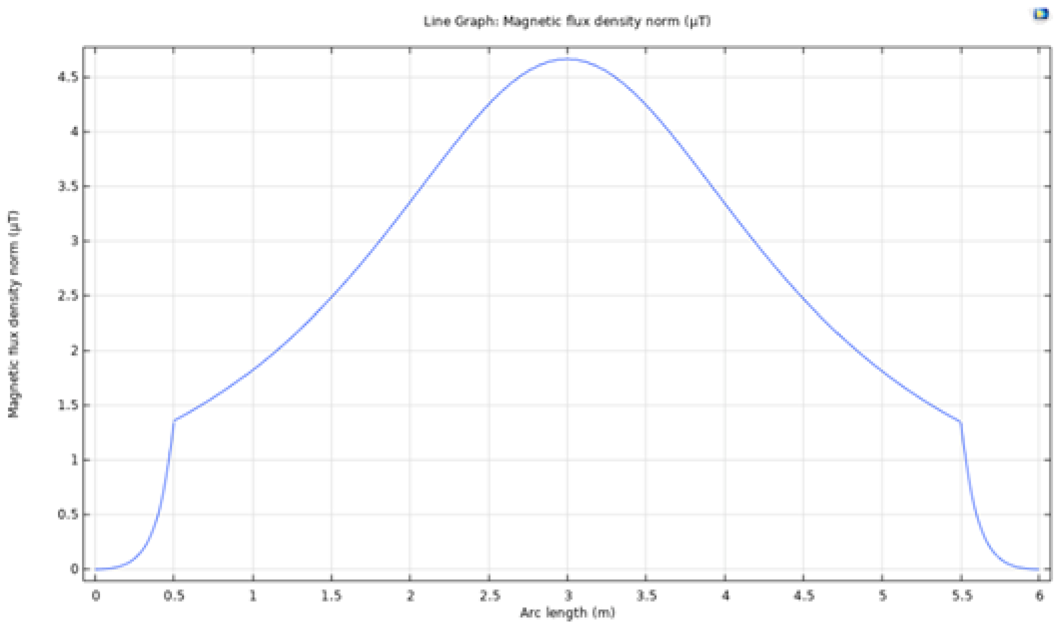

Plate 2-73 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2243. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

2244. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2245. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

2246. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.27.2.3 Temporary increase in SSC and contaminated sediments

2247. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2248. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2249. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

2250. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.27.2.3.1 Dredging and dredge disposal

2251. 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).

2252. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2253. 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.

2.27.2.3.2 Trenching

2254. 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.

2255. Based upon the representative scenario, the modelled 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.

2256. 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.

2257. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2258. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[58]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2259. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.27.2.4 Direct impacts on habitats

2260. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2261. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the

[58] https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2262. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2263. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2264. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.27.2.5 Presence of structures and predator aggregation

2265. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2266. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2267. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2268. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2269. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.28 Castlemaine Harbour SAC (IE0000343)

2270. This SAC is 474 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-49 Conservation Objectives, Attributes and Targets for Castlemaine Harbour SAC and summary of associated assessment (NPWS, 2011c)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.28.1**			
Juvenile density in fine sediment. Mean catchment juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.28.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	potential to affect this attribute and target			
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatili*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.28.1**			
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m^2	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.28.1**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary. Currently present in 88–100% of sites sampled	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.28.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.28.2**			
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.28.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact on redds possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Water quality. At least Q4 at all sites sampled by EPA. 85% of relevant sites currently at least Q4 on Laune	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.28.1 Sea lamprey [1095] and River lamprey [1099]

2271. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2272. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m².

2273. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m².

2.28.1.1 Increase in underwater noise and vibration

2274. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2275. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2276. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2277. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[59], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2278. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.28.1.1.1 Mortality

2279. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2280. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2281. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.28.1.1.2 Recoverable injury

2282. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2283. Recoverable injury in proximity to the Liffey piling operations 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

[59] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.28.1.1.3 Temporary threshold shift and behavioural responses

2284. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2285. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2286. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2287. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2288. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.28.1.1.4 Conclusions relating to underwater noise impacts

2289. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2290. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.28.1.2 Presence of EMF

2291. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2292. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2293. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2294. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-74**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-75**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-76**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-74, Plate 2-75**).

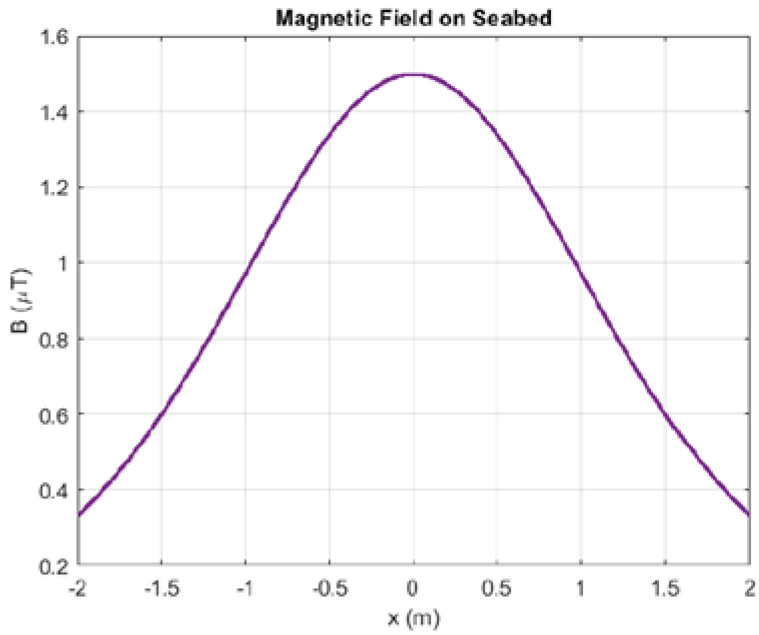

Plate 2-74 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

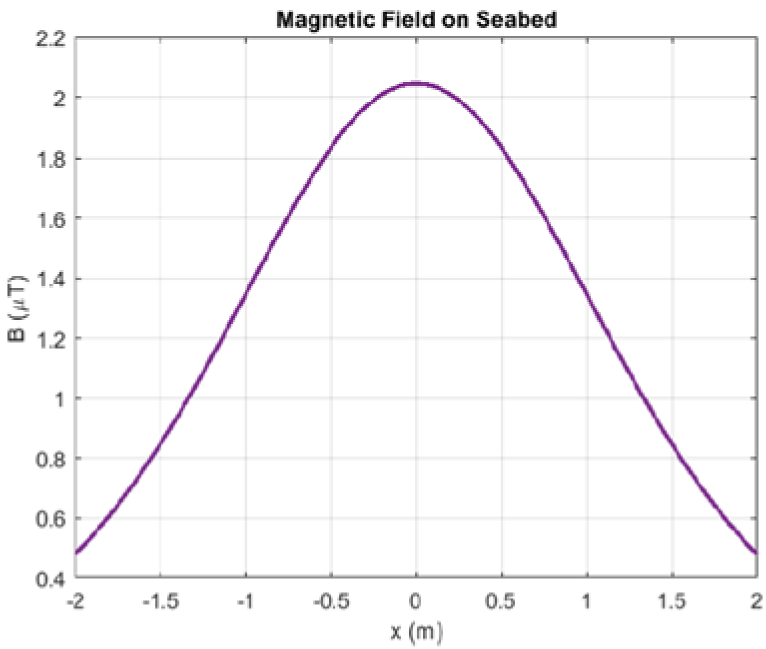

Plate 2-75 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

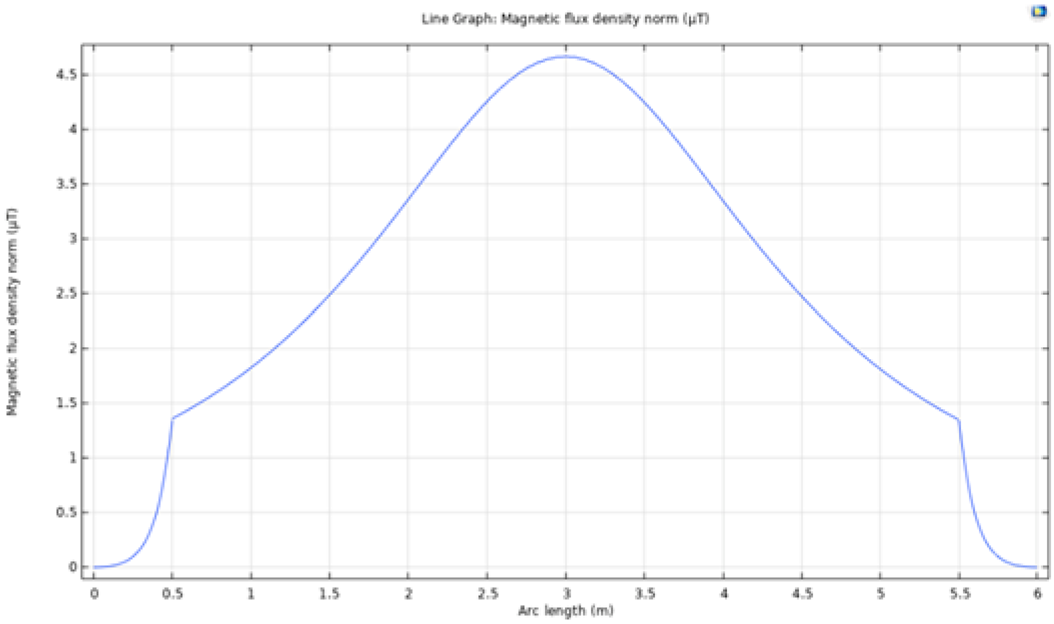

Plate 2-76 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2295. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2296. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2297. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2298. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.28.1.3 Temporary increase in SSC and contaminated sediments

2299. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2300. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2301. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2302. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.28.1.3.1 Dredging and dredge disposal

2303. 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).

2304. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2305. 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.

2.28.1.3.2 Trenching

2306. 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.

2307. Based upon the representative scenario, the modelled 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.

2308. 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.

2309. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2310. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2311. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.28.1.4 Direct impacts on habitats

2312. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2313. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2314. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2315. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2316. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.28.1.5 Presence of structures and predator aggregation

2317. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2318. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2319. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2320. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2321. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.28.2 Atlantic salmon [1106]

2322. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.28.2.1 Increase in underwater noise and vibration

2323. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

2324. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2325. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2326. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[60], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2327. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2328. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.28.2.1.1 Mortality

2329. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

2330. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

2331. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.28.2.1.2 Recoverable injury

2332. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 m from the source for cumulative level

[60] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the more realistic fleeing model is used.

2333. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.28.2.1.3 Temporary threshold shift and behavioural responses

2334. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2335. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2336. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2337. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2338. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.28.2.1.4 *Conclusions relating to underwater noise impacts*

2339. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2340. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.28.2.2 Presence of EMF

2341. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2342. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2343. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2344. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-77**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-78**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-79**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-77, Plate 2-78**).

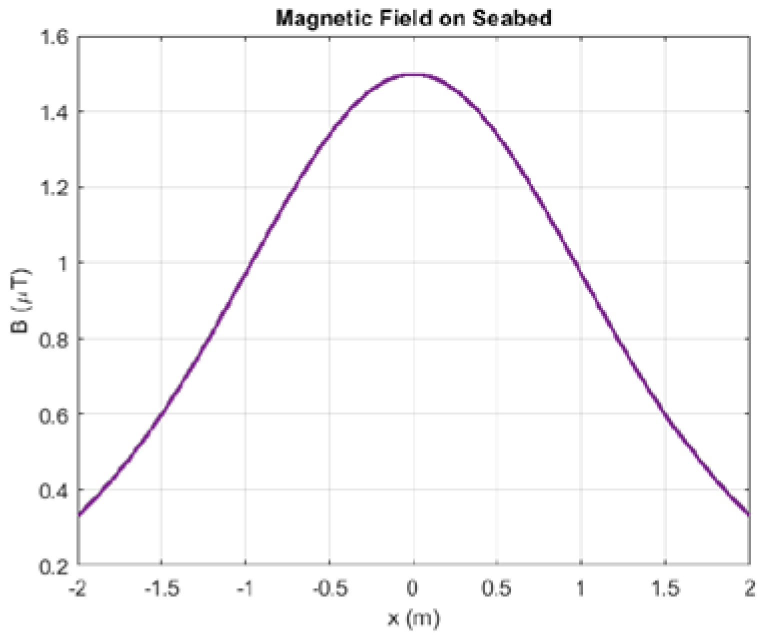

Plate 2-77 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

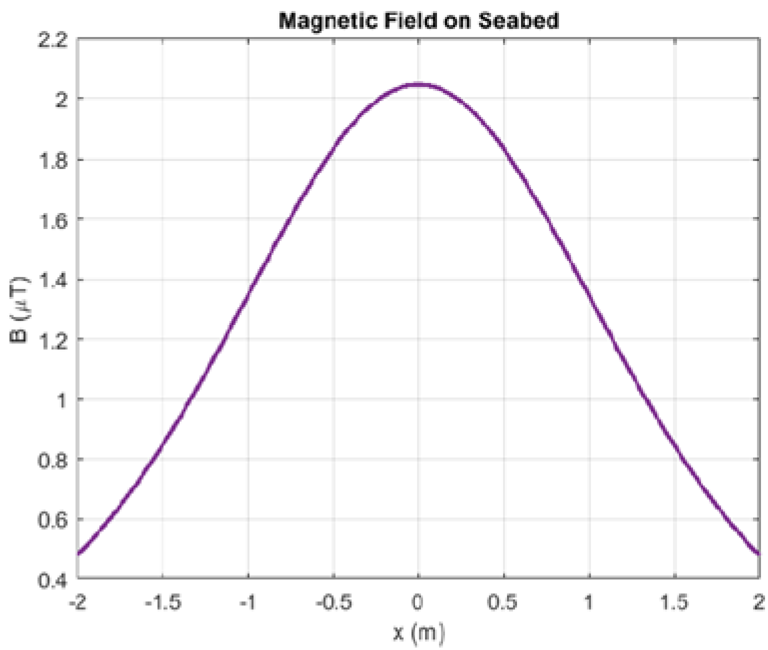

Plate 2-78 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

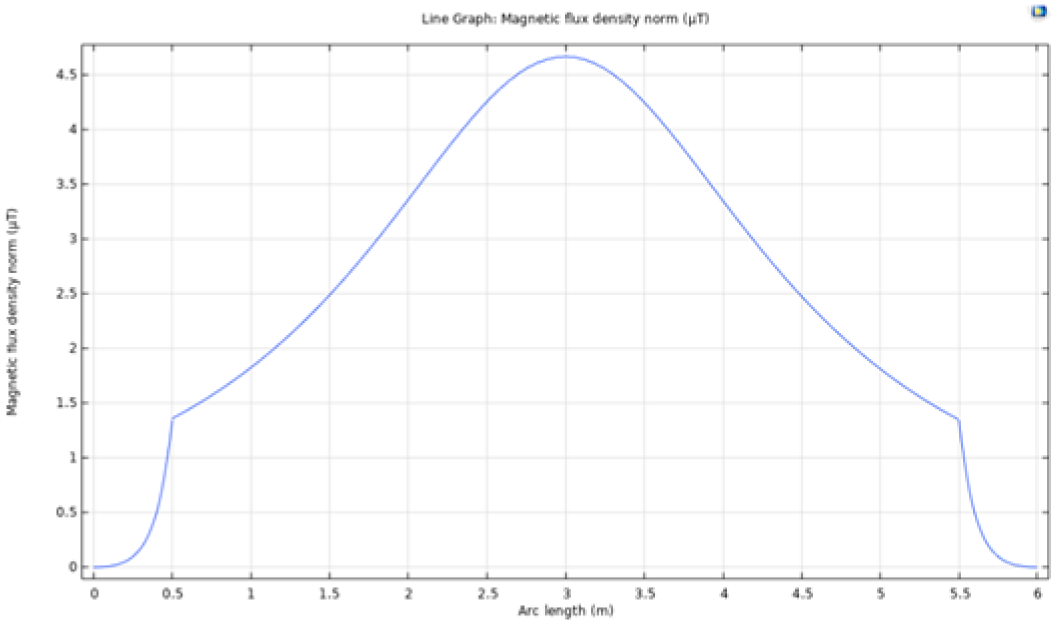

Plate 2-79 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2345. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

2346. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2347. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

2348. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.28.2.3 Temporary increase in SSC and contaminated sediments

2349. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in suspended sediment concentration (SSC). Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2350. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2351. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

2352. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.28.2.3.1 Dredging and dredge disposal

2353. 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).

2354. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2355. 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.

2.28.2.3.2 Trenching

2356. 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.

2357. Based upon the representative scenario, the modelled 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.

2358. 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.

2359. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2360. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[61]). This is considerably higher than the predicted levels of

[61]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2361. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.28.2.4 Direct impacts on habitats

2362. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2363. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2364. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2365. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2366. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.28.2.5 Presence of structures and predator aggregation

2367. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2368. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2369. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2370. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2371. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.29 Lower River Shannon SAC (IE0002165)

2372. This SAC is 506 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-50 Conservation Objectives, Attributes and Targets for Lower River Shannon SAC and summary of associated assessment (NPWS, 2012c)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.29.1**			
Juvenile density in fine sediment. Juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.29.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	potential to affect this attribute and target			
Availability of juvenile habitat. More than 50% of sample sites positive	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1099] River lamprey (*Lampetra fluviatili*)				
Distribution: Access to all water courses down to first order streams	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Population structure of juveniles. At least three age / size groups of river / brook lamprey present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.29.1**			
Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.29.1**			
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	No impact on spawning habitat and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Availability of juvenile habitat. More than 50% of sample sites positive	No impact on juvenile habitat, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1106] Atlantic salmon (*Salmo salar*) (only in fresh water)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary.	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.29.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.29.2**			
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.29.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact on redds possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Water quality. At least Q4 at all sites sampled by EPA.	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

2.29.1 Sea lamprey [1095] and River lamprey [1099]

2373. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2374. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Juvenile density at least 1 / m^2.

2375. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population structure of juveniles. At least three age / size groups of river / brook lamprey present; and
- Juvenile density in fine sediment. Mean catchment juvenile density of brook / river lamprey at least 2 / m^2.

2.29.1.1 Increase in underwater noise and vibration

2376. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2377. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2378. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2379. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[62], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2380. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.29.1.1.1 Mortality

2381. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2382. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2383. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.29.1.1.2 Recoverable injury

2384. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2385. Recoverable injury in proximity to the Liffey piling operations 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

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[62] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.29.1.1.3 Temporary threshold shift and behavioural responses

2386. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2387. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2388. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2389. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2390. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.29.1.1.4 Conclusions relating to underwater noise impacts

2391. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2392. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.29.1.2 Presence of EMF

2393. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2394. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2395. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2396. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-80**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-81**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-82**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-80, Plate 2-81**).

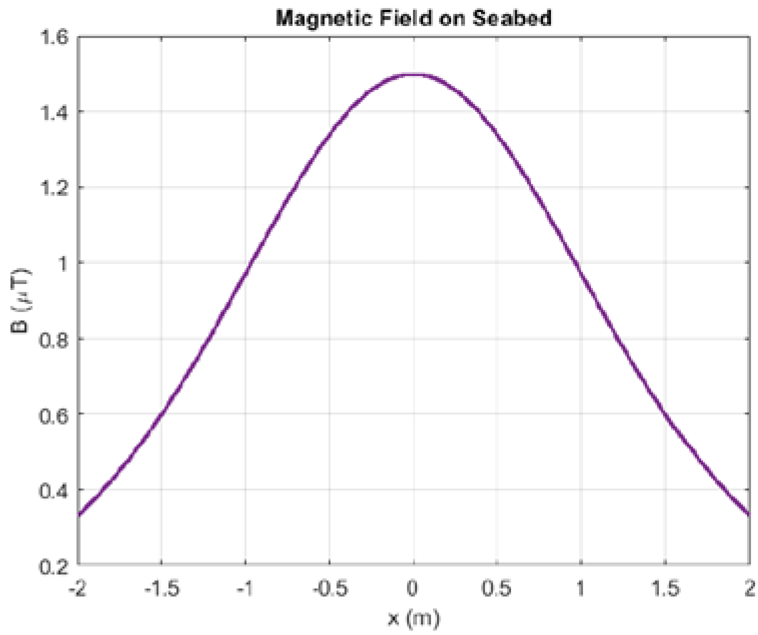

Plate 2-80 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

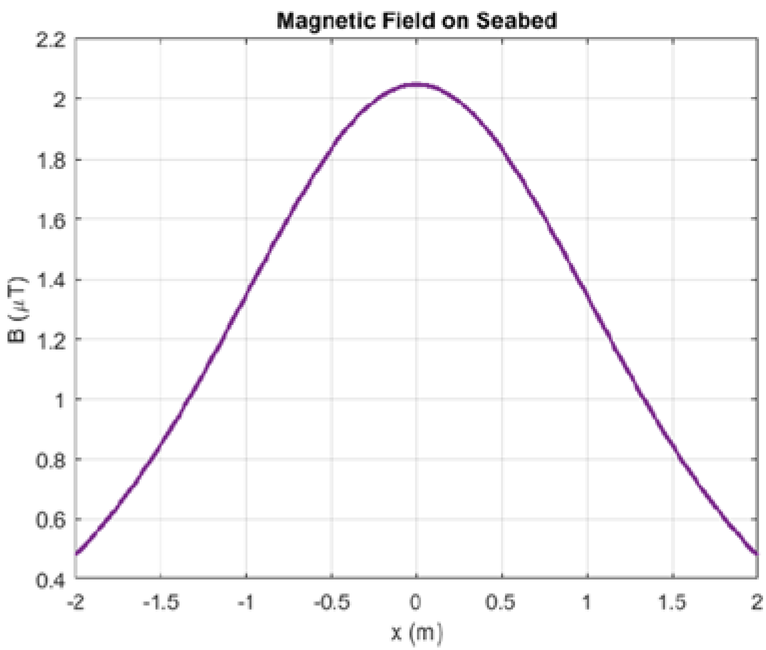

Plate 2-81 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

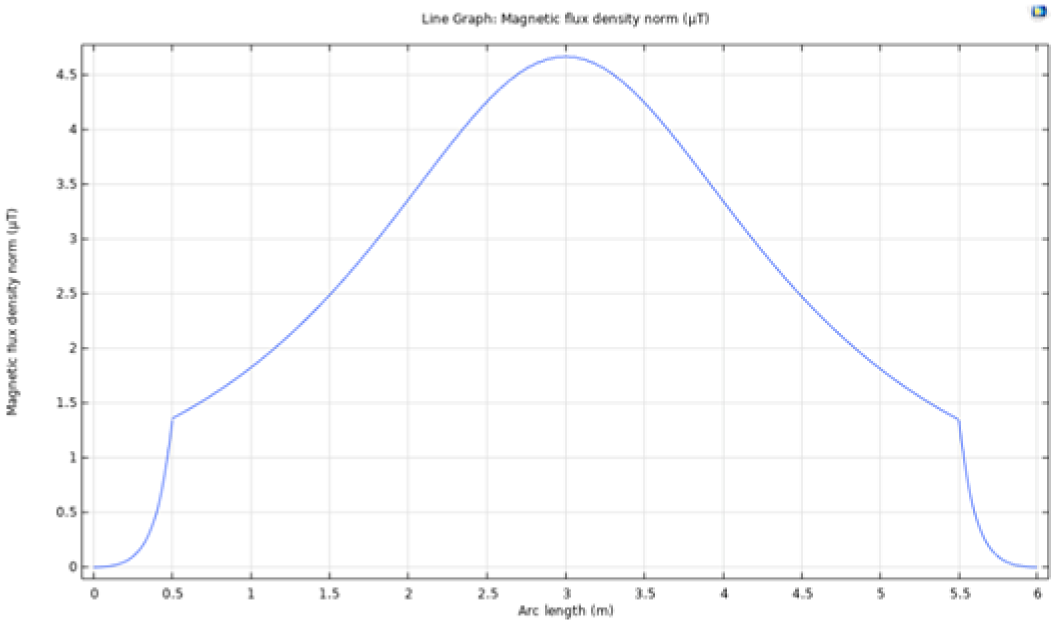

Plate 2-82 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2397. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2398. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2399. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2400. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.29.1.3 Temporary increase in SSC and contaminated sediments

2401. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2402. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2403. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2404. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.29.1.3.1 Dredging and dredge disposal

2405. 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).

2406. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2407. 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.

2.29.1.3.2 Trenching

2408. 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.

2409. Based upon the representative scenario, the modelled 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.

2410. 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.

2411. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2412. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2413. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.29.1.4 Direct impacts on habitats

2414. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2415. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2416. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2417. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2418. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.29.1.5 Presence of structures and predator aggregation

2419. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2420. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2421. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2422. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2423. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.29.2 Atlantic salmon [1106][63]

2424. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment – wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and
- Out-migrating smolt abundance. No significant decline.

2.29.2.1 Increase in underwater noise and vibration

2425. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

2426. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

[63] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

2427. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2428. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[64], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2429. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2430. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.29.2.1.1 Mortality

2431. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

2432. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

2433. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

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[64]https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.29.2.1.2 Recoverable injury

2434. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

2435. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.29.2.1.3 Temporary threshold shift and behavioural responses

2436. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2437. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2438. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2439. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2440. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.29.2.1.4 Conclusions relating to underwater noise impacts

2441. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2442. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.29.2.2 Presence of EMF

2443. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2444. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2445. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2446. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-83**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-84**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-85**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-83, Plate 2-84**).

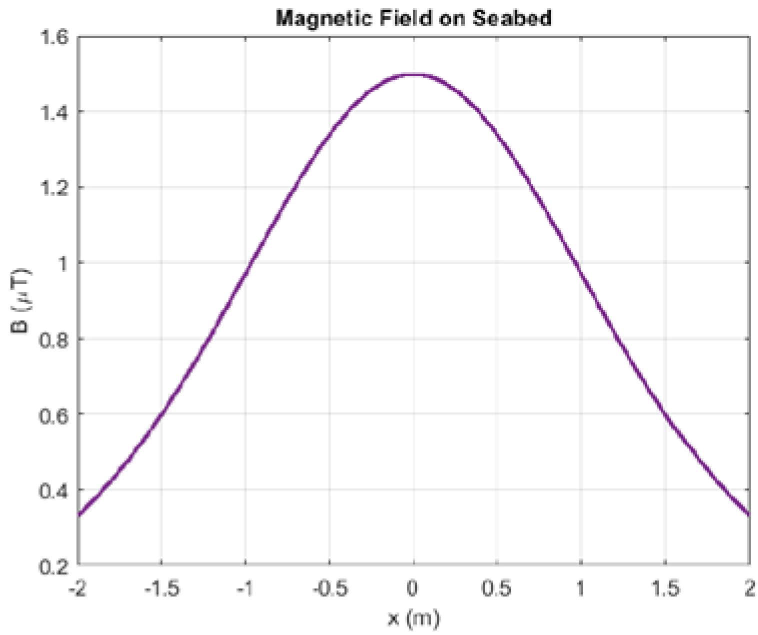

Plate 2-83 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

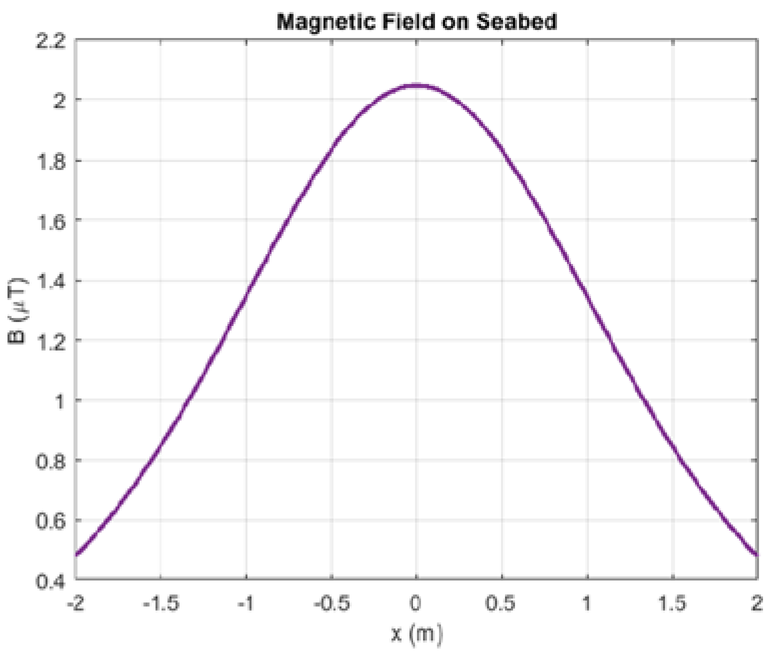

Plate 2-84 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

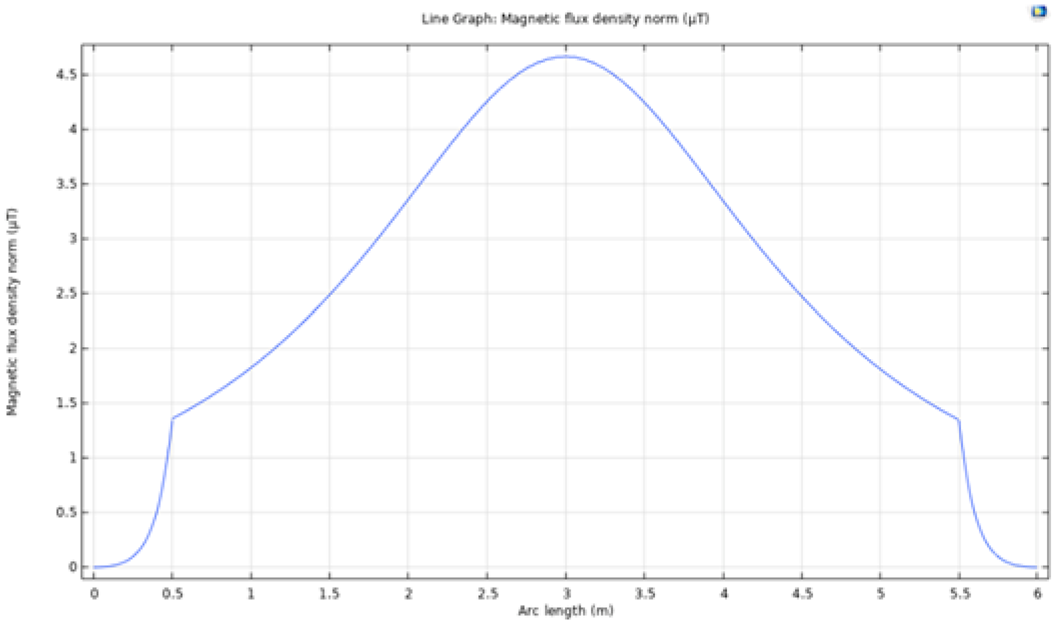

Plate 2-85 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2447. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

2448. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2449. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

2450. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.29.2.3 Temporary increase in SSC and contaminated sediments

2451. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2452. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2453. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

2454. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.29.2.3.1 Dredging and dredge disposal

2455. 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).

2456. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2457. 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.

2.29.2.3.2 Trenching

2458. 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.

2459. Based upon the representative scenario, the modelled 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.

2460. 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.

2461. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2462. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[65]). This is considerably higher than the predicted levels of

[65]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2463. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.29.2.4 Direct impacts on habitats

2464. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2465. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2466. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2467. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2468. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.29.2.5 Presence of structures and predator aggregation

2469. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2470. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2471. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2472. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2473. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.30 Lough Corrib SAC (IE0000297)

2474. This SAC is 623 km from the offshore development area and is screened in for Sea lamprey and Atlantic salmon.

Table 2-51 Conservation Objectives, Attributes and Targets for Lough Corrib SAC and summary of associated assessment (NPWS, 2017c)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*)				
Distribution: extent of anadromy. Greater than 75% of main stem length of rivers accessible from estuary	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Population structure of juveniles. At least three age / size groups present	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.30.1**			
Juvenile density in fine sediment. Mean catchment juvenile density at least 1 / m²	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.30.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Extent and distribution of spawning habitat. No decline in extent and distribution of spawning beds	CWP Project has no connectivity to freshwater spawning habitat and as such no	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	potential to affect this attribute and target			
Availability of juvenile habitat. More than 50% of sample sites positive, with a minimum of four positive sites in a catchment, which are at least 5 km apart	There will be no change in juvenile habitat as a result of the CWP Project, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*) (only in fresh water)				
Distribution: extent of anadromy. 100% of river channels down to second order accessible from estuary.	No impact to river morphology, and as such no impact to this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Adult spawning fish. Conservation Limit (CL) for each system consistently exceeded	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.30.2**			
Salmon fry abundance. Maintain or exceed 0 + fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.30.2**			
Out-migrating smolt abundance. No significant decline	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.30.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Number and distribution of redds. No decline in number and distribution of spawning redds due to anthropogenic causes	No direct connectivity with the SAC and as such no impact on redds possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Water quality. At least Q4 at all sites sampled by EPA.	No direct connectivity with the SAC and as such no impact on water quality possible	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.30.1 Sea lamprey [1095]

2475. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population structure of juveniles. At least three age / size groups present; and
- Juvenile density in fine sediment. Mean catchment juvenile density at least 1 / m².

2.30.1.1 Increase in underwater noise and vibration

2476. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2477. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2478. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2479. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[66], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

[66] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2480. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.30.1.1.1 Mortality

2481. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2482. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2483. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.30.1.1.2 Recoverable injury

2484. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2485. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.30.1.1.3 Temporary threshold shift and behavioural responses

2486. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2487. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2488. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2489. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2490. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.30.1.1.4 Conclusions relating to underwater noise impacts

2491. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2492. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.30.1.2 Presence of EMF

2493. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2494. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2495. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2496. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-86**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-87**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-88**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-86, Plate 2-87**).

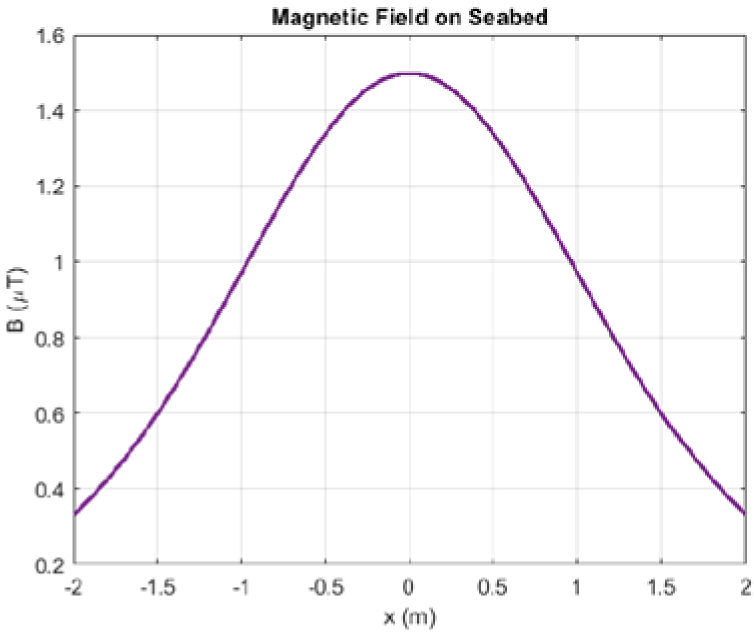

Plate 2-86 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

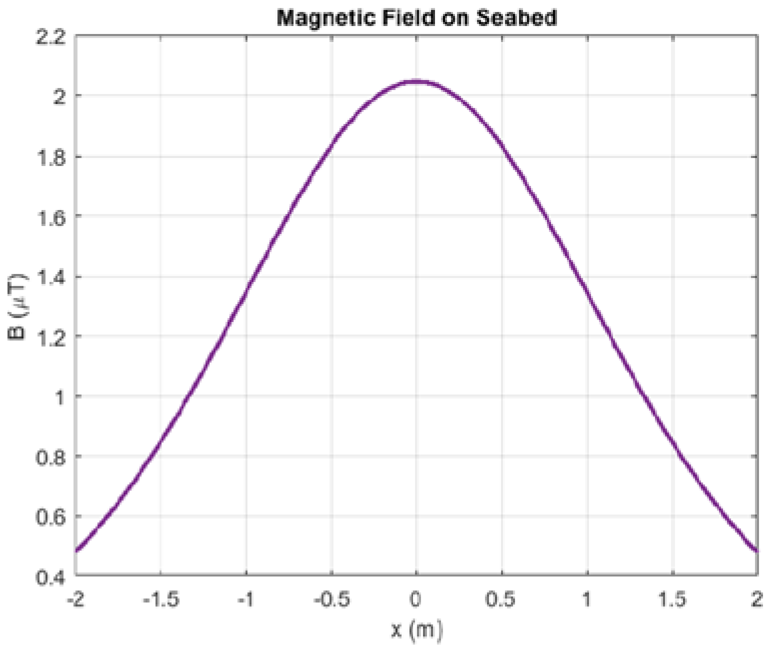

Plate 2-87 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

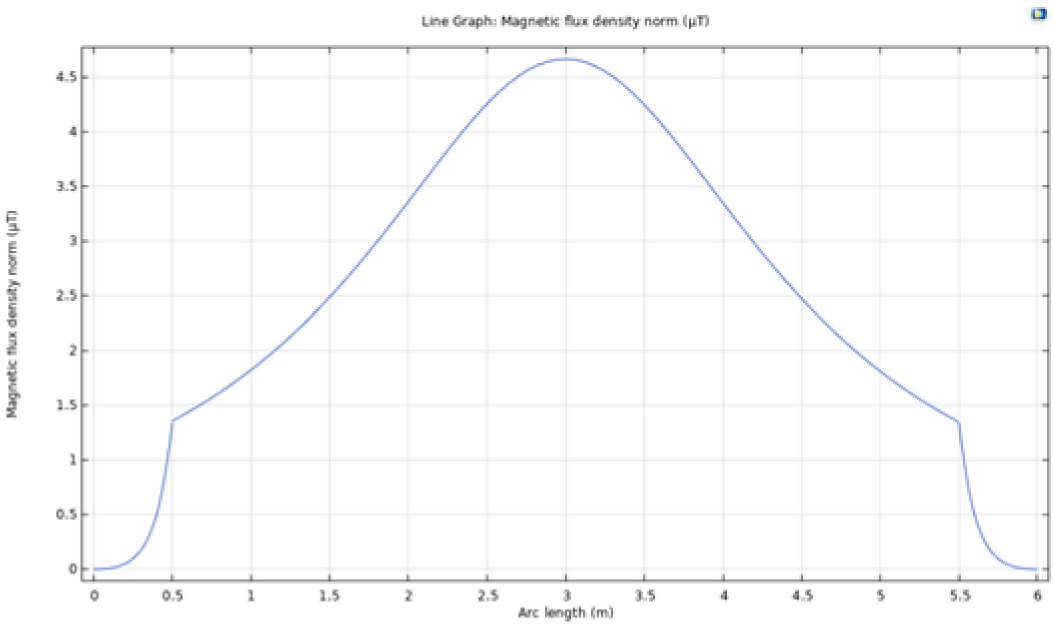

Plate 2-88 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2497. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2498. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2499. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2500. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.30.1.3 Temporary increase in SSC and contaminated sediments

2501. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2502. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2503. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2504. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.30.1.3.1 Dredging and dredge disposal

2505. 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).

2506. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2507. 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.

2.30.1.3.2 Trenching

2508. 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.

2509. Based upon the representative scenario, the modelled 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.

2510. 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.

2511. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2512. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2513. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.30.1.4 Direct impacts on habitats

2514. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2515. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2516. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2517. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2518. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea,

and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.30.1.5 Presence of structures and predator aggregation

2519. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2520. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2521. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2522. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2523. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.30.2 Atlantic salmon [1106][67]

2524. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult spawning fish. CL for each system consistently exceeded;
- Salmon fry abundance. Maintain or exceed 0 + fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry / 5 minutes sampling; and

[67] Freshwater Pearl Mussel (FWPM) are dependent on salmonid individuals on which their larvae develop during a parasitic phase. As such it is considered that where the potential for adverse effects on site integrity through effects on salmon can be ruled out, it can be similarly ruled out for FWPM where they are QIs of the same SAC. Conversely, should adverse effects on site integrity not be ruled out due to effects on salmon for a given European Site, neither shall it be ruled out on FWPM where both are QIs of the same SAC. Accordingly, FWPM are not listed here or elsewhere in the NIS as separate receptors.

- Out-migrating smolt abundance. No significant decline.

2.30.2.1 Increase in underwater noise and vibration

2525. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

2526. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2527. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2528. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[68], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2529. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2530. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

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[68] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.30.2.1.1 Mortality

2531. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

2532. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

2533. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.30.2.1.2 Recoverable injury

2534. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

2535. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.30.2.1.3 Temporary threshold shift and behavioural responses

2536. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2537. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2538. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2539. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2540. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.30.2.1.4 Conclusions relating to underwater noise impacts

2541. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2542. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.30.2.2 Presence of EMF

2543. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric

fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2544. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2545. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2546. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-89**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-90**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-91**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-89, Plate 2-90**).

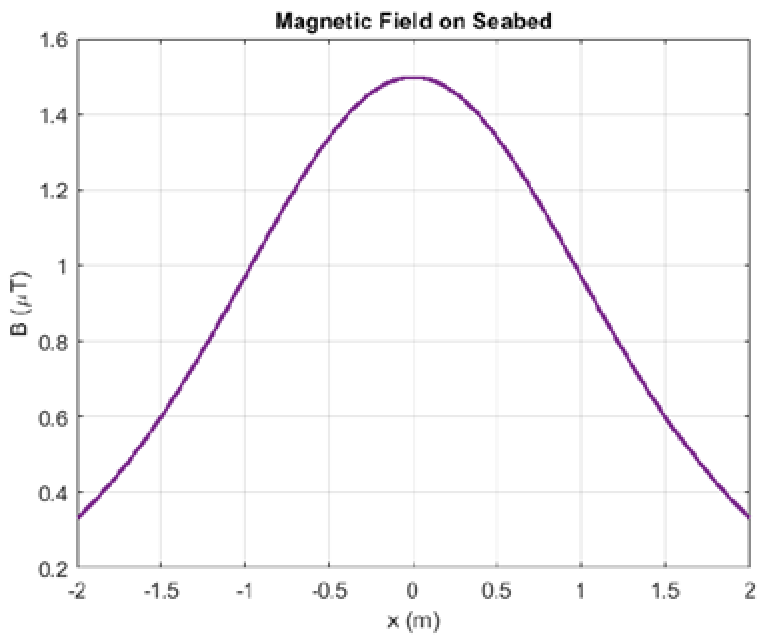

Plate 2-89 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

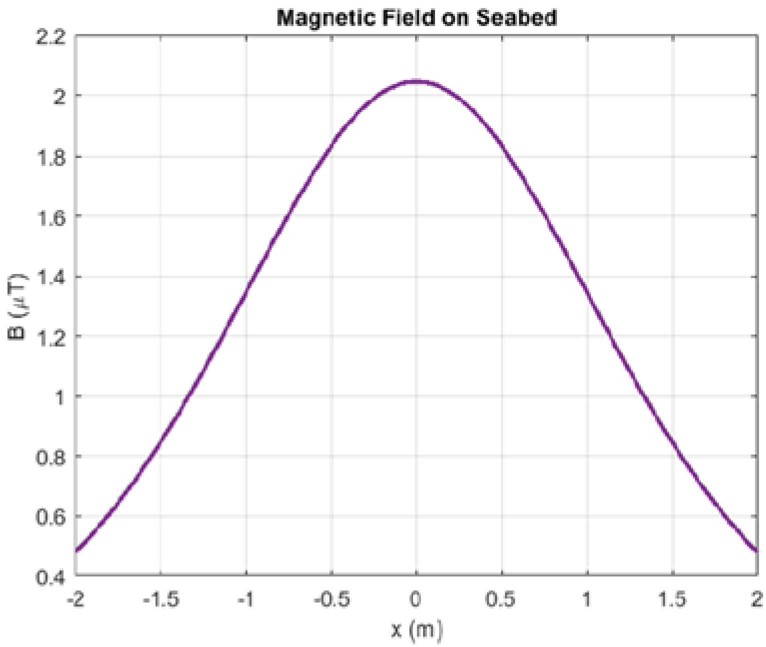

Plate 2-90 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

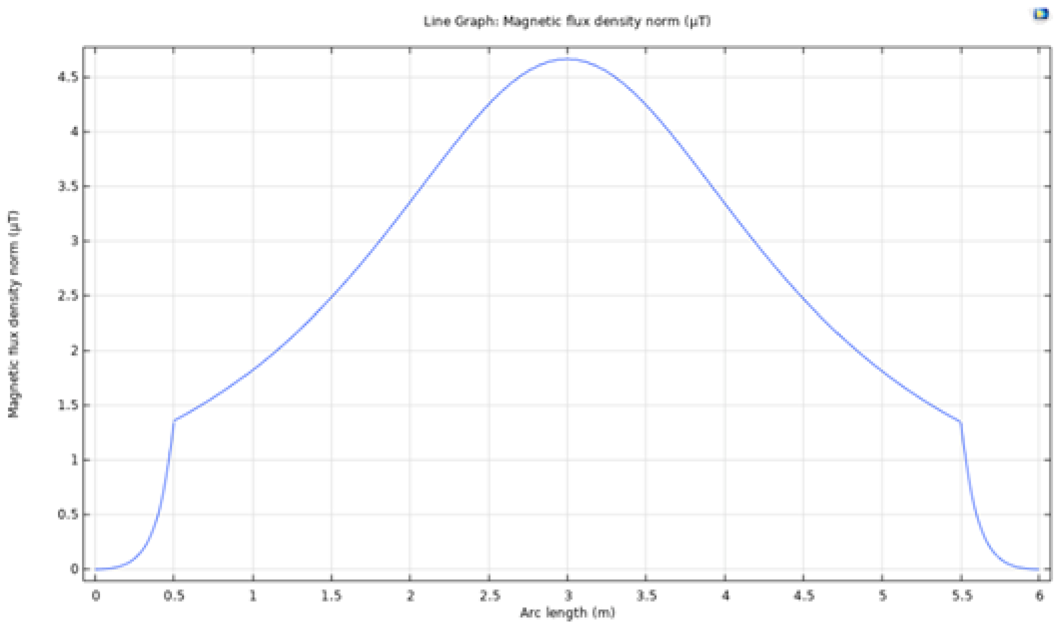

Plate 2-91 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2547. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

2548. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2549. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

2550. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.30.2.3 Temporary increase in SSC and contaminated sediments

2551. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2552. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2553. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

2554. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.30.2.3.1 Dredging and dredge disposal

2555. 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).

2556. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2557. 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.

2.30.2.3.2 Trenching

2558. 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.

2559. Based upon the representative scenario, the modelled 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.

2560. 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.

2561. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2562. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[69]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2563. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.30.2.4 Direct impacts on habitats

2564. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2565. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the

[69]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2566. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2567. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2568. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.30.2.5 Presence of structures and predator aggregation

2569. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2570. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2571. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2572. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2573. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.31 Pembrokeshire Marine / Sir Benfro Forol (UK0013116)

2574. This SAC is 117 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Allis shad.

Table 2-52 Conservation Objectives, Attributes and Targets for Pembrokeshire Marine / Sir Benfro Forol and summary of associated assessment (NRW, 2018a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1095] Sea lamprey (*Petromyzon marinus)* Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site.	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Sections 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Sections 2.31.1**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Sections 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site.	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of structures and predator aggregation. See **Section 2.31.1**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Twaite shad [1103] Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size,	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
structure, production and condition of the species within the site	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**			
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Supporting habitats and species. The presence, abundance, condition and diversity of	Increase in underwater noise and vibration	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**			site integrity predicted from the project alone
[1102] Allis shad (Alosa alosa) Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site.	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of structures and predator aggregation. See **Section 2.31.2**			
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
population beyond the site is stable or increasing	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**			

2.31.1 Sea lamprey [1095] and River lamprey [1099]

2575. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2576. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2577. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2.31.1.1 Increase in underwater noise and vibration

2578. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2579. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and

- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2580. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2581. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[70], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2582. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.31.1.1.1 Mortality

2583. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2584. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2585. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

[70] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.31.1.1.2 Recoverable injury

2586. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2587. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.31.1.1.3 Temporary threshold shift and behavioural responses

2588. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2589. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2590. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2591. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2592. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.31.1.1.4 Conclusions relating to underwater noise impacts

2593. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2594. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.31.1.2 Presence of EMF

2595. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2596. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2597. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2598. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-92**), 2 µT for a 1800 Cu mild steel cable (

2599. **Plate** 2-93) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-94**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-92,**

2600. **Plate** 2-93).

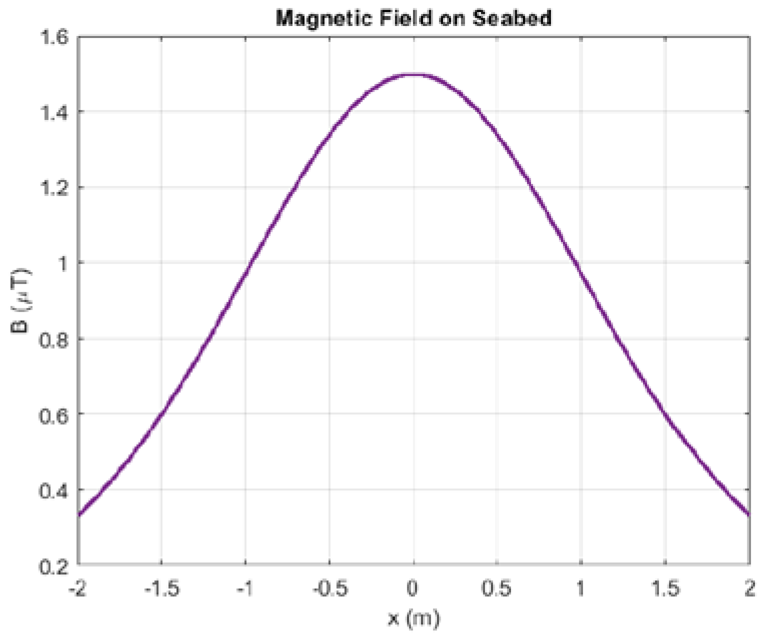

Plate 2-92 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

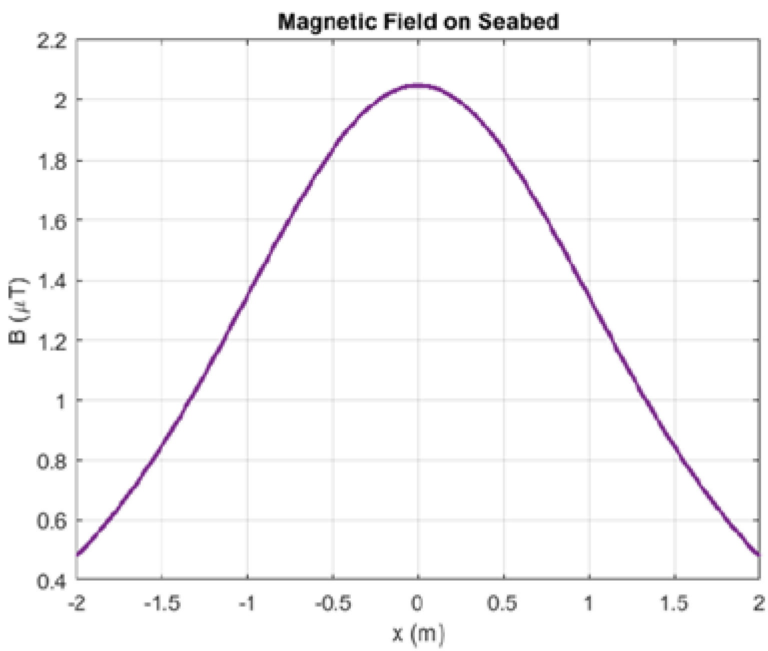

Plate 2-93 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

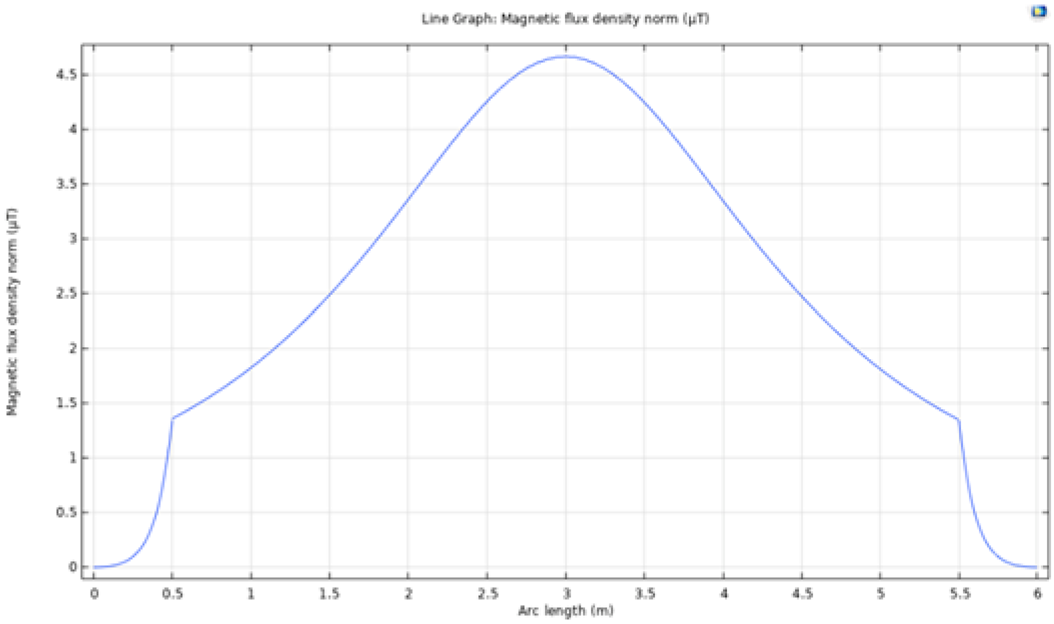

Plate 2-94 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2601. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2602. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2603. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2604. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.31.1.3 Temporary increase in SSC and contaminated sediments

2605. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2606. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2607. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2608. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.31.1.3.1 Dredging and dredge disposal

2609. 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).

2610. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2611. 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.

2.31.1.3.2 Trenching

2612. 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.

2613. Based upon the representative scenario, the modelled 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.

2614. 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.

2615. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2616. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2617. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.31.1.4 Direct impacts on habitats

2618. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2619. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2620. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2621. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2622. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.31.1.5 Presence of structures and predator aggregation

2623. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2624. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2625. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2626. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2627. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.31.2 Twaite shad [1103] and Allis shad [1102]

2628. Due to similarities in morphology and sensitivity to the relevant impacts, Twaite shad and Allis shad are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2629. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Twaite shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2630. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Allis shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2.31.2.1 Increase in underwater noise and vibration

2631. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought

to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

2632. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2633. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2634. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[71], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2635. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

2636. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.31.2.1.1 Mortality

2637. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 14 km^2 or a maximum distance of 2,200 m from the source for cumulative level

[71] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the more realistic fleeing model is used.

2638. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

2639. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.31.2.1.2 Recoverable injury

2640. Recoverable injury effects 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 more realistic fleeing model is used.

2641. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.31.2.1.3 Temporary threshold shift and behavioural responses

2642. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

2643. 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 more realistic fleeing model is used.

2644. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2645. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable

margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2646. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.31.2.1.4 Conclusions relating to underwater noise impacts

2647. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

2648. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.31.2.2 Presence of EMF

2649. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2650. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2651. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2652. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-95**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-96**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-97**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-95, Plate 2-96**).

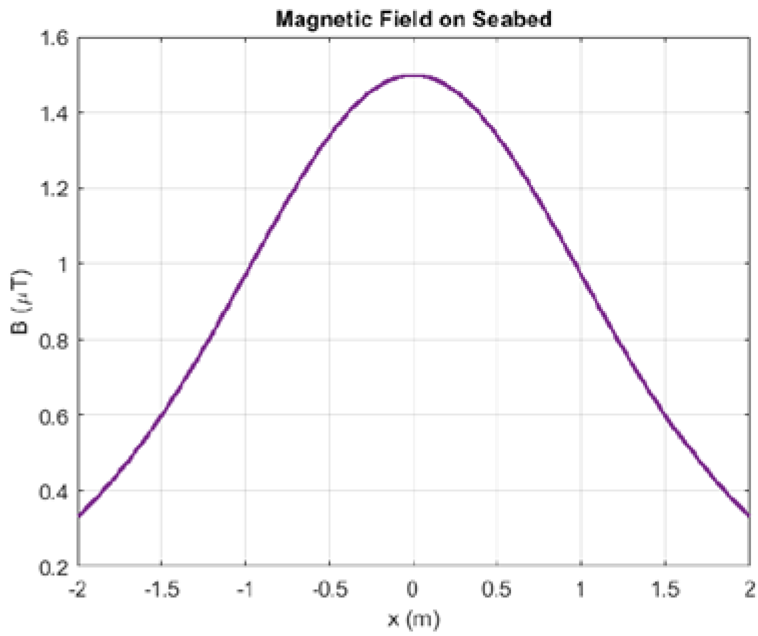

Plate 2-95 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

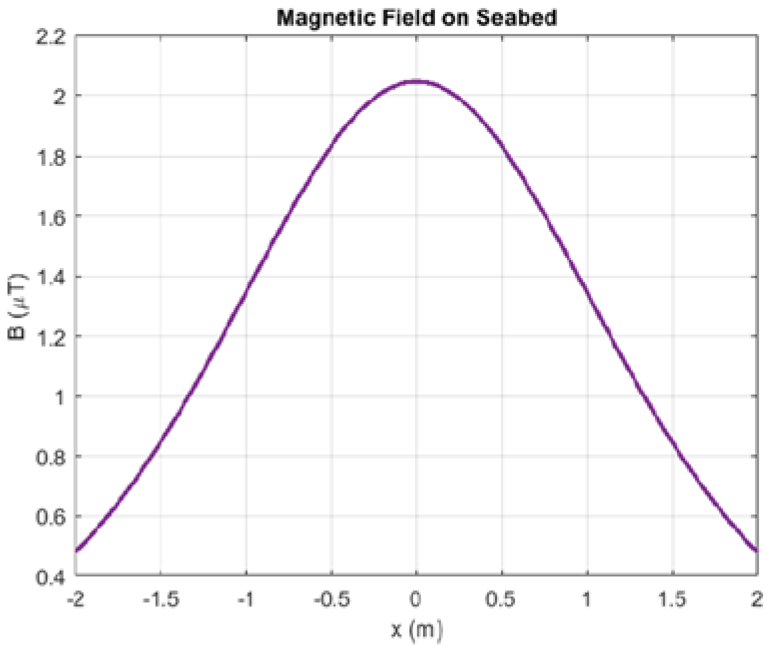

Plate 2-96 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

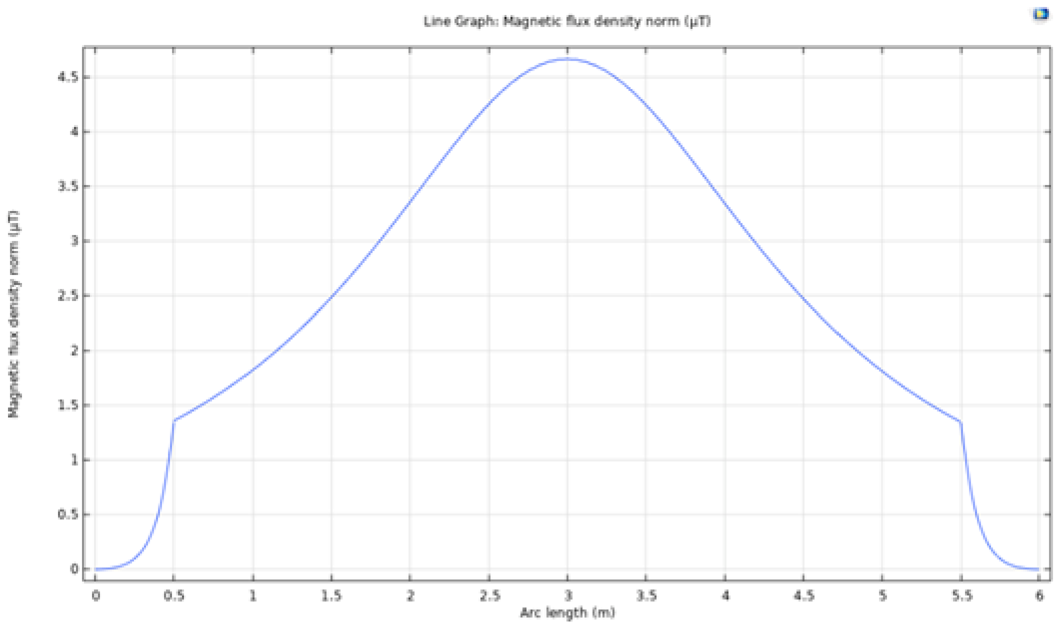

Plate 2-97 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2653. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

2654. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2655. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

2656. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.31.2.3 Temporary increase in SSC and contaminated sediments

2657. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

2658. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2659. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area.

However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2660. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.31.2.3.1 Dredging and dredge disposal

2661. 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).

2662. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2663. 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.

2.31.2.3.2 Trenching

2664. 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.

2665. Based upon the representative scenario, the modelled 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.

2666. 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.

2667. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2668. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

2669. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.31.2.4 Direct impacts on habitats

2670. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2671. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2672. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2673. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to

950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

2674. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.31.2.5 Presence of structures and predator aggregation

2675. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2676. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2677. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2678. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2679. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.32 Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd (UK0020020)

2680. This SAC is 191 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Allis shad.

Table 2-53 Conservation Objectives, Attributes and Targets for Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd SAC and summary of associated assessment (NRW, 2018b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus)* Conservation Objective: *To restore the favourable conservation condition of the Qualifying Feature in the SAC, which is defined by the following list of attributes and targets:*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.1**			
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: To restore the favourable conservation condition of the Qualifying Feature in the SAC, which is defined by the following list of attributes and targets:*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.1**			
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.32.1**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

[1103] Twaite shad (*Alosa fallax)*

Conservation Objective*: To restore the favourable conservation condition of Twaite shad in the SACs, which is defined by the following list of attributes and targets:*

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.2**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.32.2**			
[1102] Allis shad *(Alosa alosa)* Conservation Objective*: To restore the favourable conservation condition of Allis shad in the SACs, which is defined by the following list of attributes and targets:*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.32.2**			
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.32.2**			

2.32.1 Sea lamprey [1095] and River lamprey [1099]

2681. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2682. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

2683. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

2.32.1.1 Increase in underwater noise and vibration

2684. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2685. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2686. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2687. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[72], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2688. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.32.1.1.1 Mortality

2689. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2690. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2691. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.32.1.1.2 Recoverable injury

2692. Recoverable injury from piling operations under the stationary model may occur within an area of approximately 0.04 km^2 or a maximum distance of 110 m from the source for peak sound pressure

[72] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2693. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.32.1.1.3 Temporary threshold shift and behavioural responses

2694. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2695. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2696. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2697. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2698. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.32.1.1.4 Conclusions relating to underwater noise impacts

2699. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2700. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.32.1.2 Presence of EMF

2701. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2702. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2703. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2704. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-98**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-99**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-100**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-98, Plate 2-99**).

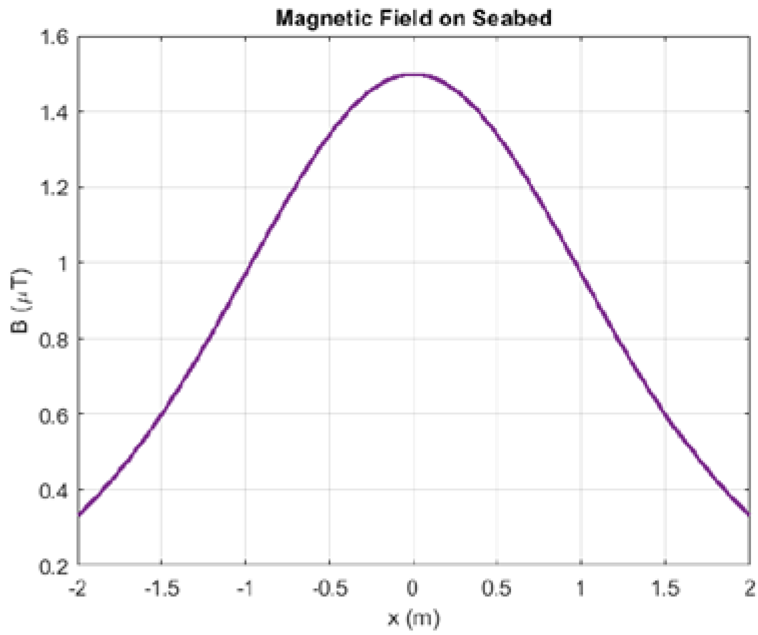

Plate 2-98 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

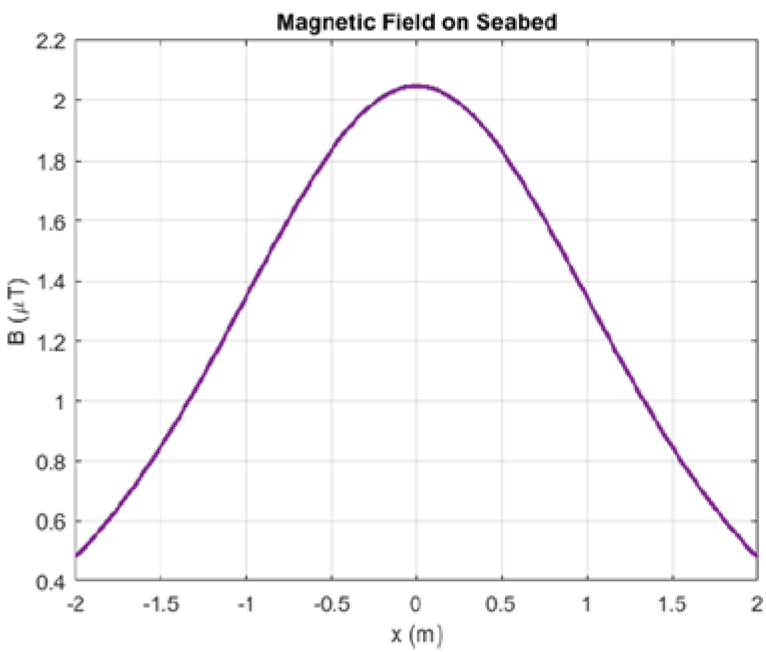

Plate 2-99 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

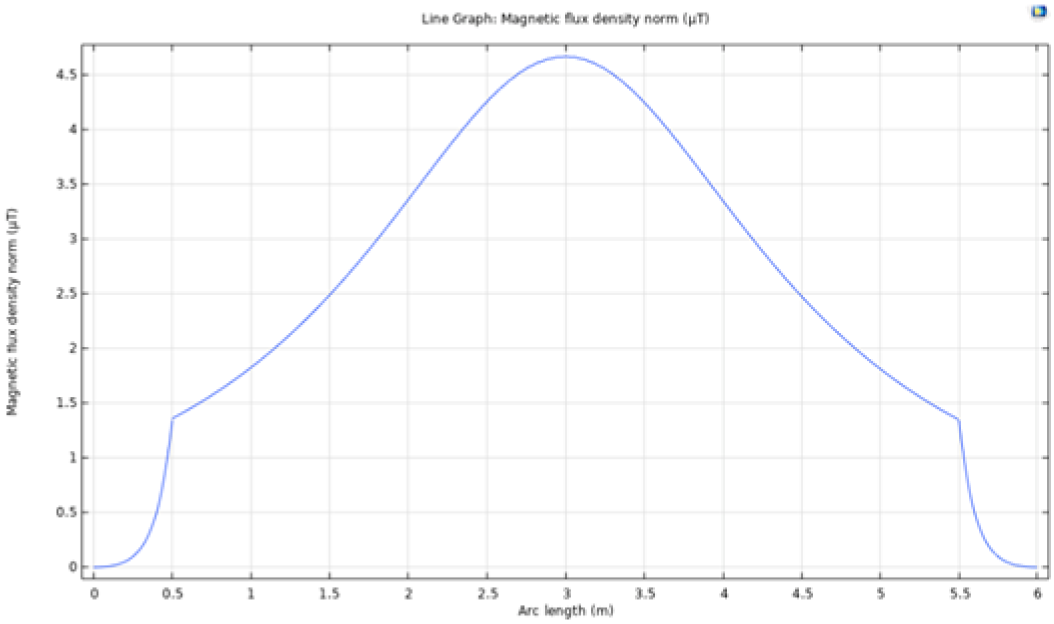

Plate 2-100 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2705. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2706. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2707. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2708. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.32.1.3 Temporary increase in SSC and contaminated sediments

2709. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2710. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2711. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2712. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.32.1.3.1 Dredging and dredge disposal

2713. 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).

2714. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2715. 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.

2.32.1.3.2 Trenching

2716. 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.

2717. Based upon the representative scenario, the modelled 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.

2718. 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.

2719. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2720. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2721. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.32.1.4 Direct impacts on habitats

2722. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2723. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2724. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2725. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2726. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.32.1.5 Presence of structures and predator aggregation

2727. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2728. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2729. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2730. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2731. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.32.2 Twaite shad [1103] and Allis shad [1102]

2732. Due to similarities in morphology and sensitivity to the relevant impacts, Twaite shad and Allis shad are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2733. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Twaite shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

2734. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Allis shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics within the site and population beyond the site is stable or increasing.

2.32.2.1 Increase in underwater noise and vibration

2735. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

2736. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2737. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2738. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[73], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2739. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

2740. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.32.2.1.1 Mortality

2741. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 14 km^2 or a maximum distance of 2,200 m from the source for cumulative level

[73]https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the more realistic fleeing model is used.

2742. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

2743. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.32.2.1.2 Recoverable injury

2744. Recoverable injury effects 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 more realistic fleeing model is used.

2745. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.32.2.1.3 Temporary threshold shift and behavioural responses

2746. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

2747. 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 more realistic fleeing model is used.

2748. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2749. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable

margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2750. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.32.2.1.4 Conclusions relating to underwater noise impacts

2751. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

2752. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.32.2.2 Presence of EMF

2753. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2754. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2755. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2756. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-101**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-102**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-103**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-101, Plate 2-102**).

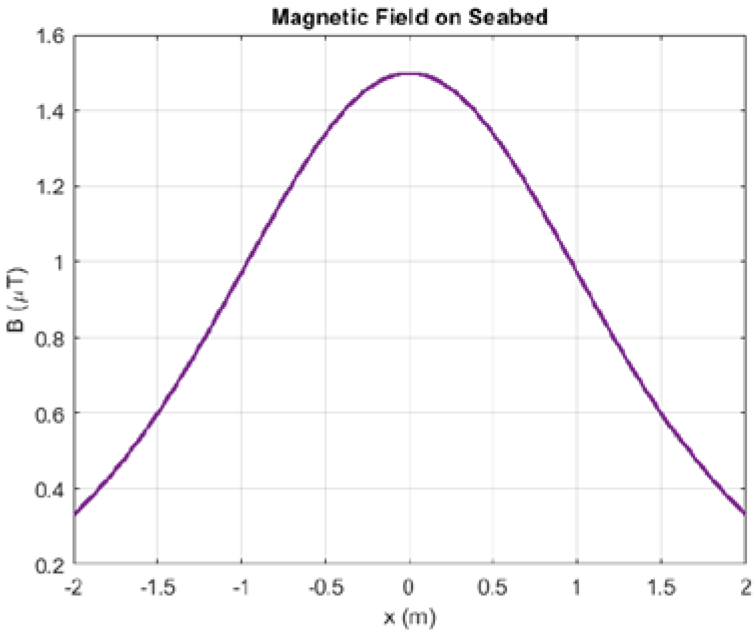

Plate 2-101 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

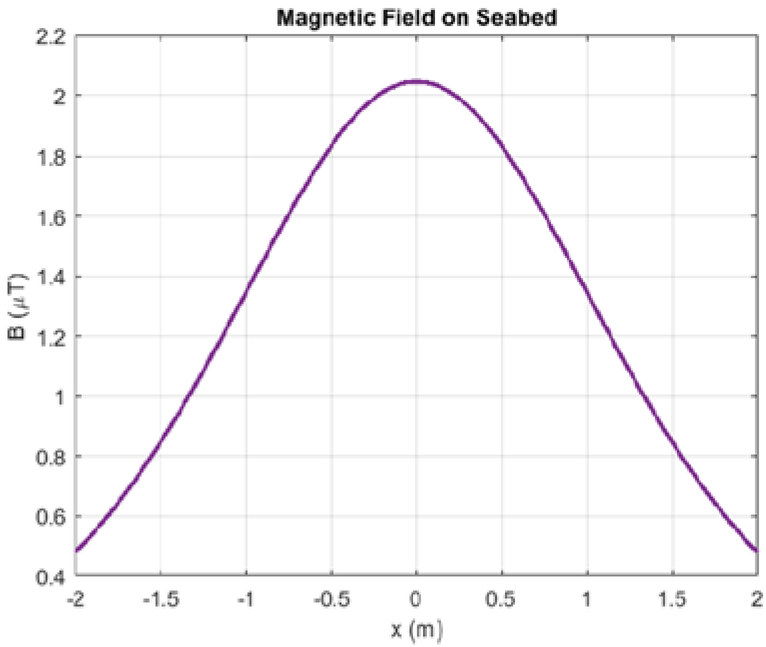

Plate 2-102 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

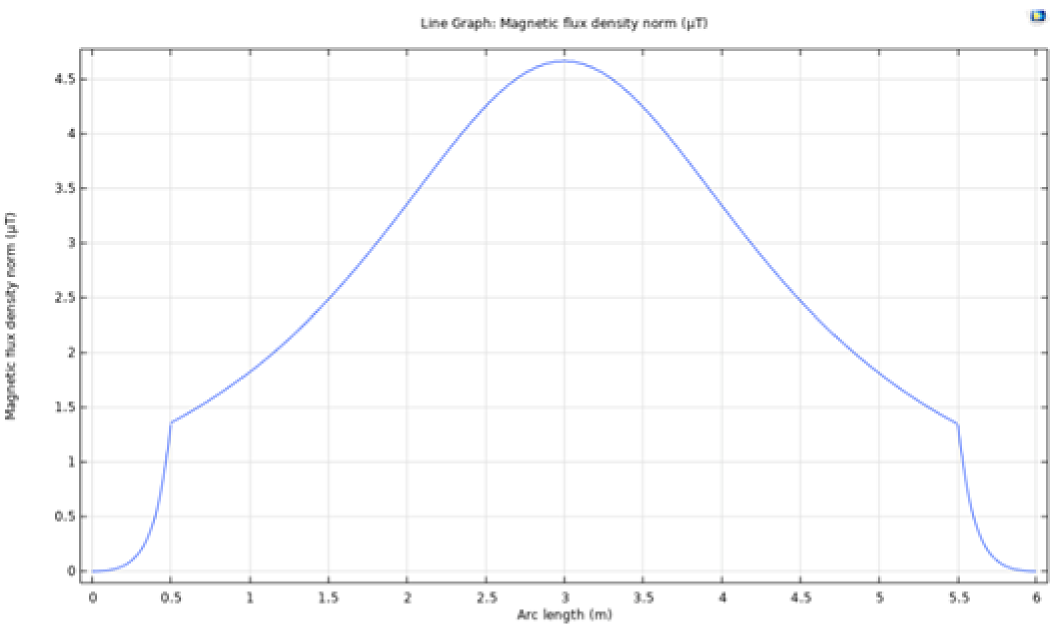

Plate 2-103 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2757. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

2758. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2759. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

2760. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.32.2.3 Temporary increase in SSC and contaminated sediments

2761. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

2762. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2763. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area.

However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2764. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.32.2.3.1 Dredging and dredge disposal

2765. 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).

2766. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2767. 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.

2.32.2.3.2 Trenching

2768. 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.

2769. Based upon the representative scenario, the modelled 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.

2770. 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.

2771. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2772. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

2773. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.32.2.4 Direct impacts on habitats

2774. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2775. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2776. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2777. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to

950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

2778. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.32.2.5 Presence of structures and predator aggregation

2779. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2780. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2781. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2782. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2783. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.33 Afon Tywi / River Tywi (UK0013010)

2784. This SAC is 242 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad and Allis shad.

Table 2-54 Conservation Objectives, Attributes and Targets for Afon Tywi / River Tywi and summary of associated assessment (Natural Resources Wales, 2022a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1095] Sea lamprey (*Petromyzon marinus)* Conservation Objective*:*				
The distribution of the population should be being maintained or where appropriate increasing	No impact on river morphology and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
There should be sufficient habitat, of sufficient quality, to support the population in the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The size of the population should be stable or increasing,	Increase in underwater noise and vibration	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
allowing for natural variability, and sustainable in the long term	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.1**			site integrity predicted from the project alone.
Factors affecting the population or its habitat should be under appropriate control	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Sections 2.18.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*:*				
The distribution of the population should be being maintained or where appropriate increasing	No impact on river morphology, and as such no impact on this attribute and target.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
There should be sufficient habitat, of sufficient quality, to support the population in the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.1**			
Factors affecting the population or its habitat should be under appropriate control	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1103] Twaite shad (*Alosa fallax)* Conservation Objective*:*				
The distribution of the population should be being maintained or where appropriate increasing	No impact on river morphology, and as such no impact on the attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
There should be sufficient habitat, of sufficient quality, to support the population in the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**			
Factors affecting the population or its habitat should be under appropriate control	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1102] Allis shad *(Alosa alosa)* Conservation Objective*:*				
The distribution of the population should be being maintained or where appropriate increasing	No impact on river morphology, and as such no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
There should be sufficient habitat, of sufficient quality, to support the population in the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**			
Factors affecting the population or its habitat should be under appropriate control	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.33.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

2.33.1 Sea lamprey [1095] and River lamprey [1099]

2785. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2786. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term; and
- Factors affecting the population or its habitat should be under appropriate control.

2787. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term; and
- Factors affecting the population or its habitat should be under appropriate control.

2.33.1.1 Increase in underwater noise and vibration

2788. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2789. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2790. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2791. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[74], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2792. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.33.1.1.1 Mortality

2793. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2794. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2795. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.33.1.1.2 Recoverable injury

2796. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2797. Recoverable injury in proximity to the Liffey piling operations 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

[74] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.33.1.1.3 Temporary threshold shift and behavioural responses

2798. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2799. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2800. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2801. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2802. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.33.1.1.4 Conclusions relating to underwater noise impacts

2803. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2804. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.33.1.2 Presence of EMF

2805. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2806. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2807. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2808. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-104**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-105**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-106**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-104, Plate 2-105**).

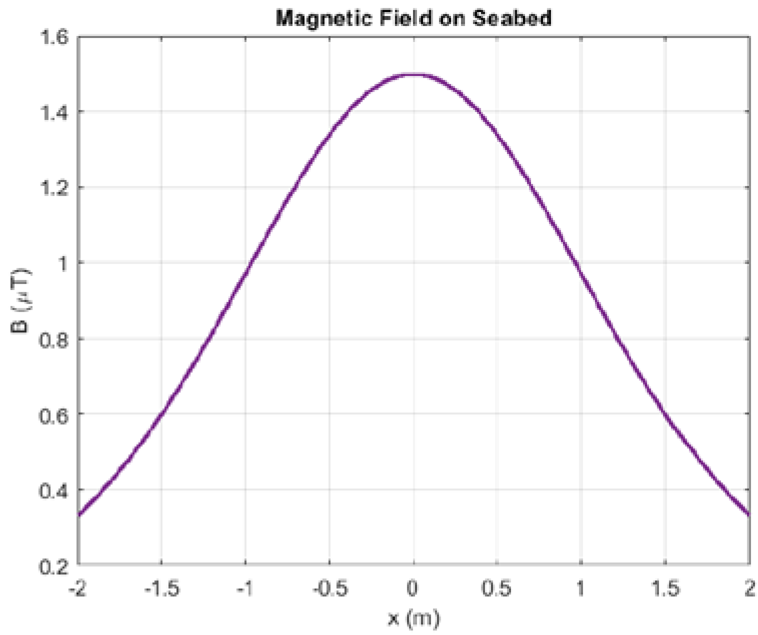

Plate 2-104 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

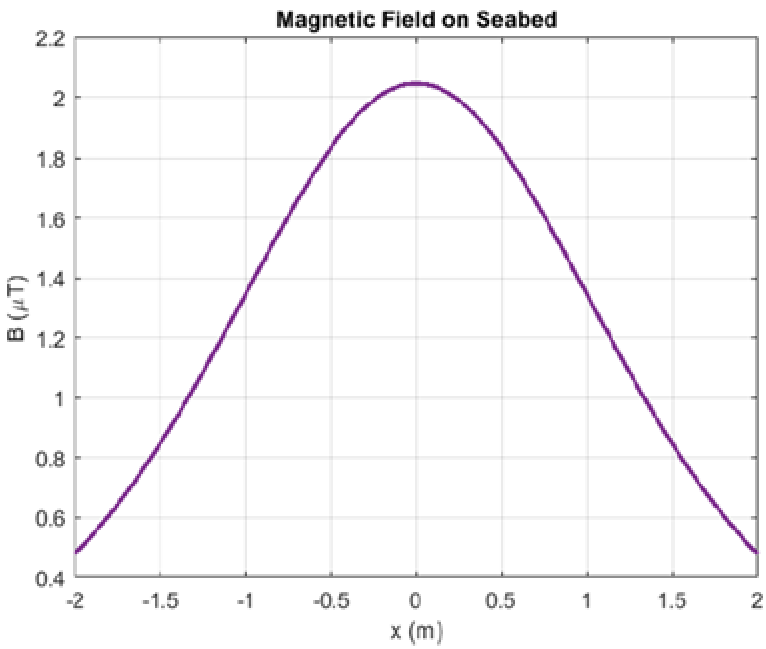

Plate 2-105 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

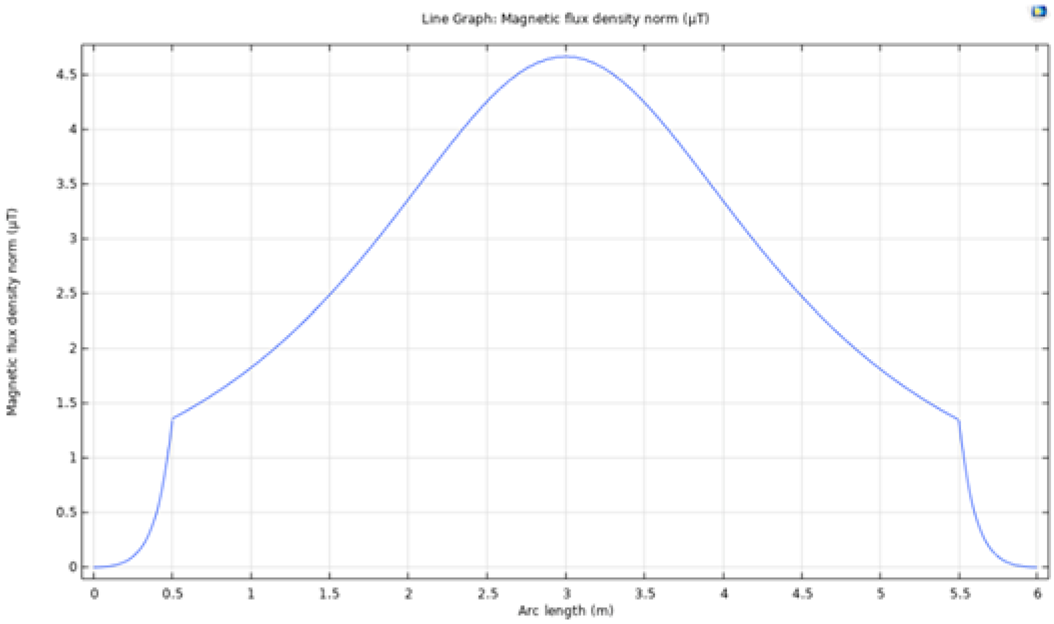

Plate 2-106 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2809. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2810. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2811. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2812. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.33.1.3 Temporary increase in SSC and contaminated sediments

2813. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2814. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2815. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2816. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.33.1.3.1 Dredging and dredge disposal

2817. 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).

2818. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2819. 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.

2.33.1.3.2 Trenching

2820. 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.

2821. Based upon the representative scenario, the modelled 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.

2822. 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.

2823. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2824. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2825. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.33.1.4 Direct impacts on habitats

2826. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2827. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2828. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2829. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2830. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. Accordingly, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.33.1.5 Presence of structures and predator aggregation

2831. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2832. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2833. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2834. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2835. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.33.2 Twaite shad [1103] and Allis shad [1102]

2836. Due to similarities in morphology and sensitivity to the relevant impacts, Twaite shad and Allis shad are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2837. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Twaite shad:

- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term; and
- Factors affecting the population or its habitat should be under appropriate control.

2838. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Allis shad:

- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term; and
- Factors affecting the population or its habitat should be under appropriate control.

2.33.2.1 Increase in underwater noise and vibration

2839. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

2840. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;

- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2841. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2842. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[75], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2843. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

2844. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.33.2.1.1 Mortality

2845. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

2846. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

2847. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood

[75] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.33.2.1.2 Recoverable injury

2848. Recoverable injury effects 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 more realistic fleeing model is used.

2849. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.33.2.1.3 Temporary threshold shift and behavioural responses

2850. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

2851. 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 more realistic fleeing model is used.

2852. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2853. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2854. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130

dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.33.2.1.4 Conclusions relating to underwater noise impacts

2855. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

2856. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.33.2.2 Presence of EMF

2857. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2858. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2859. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2860. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-107**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-108**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-109**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-107, Plate 2-108**).

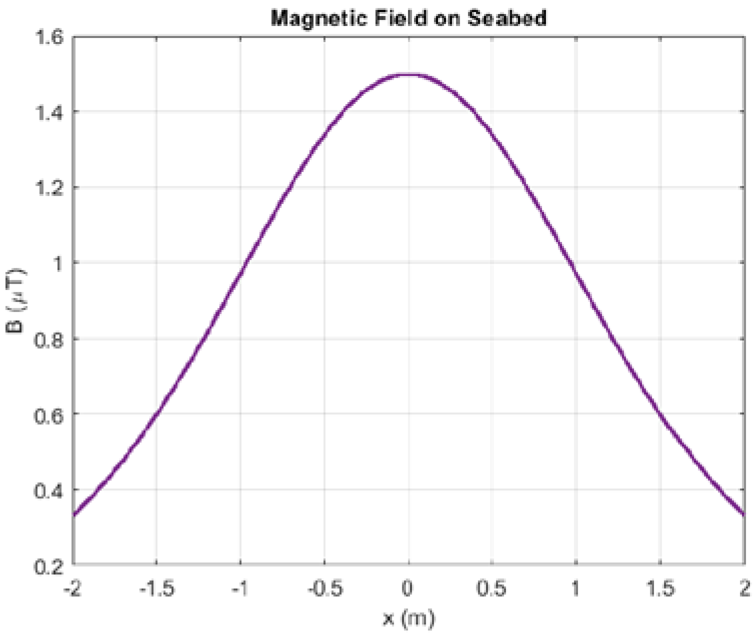

Plate 2-107 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

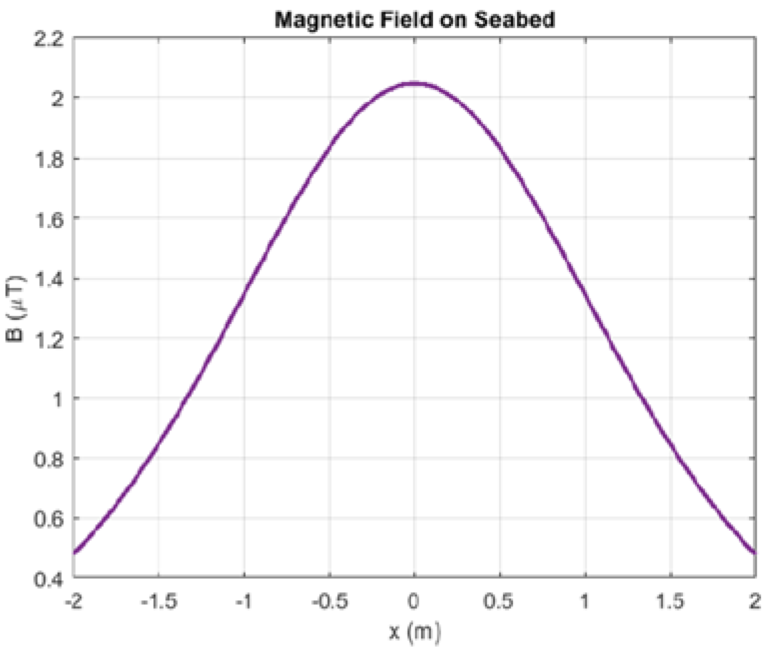

Plate 2-108 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

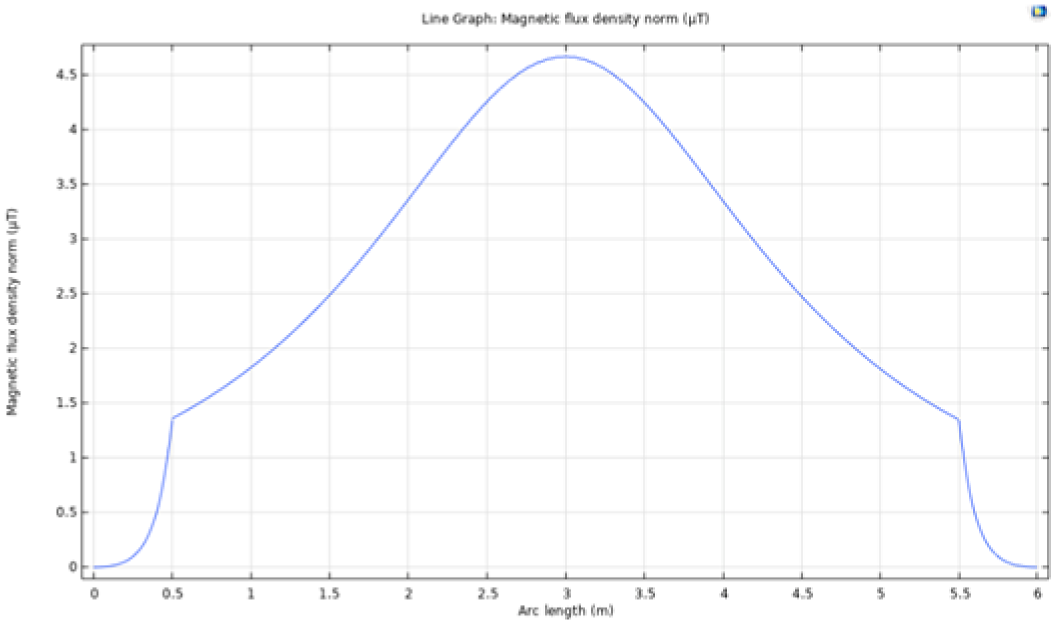

Plate 2-109 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2861. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

2862. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2863. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

2864. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.33.2.3 Temporary increase in SSC and contaminated sediments

2865. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

2866. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2867. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2868. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.33.2.3.1 Dredging and dredge disposal

2869. 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).

2870. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2871. 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.

2.33.2.3.2 Trenching

2872. 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.

2873. Based upon the representative scenario, the modelled 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.

2874. 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.

2875. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2876. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

2877. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.33.2.4 Direct impacts on habitats

2878. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2879. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2880. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2881. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

2882. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.33.2.5 Presence of structures and predator aggregation

2883. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2884. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2885. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected

that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2886. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2887. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.34 Severn Estuary / Môr Hafren (UK0013030)

2888. This SAC is 301 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Twaite shad.

Table 2-55 Conservation Objectives, Attributes and Targets for Severn Estuary / Môr Hafren SAC and summary of associated assessment (NE, 2018a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.34.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.34.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.34.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.34.1**			
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*:* Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.34.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The structure and function of the habitats of qualifying species	Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.34.1**			site integrity predicted from the project alone.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.34.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.34.1**			
[1103] Twaite shad (*Alosa fallax*) Conservation Objective: *Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.34.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.34.2**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.34.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.34.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

2.34.1 Sea lamprey [1095] and River lamprey [1099]

2889. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

2890. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2891. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.34.1.1 Increase in underwater noise and vibration

2892. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2893. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2894. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2895. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[76], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2896. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.34.1.1.1 Mortality

2897. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2898. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2899. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.34.1.1.2 Recoverable injury

2900. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

2901. Recoverable injury in proximity to the Liffey piling operations 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

[76] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.34.1.1.3 Temporary threshold shift and behavioural responses

2902. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

2903. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

2904. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2905. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2906. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.34.1.1.4 Conclusions relating to underwater noise impacts

2907. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

2908. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.34.1.2 Presence of EMF

2909. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2910. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2911. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2912. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-110**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-111**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-112**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-110, Plate 2-111**).

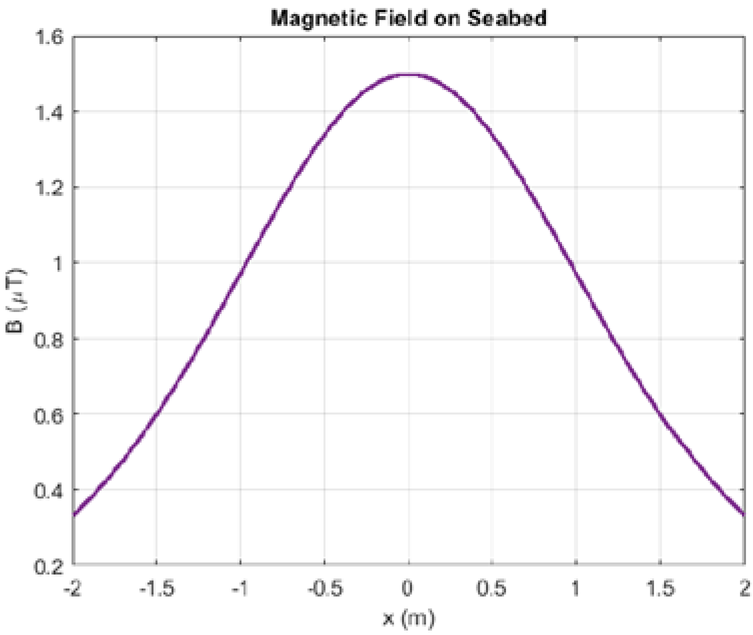

Plate 2-110 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

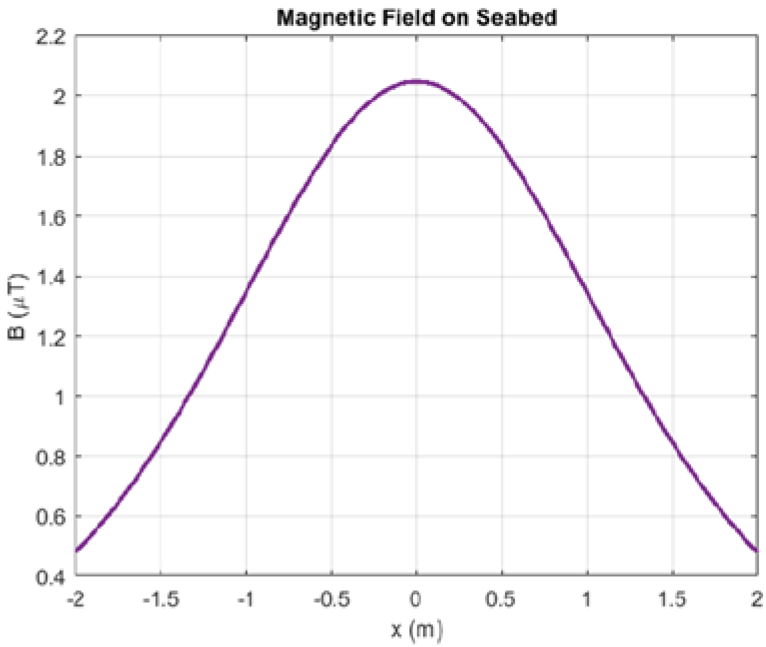

Plate 2-111 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

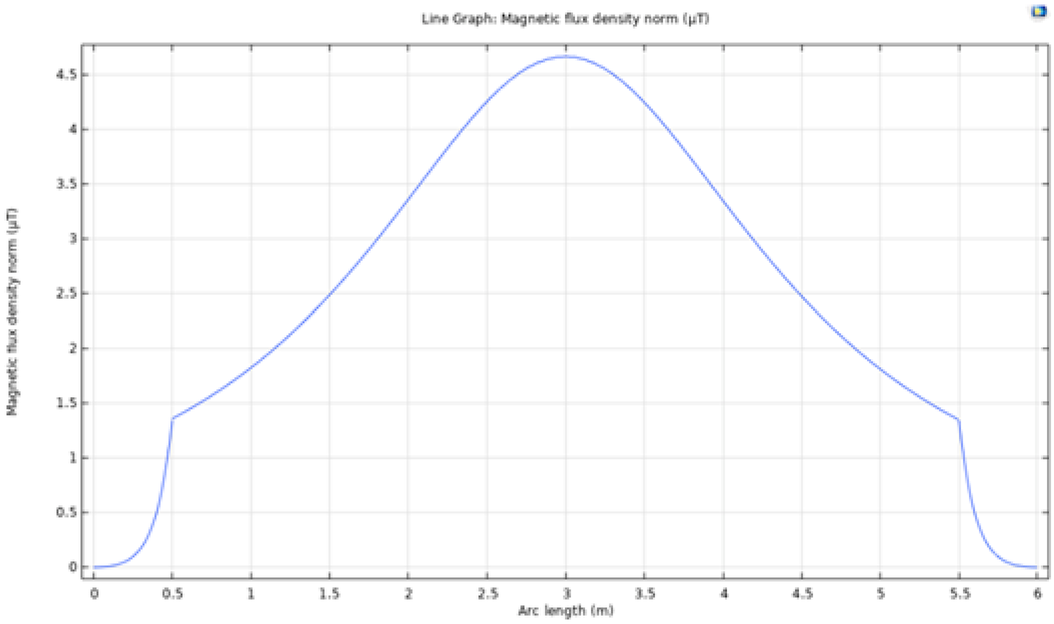

Plate 2-112 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2913. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

2914. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2915. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2916. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.34.1.3 Temporary increase in SSC and contaminated sediments

2917. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

2918. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2919. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

2920. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.34.1.3.1 Dredging and dredge disposal

2921. 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).

2922. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2923. 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.

2.34.1.3.2 Trenching

2924. 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.

2925. Based upon the representative scenario, the modelled 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.

2926. 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.

2927. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2928. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

2929. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.34.1.4 Direct impacts on habitats

2930. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2931. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2932. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2933. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

2934. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.34.1.5 Presence of structures and predator aggregation

2935. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2936. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2937. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2938. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2939. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.34.2 Twaite shad [1103]

2940. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.34.2.1 Increase in underwater noise and vibration

2941. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

2942. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2943. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2944. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[77], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

2945. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

2946. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.34.2.1.1 Mortality

2947. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

2948. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

2949. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.34.2.1.2 Recoverable injury

2950. Recoverable injury effects 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

[77] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2951. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.34.2.1.3 Temporary threshold shift and behavioural responses

2952. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

2953. 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 more realistic fleeing model is used.

2954. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

2955. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

2956. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.34.2.1.4 Conclusions relating to underwater noise impacts

2957. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

2958. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.34.2.2 Presence of EMF

2959. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

2960. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

2961. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

2962. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-113**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-114**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-115**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-113, Plate 2-114**).

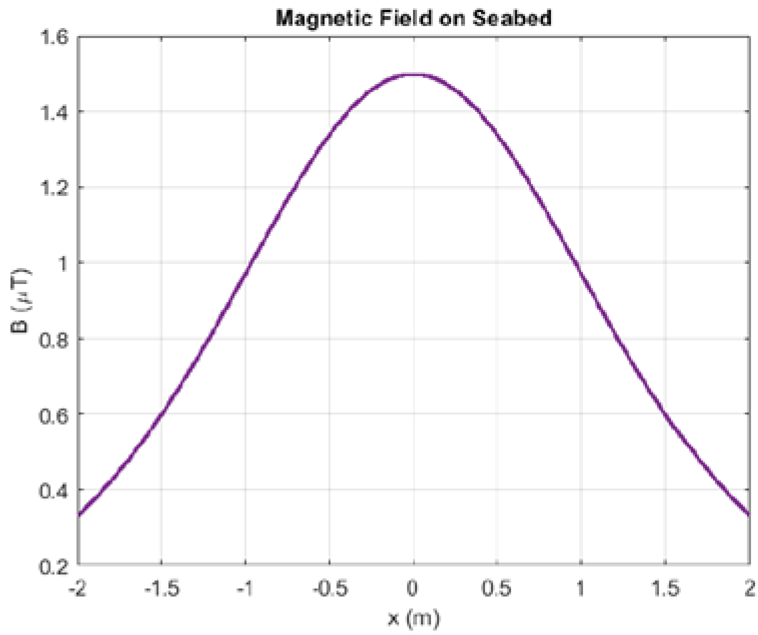

Plate 2-113 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

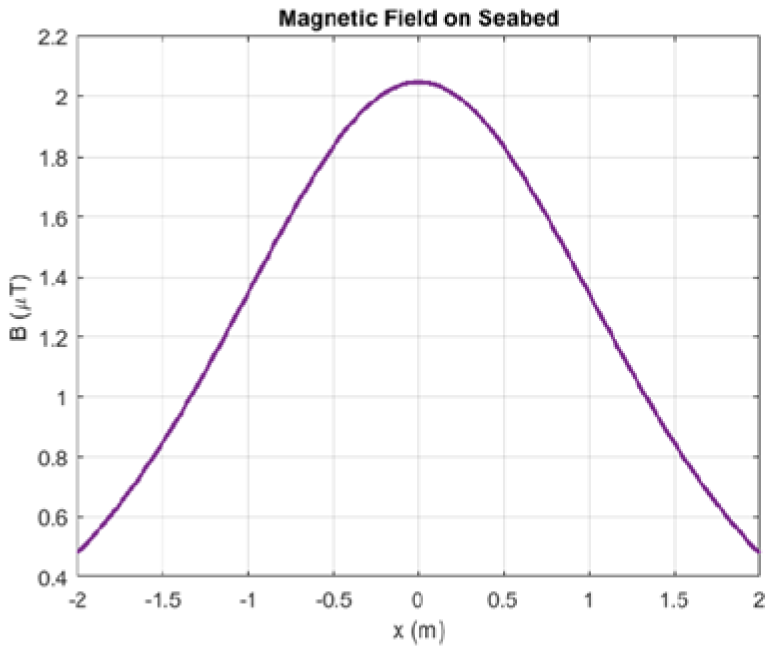

Plate 2-114 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

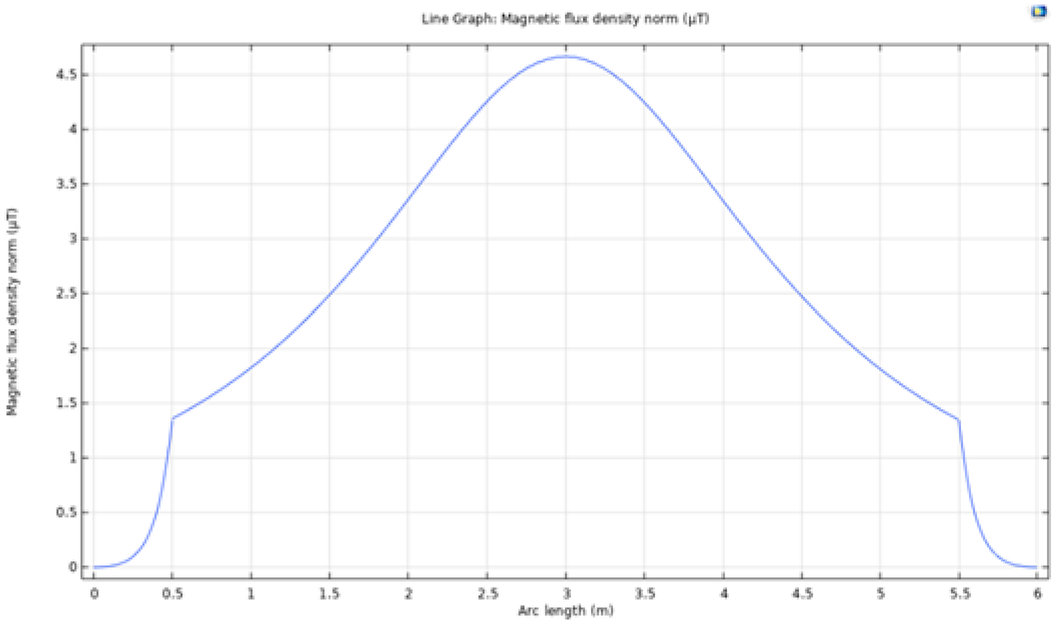

Plate 2-115 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

2963. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

2964. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

2965. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

2966. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.34.2.3 Temporary increase in SSC and contaminated sediments

2967. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

2968. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

2969. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

2970. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.34.2.3.1 Dredging and dredge disposal

2971. 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).

2972. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

2973. 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.

2.34.2.3.2 Trenching

2974. 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.

2975. Based upon the representative scenario, the modelled 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.

2976. 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.

2977. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

2978. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

2979. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.34.2.4 Direct impacts on habitats

2980. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

2981. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

2982. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

2983. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

2984. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.34.2.5 Presence of structures and predator aggregation

2985. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

2986. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

2987. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected

that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

2988. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

2989. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.35 River Usk / Afon Wysg (UK0013007)

2990. This SAC is 327 km from the offshore development area and is screened in for River lamprey and Allis shad.

Table 2-56 Conservation Objectives, Attributes and Targets for River Usk / Afon Wysg SAC and summary of associated assessment (Natural Resources Wales, 2022b)

Attributes and Targets	**Predicted Effect**	**Mitigation**	**Residual Effect**	**Conclusion**
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: To restore the favourable conservation condition of the Qualifying Feature in the SAC, which is defined by the following list of attributes and targets:*				
The population of the feature in the SAC is stable or increasing over the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.35.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.35.1**			the project alone.
Maintain a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis	No direct or indirect impact on SAC habitats and thus no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
[1102] Allis shad *(Alosa alosa)* Conservation Objective*: To restore the favourable conservation condition of the Qualifying Feature in the SAC, which is defined by the following list of attributes and targets:*				
The population of the feature in the SAC is stable or increasing over the long term	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.35.2**			the project alone.
The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.35.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.
Maintain a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis	No direct or indirect impact on SAC habitat, and therefore no impact on this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone.

2.35.1 River lamprey [1099]

2991. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The population of the feature in the SAC is stable or increasing over the long term; and
- The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.

2.35.1.1 Increase in underwater noise and vibration

2992. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

2993. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

2994. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

2995. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[78], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

[78] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2996. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.35.1.1.1 Mortality

2997. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

2998. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2999. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.35.1.1.2 Recoverable injury

3000. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3001. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.35.1.1.3 Temporary threshold shift and behavioural responses

3002. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3003. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3004. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3005. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3006. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.35.1.1.4 Conclusions relating to underwater noise impacts

3007. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3008. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.35.1.2 Presence of EMF

3009. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3010. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3011. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3012. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-116**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-117**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-118**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-116, Plate 2-117**).

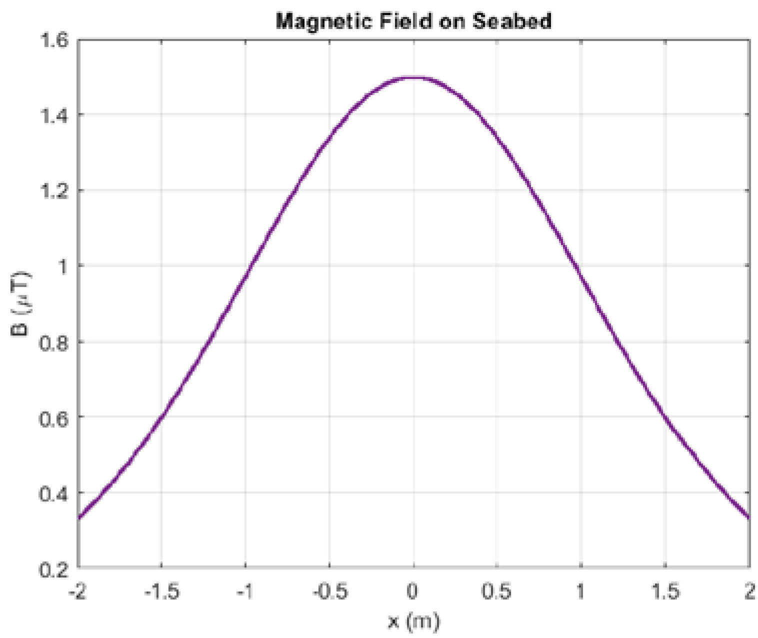

Plate 2-116 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

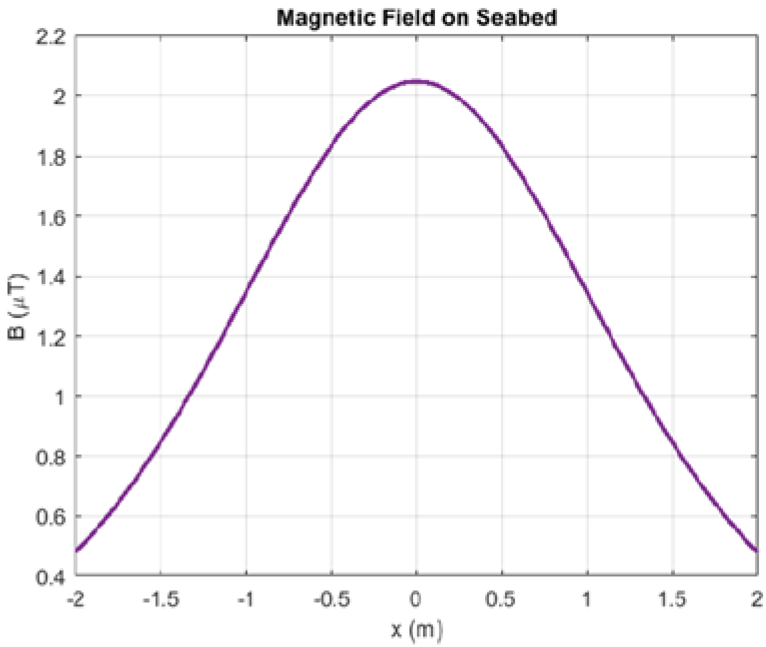

Plate 2-117 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

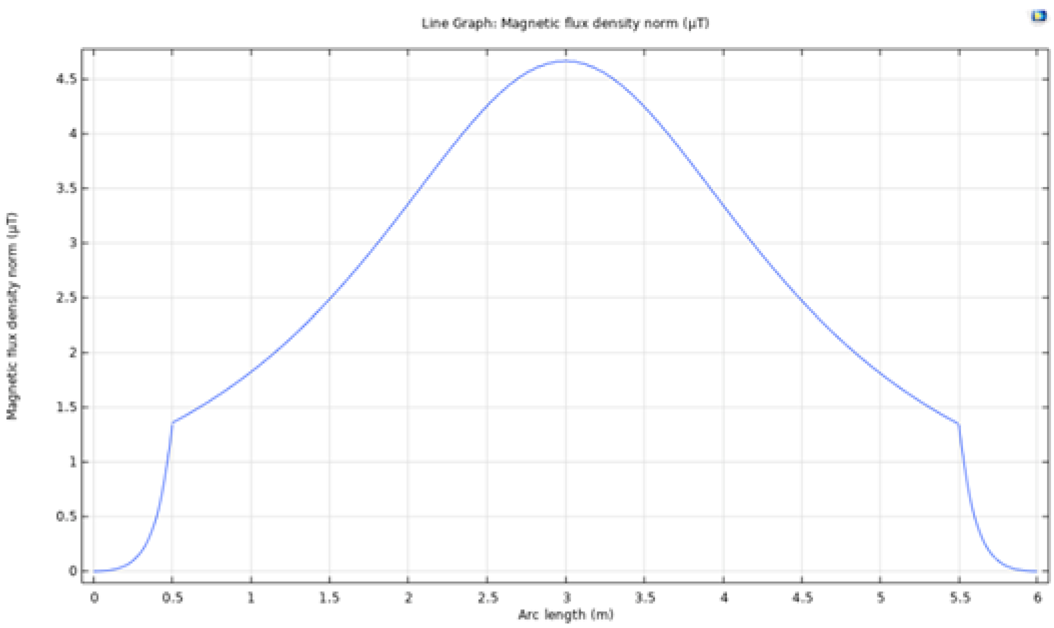

Plate 2-118 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3013. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3014. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3015. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3016. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.35.1.3 Temporary increase in SSC and contaminated sediments

3017. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3018. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3019. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3020. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.35.1.3.1 Dredging and dredge disposal

3021. 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).

3022. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3023. 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.

2.35.1.3.2 Trenching

3024. 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.

3025. Based upon the representative scenario, the modelled 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.

3026. 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.

3027. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3028. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3029. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.35.1.4 Direct impacts on habitats

3030. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3031. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3032. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3033. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3034. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish

Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.35.1.5 Presence of structures and predator aggregation

3035. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3036. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3037. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3038. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3039. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.35.2 Allis shad [1103]

3040. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The population of the feature in the SAC is stable or increasing over the long term.

2.35.2.1 Increase in underwater noise and vibration

3041. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought

to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

3042. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3043. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3044. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[79], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3045. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

3046. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.35.2.1.1 Mortality

3047. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 14 km^2 or a maximum distance of 2,200 m from the source for cumulative level

[79] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or less than 100 m from the source when the more realistic fleeing model is used.

3048. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

3049. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.35.2.1.2 Recoverable injury

3050. Recoverable injury effects 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 more realistic fleeing model is used.

3051. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.35.2.1.3 Temporary threshold shift and behavioural responses

3052. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

3053. 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 more realistic fleeing model is used.

3054. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3055. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable

margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3056. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.35.2.1.4 Conclusions relating to underwater noise impacts

3057. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

3058. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.35.2.2 Presence of EMF

3059. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3060. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3061. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3062. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-119**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-120**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-121**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-119, Plate 2-120**).

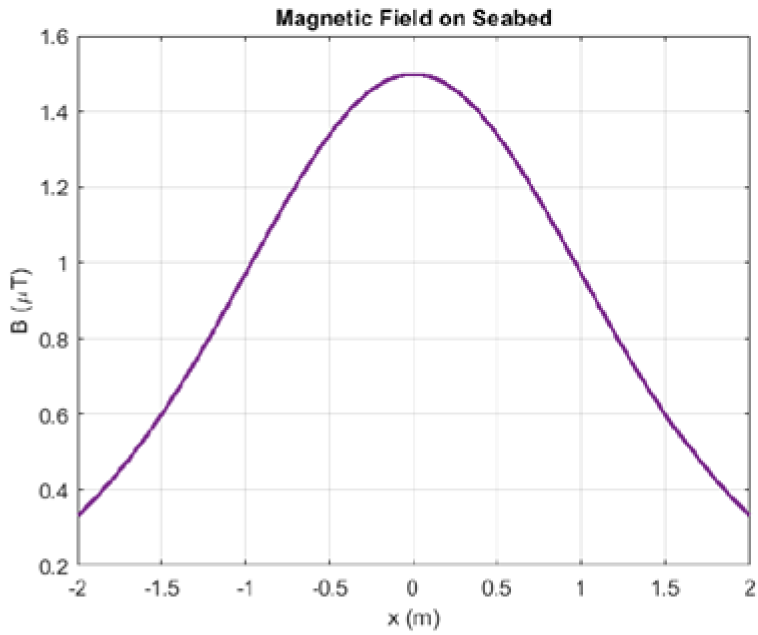

Plate 2-119 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

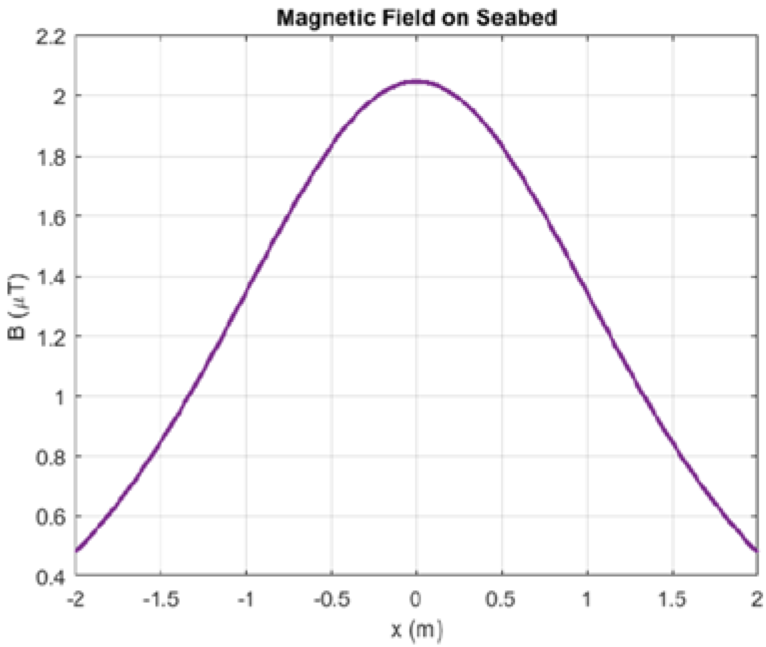

Plate 2-120 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

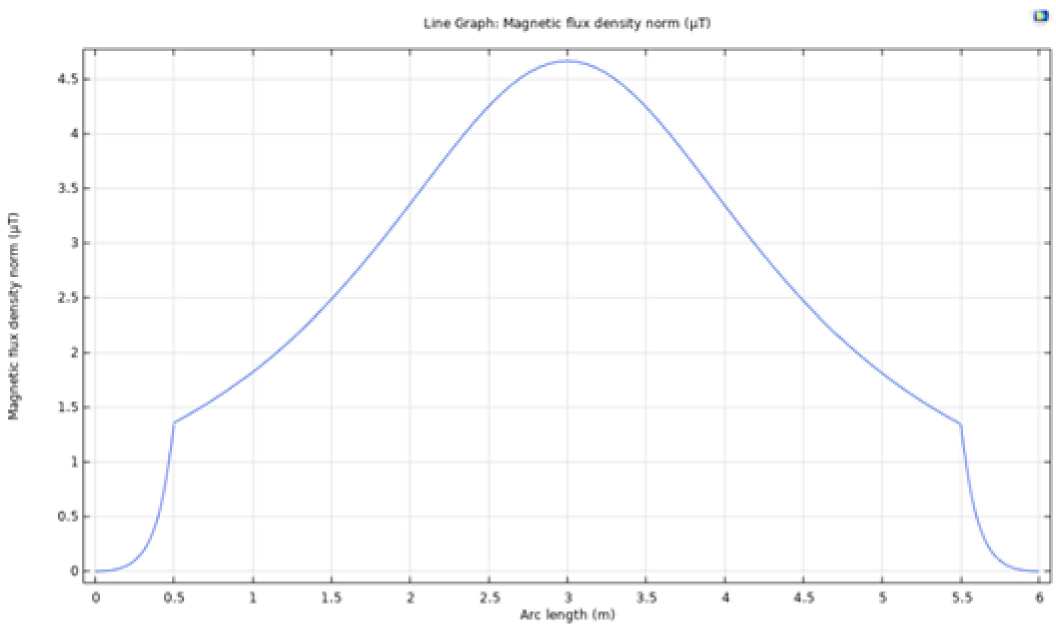

Plate 2-121 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3063. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

3064. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3065. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

3066. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.35.2.3 Temporary increase in SSC and contaminated sediments

3067. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

3068. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3069. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area.

However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3070. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.35.2.3.1 Dredging and dredge disposal

3071. 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).

3072. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3073. 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.

2.35.2.3.2 Trenching

3074. 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.

3075. Based upon the representative scenario, the modelled 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.

3076. 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.

3077. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3078. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

3079. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.35.2.4 Direct impacts on habitats

3080. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3081. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3082. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3083. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to

950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

3084. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.35.2.5 Presence of structures and predator aggregation

3085. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3086. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3087. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3088. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3089. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.36 River Wye / Afon Gwy SAC (UK0012642)

3090. This SAC is 349 km from the offshore development area and is screened in for Sea lamprey, River lamprey, Twaite shad, Allis shad and Atlantic salmon.

Table 2-57 Conservation Objectives, Attributes and Targets for River Wye / Afon Gwy SAC and summary of associated assessment (NE, 2018b)

Attributes and Targets	**Predicted Effect**	**Mitigation**	**Residual Effect**	**Conclusion**
[1095] Sea lamprey (*Petromyzon marinus)* Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.36.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.36.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.36.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1103] Twaite shad (*Alosa fallax)* Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.36.2**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1102] Allis shad *(Alosa alosa)*				
Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.36.2**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.36.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1106] Atlantic salmon (*Salmo salar*)				
Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.36.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.36.3**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.36.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.36.3**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.36.1 Sea lamprey [1095] and River lamprey [1099]

3091. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3092. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3093. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.36.1.1 Increase in underwater noise and vibration

3094. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3095. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3096. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3097. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[80], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3098. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.36.1.1.1 Mortality

3099. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3100. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3101. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.36.1.1.2 Recoverable injury

3102. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3103. Recoverable injury in proximity to the Liffey piling operations 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

[80] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.36.1.1.3 Temporary threshold shift and behavioural responses

3104. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3105. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3106. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3107. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3108. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.36.1.1.4 Conclusions relating to underwater noise impacts

3109. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3110. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.36.1.2 Presence of EMF

3111. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3112. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3113. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3114. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-122**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-123**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-124**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-122, Plate 2-123**).

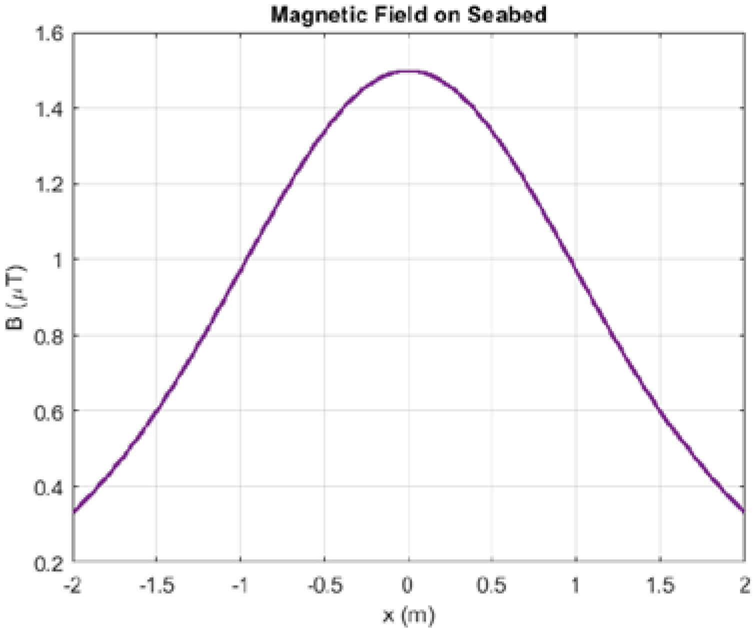

Plate 2-122 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

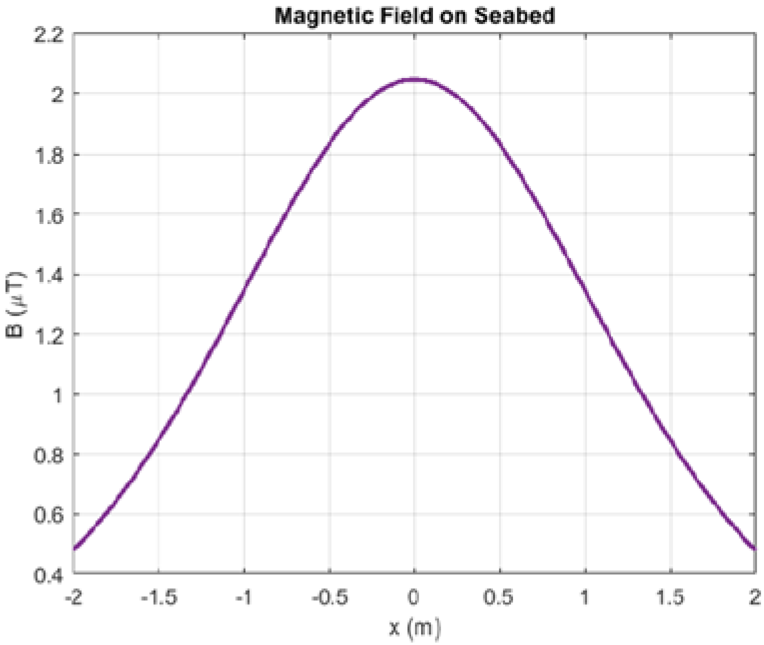

Plate 2-123 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

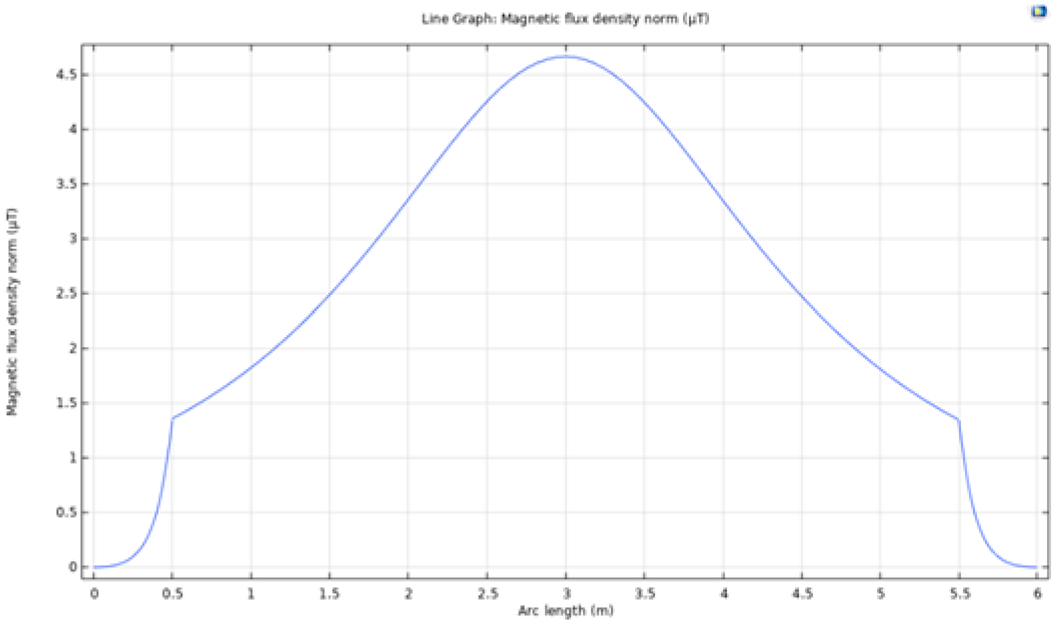

Plate 2-124 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3115. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3116. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3117. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3118. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.36.1.3 Temporary increase in SSC and contaminated sediments

3119. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3120. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3121. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3122. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.36.1.3.1 Dredging and dredge disposal

3123. 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).

3124. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3125. 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.

2.36.1.3.2 Trenching

3126. 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.

3127. Based upon the representative scenario, the modelled 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.

3128. 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.

3129. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3130. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3131. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.36.1.4 Direct impacts on habitats

3132. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3133. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3134. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3135. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3136. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.36.1.5 Presence of structures and predator aggregation

3137. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3138. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3139. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3140. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3141. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.36.2 Twaite shad [1103] and Allis shad [1102]

3142. Due to similarities in morphology and sensitivity to the relevant impacts, Twaite shad and Allis shad are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3143. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Twaite shad:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3144. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Allis shad:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.36.2.1 Increase in underwater noise and vibration

3145. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

3146. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;

- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3147. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3148. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[81], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3149. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

3150. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.36.2.1.1 Mortality

3151. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

3152. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

[81] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

3153. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.36.2.1.2 Recoverable injury

3154. Recoverable injury effects 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 more realistic fleeing model is used.

3155. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.36.2.1.3 Temporary threshold shift and behavioural responses

3156. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

3157. 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 more realistic fleeing model is used.

3158. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3159. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3160. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.36.2.1.4 Conclusions relating to underwater noise impacts

3161. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

3162. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.36.2.2 Presence of EMF

3163. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3164. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3165. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3166. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-125**, 2 µT for a 1800 Cu mild steel cable (**Plate 2-126**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate**

2-127). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-125, Plate 2-126**).

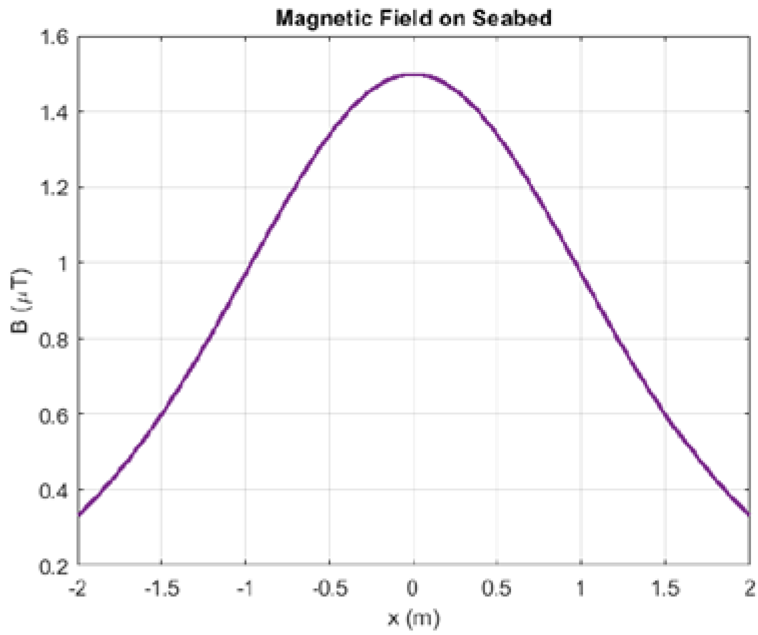

Plate 2-125 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

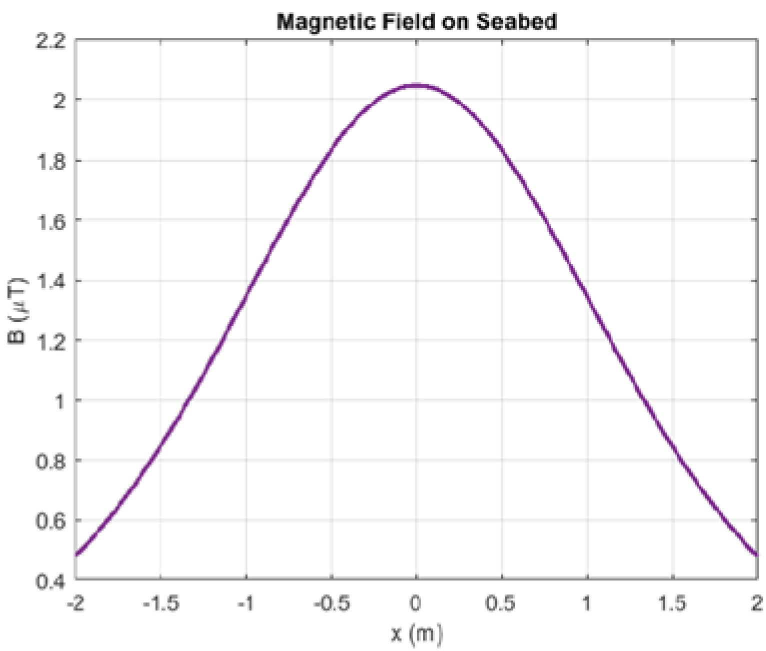

Plate 2-126 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

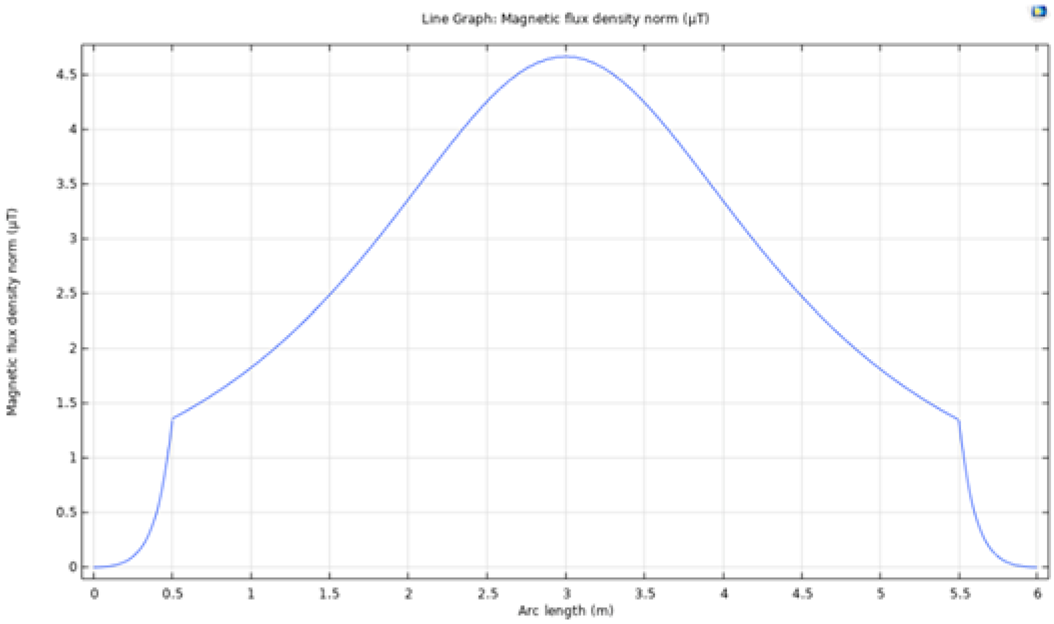

Plate 2-127 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3167. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

3168. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3169. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

3170. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.36.2.3 Temporary increase in SSC and contaminated sediments

3171. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

3172. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3173. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3174. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.36.2.3.1 Dredging and dredge disposal

3175. 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).

3176. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3177. 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.

2.36.2.3.2 Trenching

3178. 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.

3179. Based upon the representative scenario, the modelled 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.

3180. 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.

3181. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3182. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

3183. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.36.2.4 Direct impacts on habitats

3184. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3185. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3186. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3187. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

3188. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.36.2.5 Presence of structures and predator aggregation

3189. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3190. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3191. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3192. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3193. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these factorsfactors, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.36.3 Atlantic salmon [1106]

3194. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.36.3.1 Increase in underwater noise and vibration

3195. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3196. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3197. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3198. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[82], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3199. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3200. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.36.3.1.1 Mortality

3201. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3202. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3203. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

[82] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.36.3.1.2 Recoverable injury

3204. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

3205. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.36.3.1.3 Temporary threshold shift and behavioural responses

3206. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3207. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3208. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3209. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3210. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.36.3.1.4 Conclusions relating to underwater noise impacts

3211. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3212. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.36.3.2 Presence of EMF

3213. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3214. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3215. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3216. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-128**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-129**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-130**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-128, Plate 2-129**).

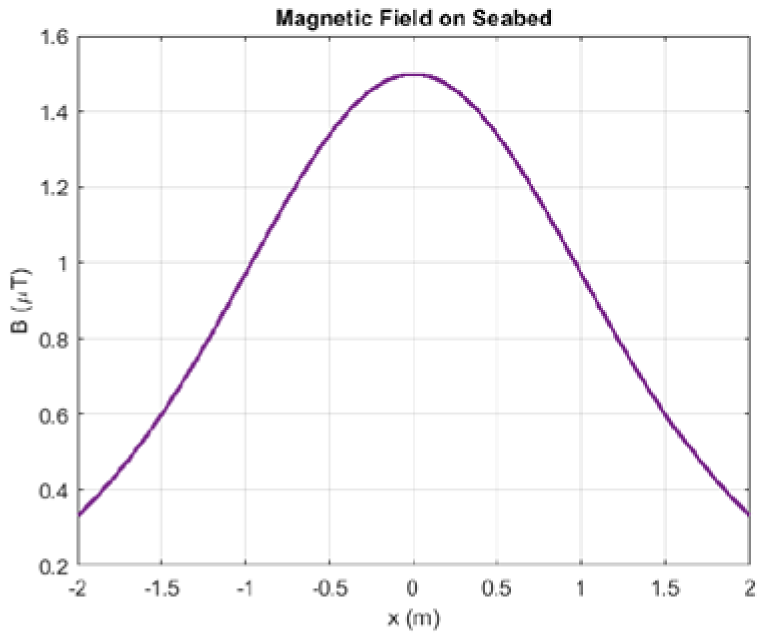

Plate 2-128 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

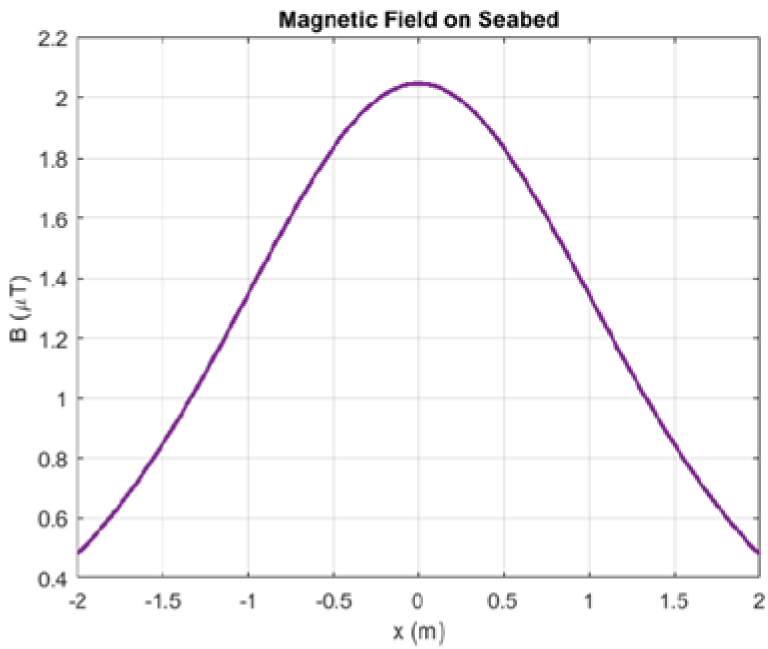

Plate 2-129 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

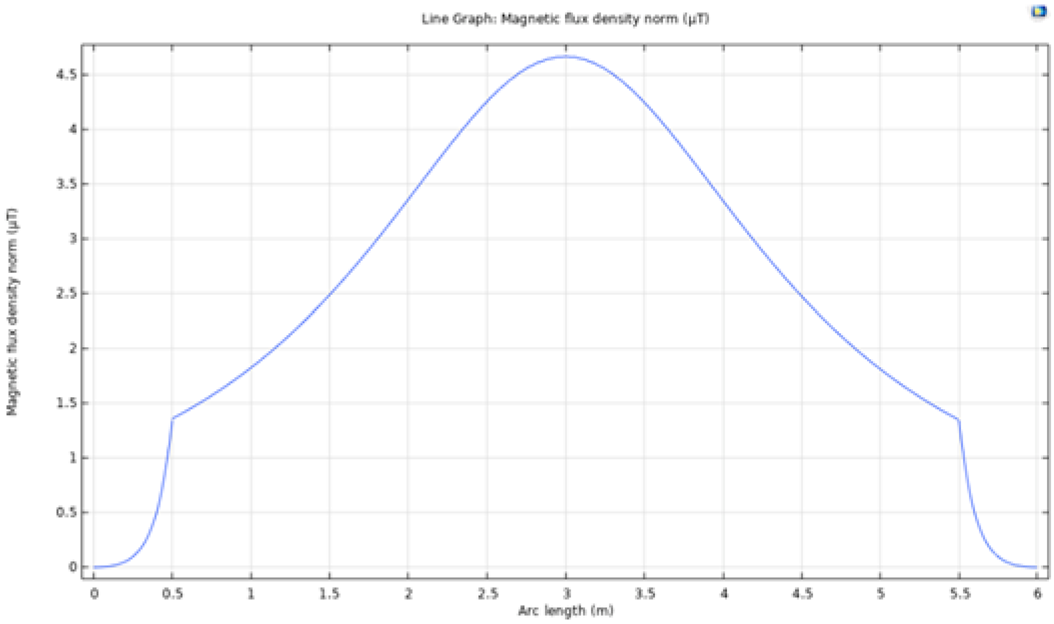

Plate 2-130 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3217. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3218. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3219. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3220. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.36.3.3 Temporary increase in SSC and contaminated sediments

3221. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3222. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3223. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3224. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.36.3.3.1 Dredging and dredge disposal

3225. 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).

3226. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3227. 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.

2.36.3.3.2 Trenching

3228. 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.

3229. Based upon the representative scenario, the modelled 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.

3230. 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.

3231. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3232. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[83]). This is considerably higher than the predicted levels of

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[83]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3233. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.36.3.4 Direct impacts on habitats

3234. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3235. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3236. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3237. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3238. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.36.3.5 Presence of structures and predator aggregation

3239. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3240. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3241. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3242. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3243. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.37 Afon Teifi / River Teifi (UK0012670)

3244. This SAC is 121 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-58 Conservation Objectives, Attributes and Targets for Afon Teifi / River Teifi and summary of associated assessment (Cyngor Cefn Gwlad Cymru Countryside Council for Wales 2008a)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) *Conversation Objective: The vision for these features is for them to be in a FCS, where all of the following conditions are satisfied:*				
Distribution within catchment. Suitable habitat adjacent to or downstream of suitable spawning sites should contain *Petromyzon* ammocoetes; spawning adults to be reported from units 1–2 in at least 5 years out of 6	CWP Project has no connectivity to SAC habitat and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Ammocoete density. Ammocoetes should be present in at least four sampling sites each not less than 5 km apart	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.37.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) *Conversation Objective: The vision for these features is for them to be in a FCS, where all of the following conditions are satisfied:*				
Age / size structure of ammocoete population. Samples <50 ammocoetes contain at least 2 size classes; samples of >50 ammocoetes at least 3 size classes	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.37.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Distribution of ammocoetes within catchment. Present at not less than 2 / 3 of sites surveyed within natural range; no reduction in distribution of ammocoetes	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Presence of structures and predator aggregation. See **Section 2.37.1**			
Ammocoete density. Optimal habitat: >10 /m^2; overall catchment mean: >5 /m^2	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.37.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*) *Conversation Objective: The vision for these features is for them to be in a FCS, where all of the following conditions are satisfied:*				
Adult run size. Conservation Limit complied with at least four years in five	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.37.2**			
Juvenile densities. Expected densities for each sample site using HABSCORE	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.37.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.37.1 Sea lamprey [1095] and River lamprey [1099]

3245. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3246. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Ammocoete density. Ammocoetes should be present in at least four sampling sites each not less than 5 km apart.

3247. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Distribution of ammocoetes within catchment. Present at not less than 2 / 3 of sites surveyed within natural range; no reduction in distribution of ammocoetes;
- Age / size structure of ammocoete population. Samples <50 ammocoetes contain at least 2 size classes; samples of >50 ammocoetes at least 3 size classes; and
- Ammocoete density. Optimal habitat: >10 /m^2; overall catchment mean: >5 /m^2.

2.37.1.1 Increase in underwater noise and vibration

3248. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3249. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3250. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3251. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[84], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3252. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.37.1.1.1 Mortality

3253. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3254. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3255. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.37.1.1.2 Recoverable injury

3256. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3257. Recoverable injury in proximity to the Liffey piling operations 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

[84] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.37.1.1.3 Temporary threshold shift and behavioural responses

3258. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3259. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3260. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3261. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3262. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.37.1.1.4 Conclusions relating to underwater noise impacts

3263. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3264. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.37.1.2 Presence of EMF

3265. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3266. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3267. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3268. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-131**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-132**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-133**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-131, Plate 2-132**).

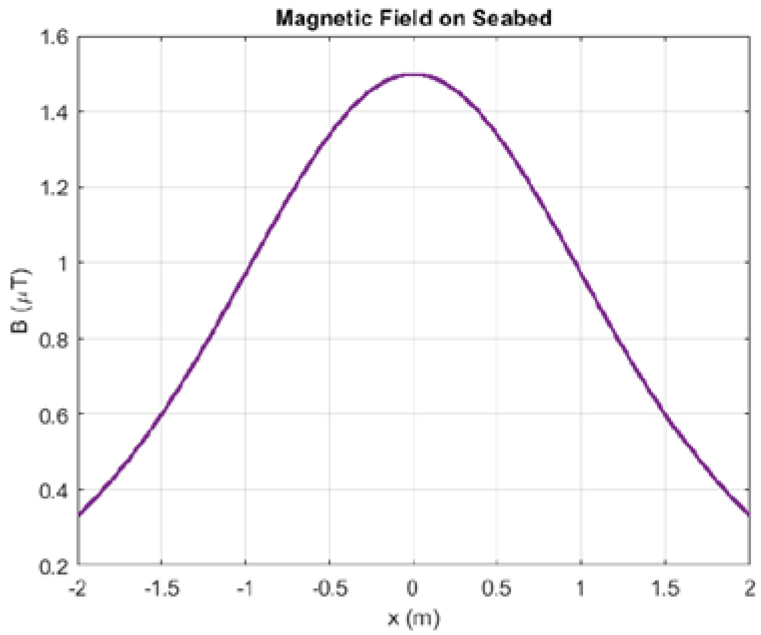

Plate 2-131 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

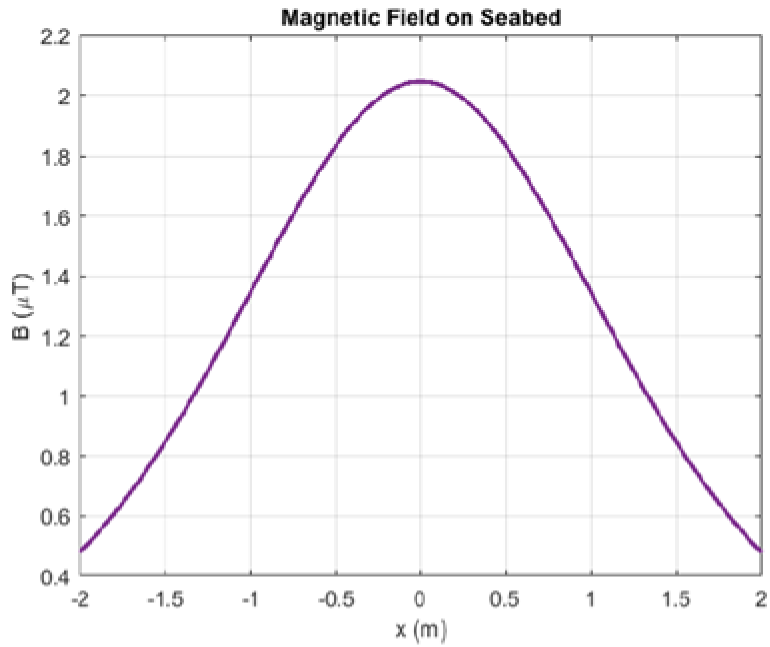

Plate 2-132 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

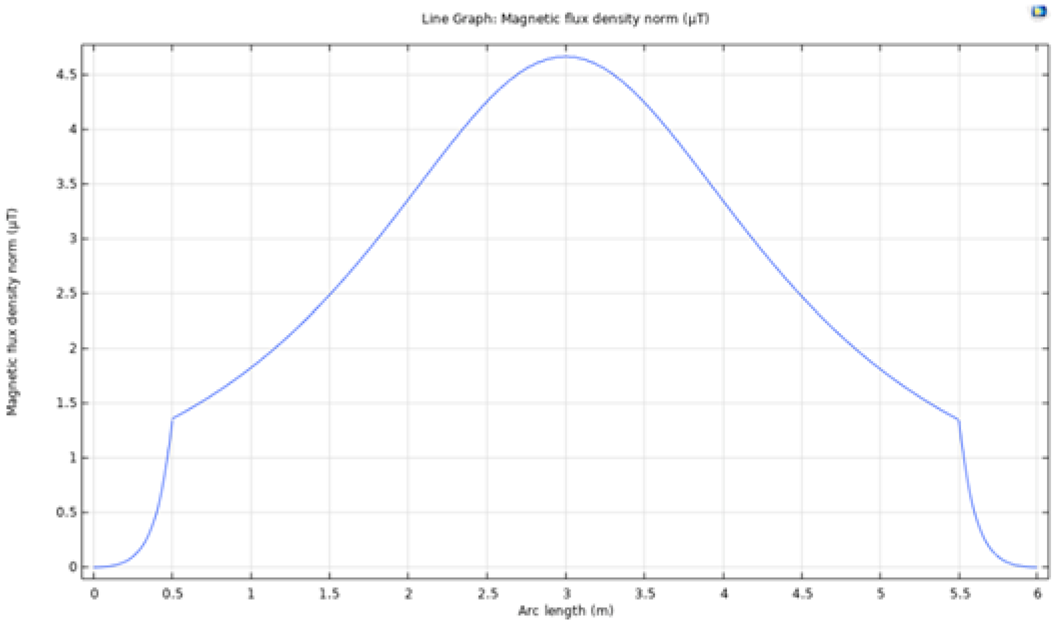

Plate 2-133 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3269. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3270. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3271. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3272. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.37.1.3 Temporary increase in SSC and contaminated sediments

3273. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3274. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3275. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3276. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.37.1.3.1 Dredging and dredge disposal

3277. 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).

3278. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3279. 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.

2.37.1.3.2 Trenching

3280. 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.

3281. Based upon the representative scenario, the modelled 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.

3282. 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.

3283. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3284. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3285. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.37.1.4 Direct impacts on habitats

3286. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3287. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3288. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3289. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3290. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.37.1.5 Presence of structures and predator aggregation

3291. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3292. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3293. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3294. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3295. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.37.2 Atlantic salmon [1106]

3296. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- Adult run size. Conservation Limit complied with at least four years in five; and
- Juvenile densities. Expected densities for each sample site using HABSCORE.

2.37.2.1 Increase in underwater noise and vibration

3297. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3298. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3299. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3300. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[85], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3301. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3302. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.37.2.1.1 Mortality

3303. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3304. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3305. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.37.2.1.2 Recoverable injury

3306. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

[85] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

3307. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.37.2.1.3 Temporary threshold shift and behavioural responses

3308. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3309. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3310. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3311. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3312. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.37.2.1.4 Conclusions relating to underwater noise impacts

3313. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3314. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.37.2.2 Presence of EMF

3315. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3316. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3317. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3318. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-134**, 2 µT for a 1800 Cu mild steel cable (**Plate 2-135**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-136**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-134, Plate 2-135**).

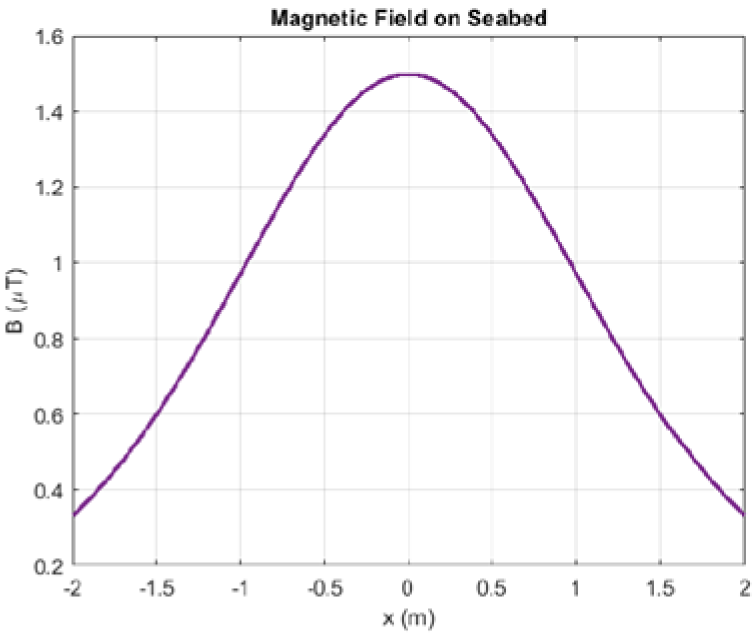

Plate 2-134 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

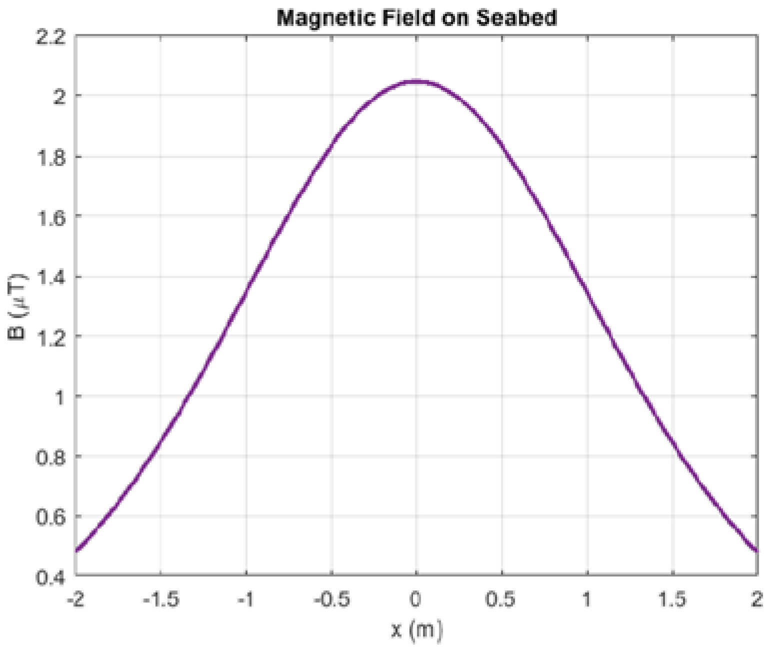

Plate 2-135 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

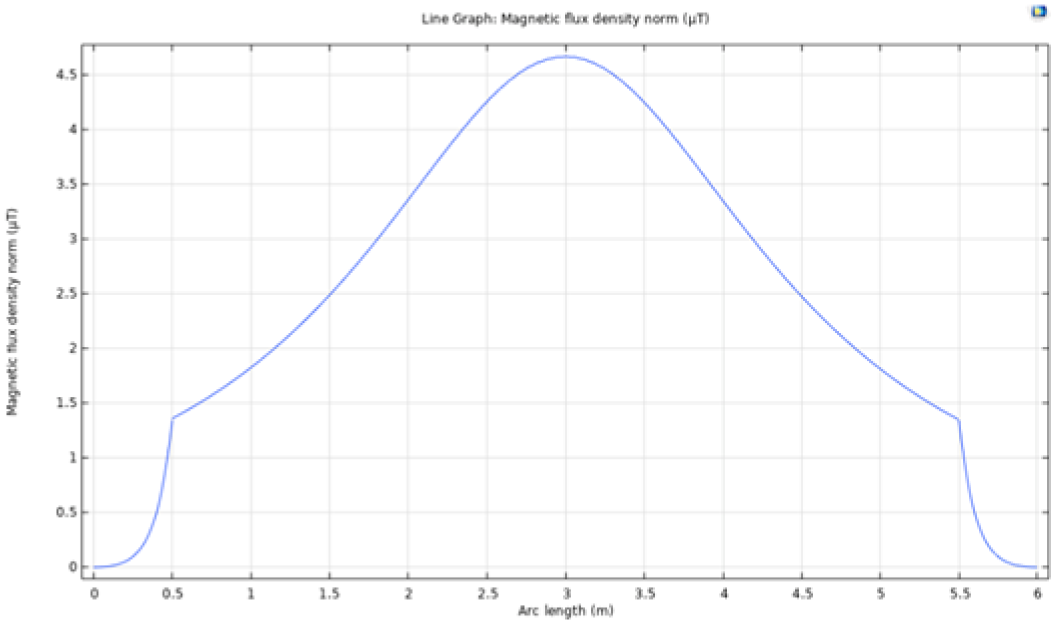

Plate 2-136 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3319. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3320. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3321. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3322. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.37.2.3 Temporary increase in SSC and contaminated sediments

3323. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3324. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3325. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3326. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.37.2.3.1 Dredging and dredge disposal

3327. 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).

3328. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3329. 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.

2.37.2.3.2 Trenching

3330. 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.

3331. Based upon the representative scenario, the modelled 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.

3332. 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.

3333. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3334. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[86]). This is considerably higher than the predicted levels of

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[86]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3335. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.37.2.4 Direct impacts on habitats

3336. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3337. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3338. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3339. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3340. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.37.2.5 Presence of structures and predator aggregation

3341. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3342. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3343. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3344. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3345. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.38 Dee Estuary / Aber Dyfrdwy (UK0030131)

3346. This SAC is 162 km from the offshore development area and is screened in for Sea lamprey and River lamprey.

Table 2-59 Conservation Objectives, Attributes and Targets for Dee Estuary / Aber Dyfrdwy SAC and summary of associated assessment (NE, 2018c)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.38.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.38.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.3.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.38.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.38.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.38.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.3.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.38.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.38.1 Sea lamprey [1095] and River lamprey [1099]

3347. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3348. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3349. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.38.1.1 Increase in underwater noise and vibration

3350. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3351. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3352. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

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3353. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[87], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3354. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.38.1.1.1 Mortality

3355. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3356. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3357. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.38.1.1.2 Recoverable injury

3358. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

[87] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

3359. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.38.1.1.3 Temporary threshold shift and behavioural responses

3360. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3361. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3362. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3363. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3364. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.38.1.1.4 Conclusions relating to underwater noise impacts

3365. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3366. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.38.1.2 Presence of EMF

3367. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3368. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3369. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3370. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-137**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-138**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-139**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-137, Plate 2-138**).

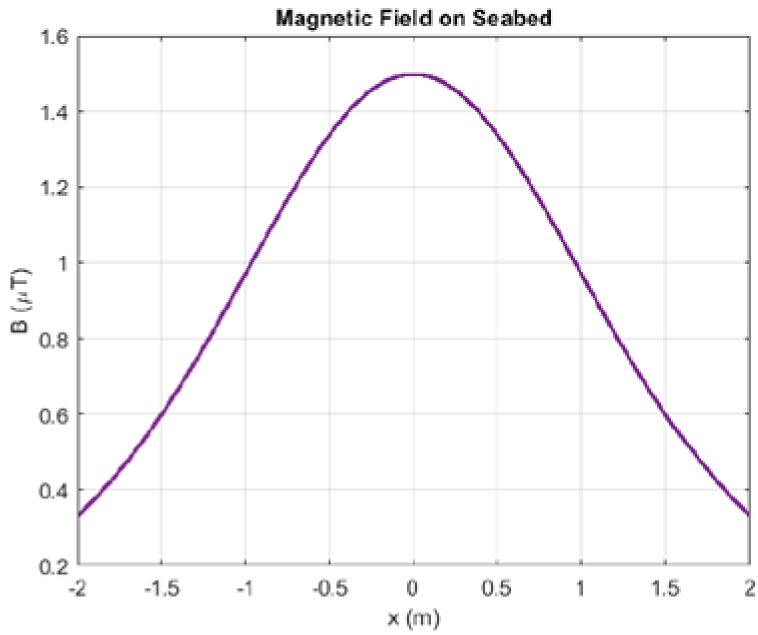

Plate 2-137 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

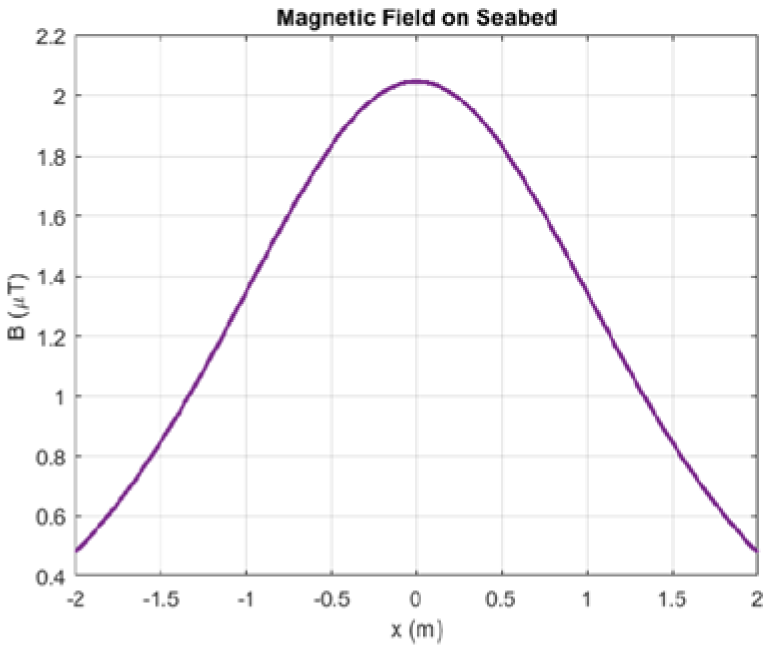

Plate 2-138 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

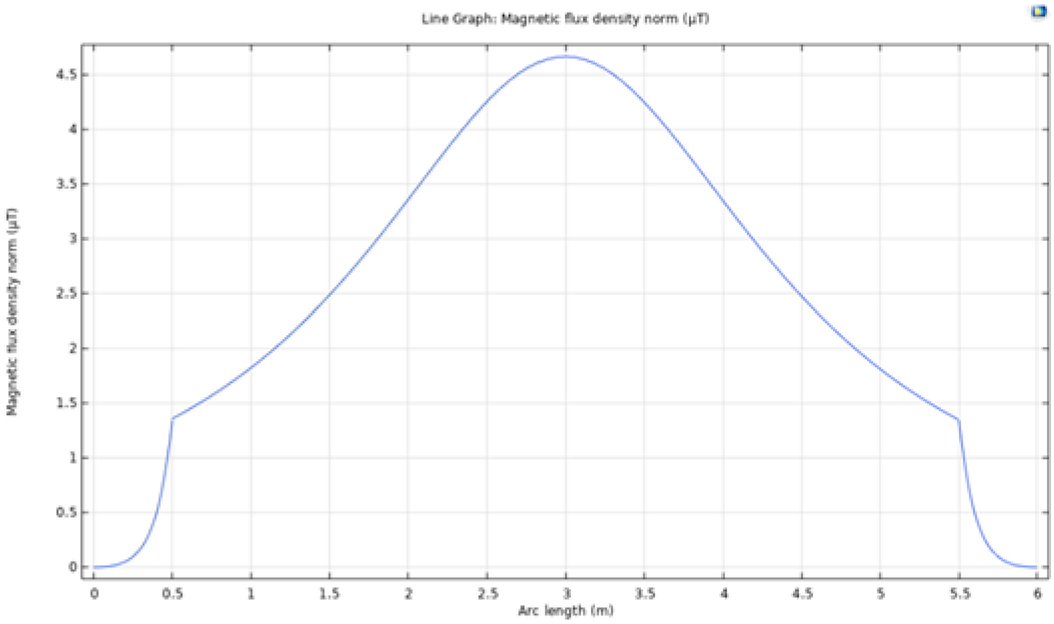

Plate 2-139 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3371. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3372. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3373. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3374. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.38.1.3 Temporary increase in SSC and contaminated sediments

3375. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3376. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3377. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3378. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.38.1.3.1 Dredging and dredge disposal

3379. 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).

3380. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3381. 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.

2.38.1.3.2 Trenching

3382. 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.

3383. Based upon the representative scenario, the modelled 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.

3384. 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.

3385. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3386. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3387. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

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2.38.1.4 Direct impacts on habitats

3388. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3389. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3390. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3391. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3392. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.38.1.5 Presence of structures and predator aggregation

3393. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3394. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3395. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3396. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3397. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.39 Afonydd Cleddau / Cleddau Rivers (UK0030074)

3398. This SAC is 125 km from the offshore development area and is screened in for Sea lamprey and River lamprey.

Table 2-60 Conservation Objectives, Attributes and Targets for Afonydd Cleddau / Cleddau Rivers SAC and summary of associated assessment (Cyngor Cefn Gwlad Cymru Countryside Council for Wales 2008b)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: The vision for this feature is for it to be in a FCS, where the following are satisfied:*				
Distribution within catchment. Any silt beds adjacent to or downstream of suitable spawning sites should contain *Petromyzon* ammocoetes	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.39.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Ammocoete density. Ammocoetes should be present in at least four sampling sites each not less than 5 km apart	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.39.1**			
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: The vision for this feature is for it to be in a FCS, where the following are satisfied:*				
Age / size structure of ammocoete population. Samples <50 ammocoetes 2 size classes; samples >50 ammocoetes at least 3 size classes	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.39.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Distribution of ammocoetes within catchment. Present at not less that 2 / 3 of sites surveyed within natural range; no reduction in	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
distribution of ammocoetes	Presence of structures and predator aggregation. See **Section 2.39.1**			
Ammocoete density. Optimal habitat: >10 /m^2; overall catchment mean: >5 /m^2	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.39.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.39.1 Sea lamprey [1095] and River lamprey [1099]

3399. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3400. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Distribution within catchment. Any silt beds adjacent to or downstream of suitable spawning sites should contain Petromyzon ammocoetes; and
- Ammocoete density. Ammocoetes should be present in at least four sampling sites each not less than 5 km apart.

3401. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- Age / size structure of ammocoete population. Samples <50 ammocoetes 2 size classes; samples >50 ammocoetes at least 3 size classes;
- Distribution of ammocoetes within catchment. Present at not less that 2 / 3 of sites surveyed within natural range; no reduction in distribution of ammocoetes; and
- Ammocoete density. Optimal habitat: >10 /m^2; overall catchment mean: >5 /m^2.

2.39.1.1 Increase in underwater noise and vibration

3402. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3403. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3404. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3405. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent

work by NOAA[88], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3406. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.39.1.1.1 Mortality

3407. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3408. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3409. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.39.1.1.2 Recoverable injury

3410. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3411. Recoverable injury in proximity to the Liffey piling operations 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

[88] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.39.1.1.3 Temporary threshold shift and behavioural responses

3412. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3413. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3414. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3415. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3416. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.39.1.1.4 Conclusions relating to underwater noise impacts

3417. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely

displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3418. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.39.1.2 Presence of EMF

3419. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3420. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3421. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3422. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-140**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-141**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-142**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-140, Plate 2-141**).

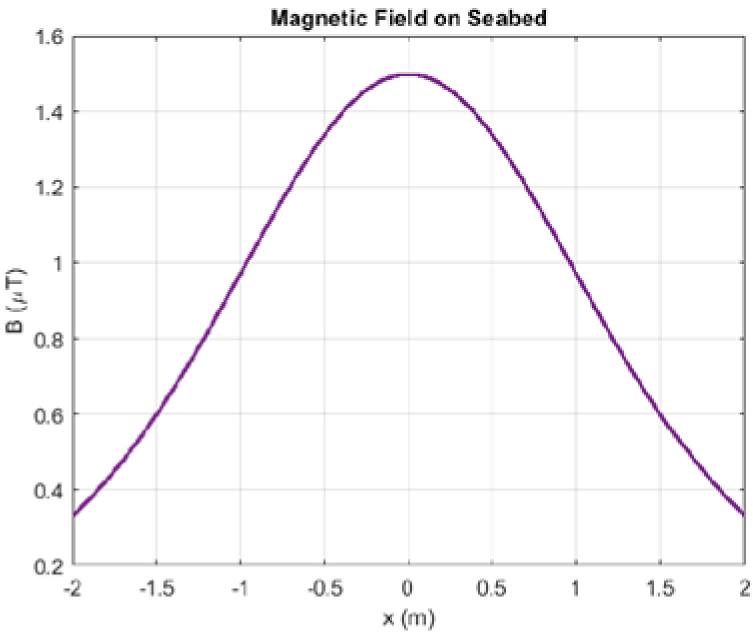

Plate 2-140 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

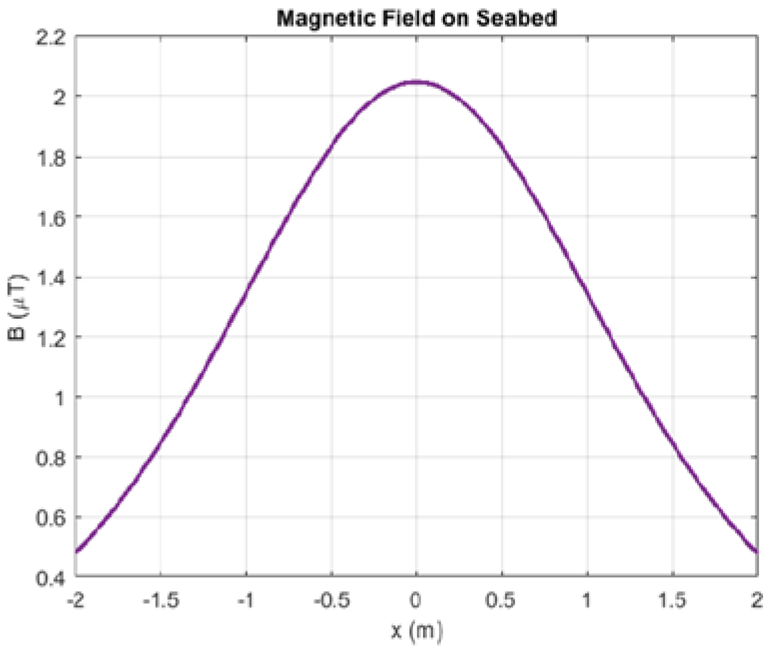

Plate 2-141 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

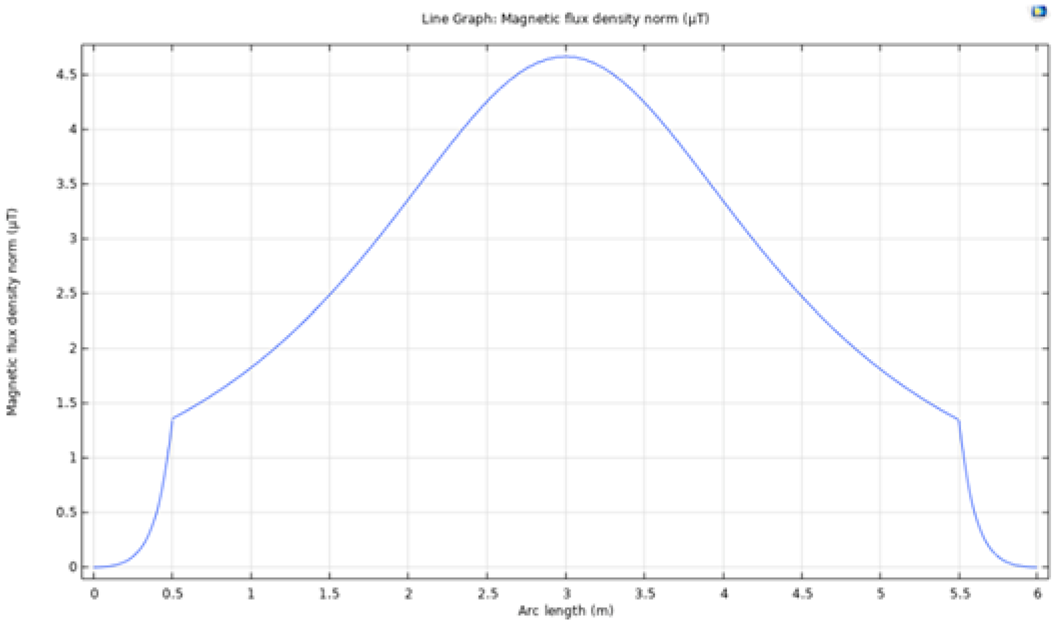

Plate 2-142 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3423. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3424. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3425. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3426. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.39.1.3 Temporary increase in SSC and contaminated sediments

3427. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3428. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3429. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3430. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.39.1.3.1 Dredging and dredge disposal

3431. 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).

3432. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3433. 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.

2.39.1.3.2 Trenching

3434. 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.

3435. Based upon the representative scenario, the modelled 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.

3436. 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.

3437. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3438. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3439. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.39.1.4 Direct impacts on habitats

3440. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3441. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3442. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3443. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3444. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.39.1.5 Presence of structures and predator aggregation

3445. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3446. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3447. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3448. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3449. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.40 River Dee and Bala Lake / Afon Dyfrdwy a Llŷn Tegid (UK0030252)

3450. This SAC is 202 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-61 Conservation Objectives, Attributes and Targets for River Dee and Bala, and summary of associated assessment (NE, 2018d)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.40.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.40.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.40.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.40.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.40.1 Sea lamprey [1095] and River lamprey [1099]

3451. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3452. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3453. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.40.1.1 Increase in underwater noise and vibration

3454. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3455. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3456. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3457. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[89], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3458. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.40.1.1.1 Mortality

3459. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3460. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3461. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.40.1.1.2 Recoverable injury

3462. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3463. Recoverable injury in proximity to the Liffey piling operations 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

[89] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.40.1.1.3 Temporary threshold shift and behavioural responses

3464. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3465. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3466. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3467. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3468. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.40.1.1.4 Conclusions relating to underwater noise impacts

3469. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3470. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.40.1.2 Presence of EMF

3471. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3472. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3473. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3474. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-143**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-144**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-145**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-143, Plate 2-144**).

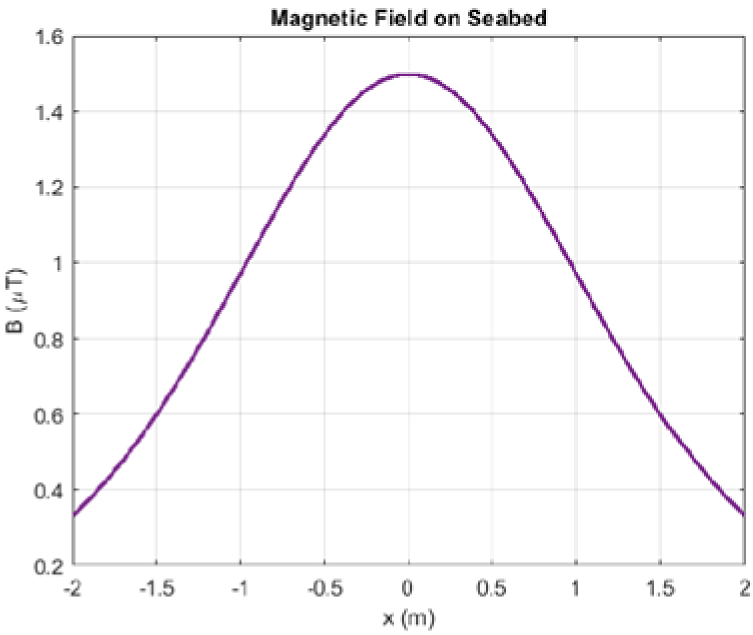

Plate 2-143 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

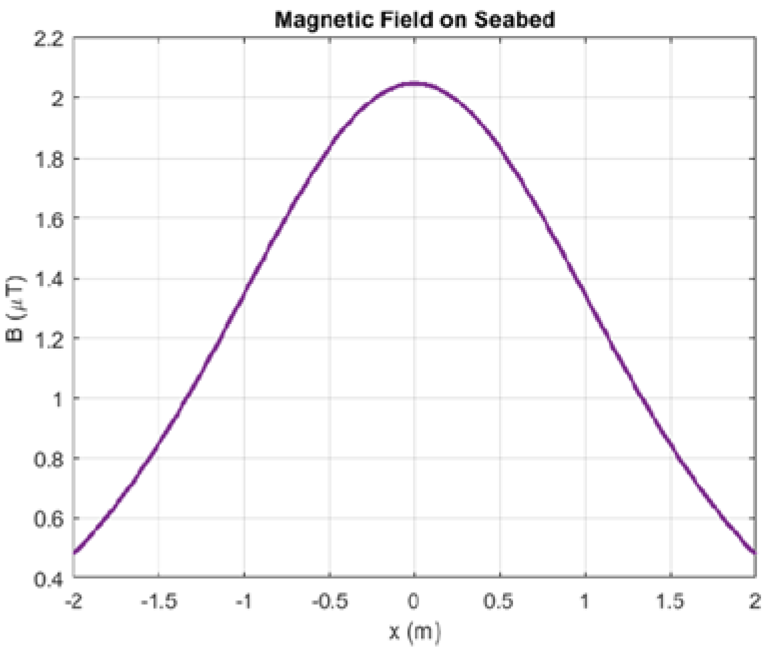

Plate 2-144 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

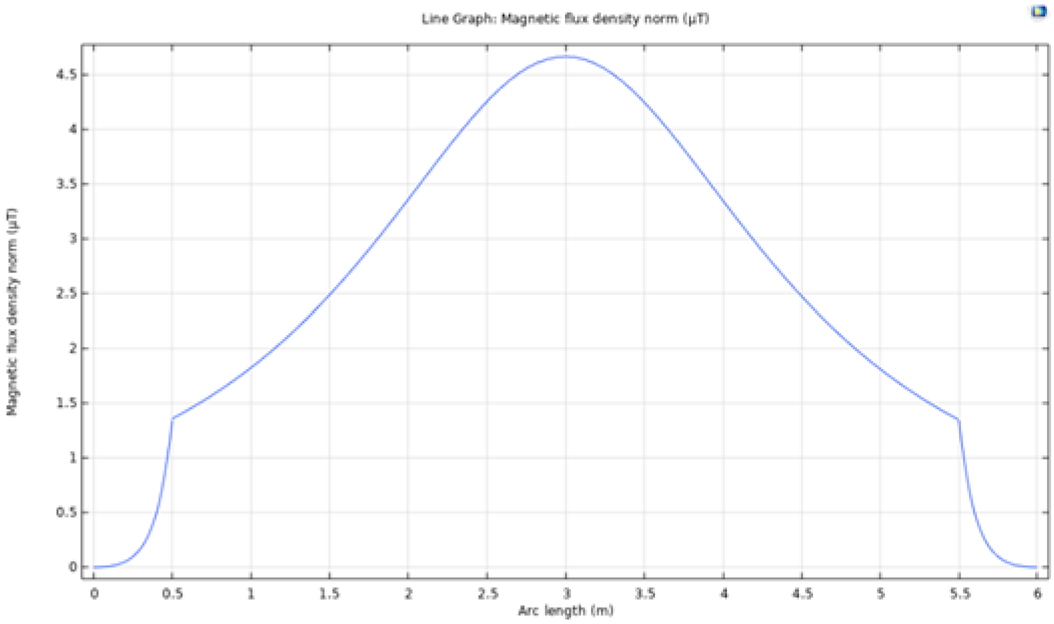

Plate 2-145 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3475. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3476. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3477. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3478. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.40.1.3 Temporary increase in SSC and contaminated sediments

3479. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3480. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3481. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3482. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.40.1.3.1 Dredging and dredge disposal

3483. 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).

3484. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3485. 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.

2.40.1.3.2 Trenching

3486. 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.

3487. Based upon the representative scenario, the modelled 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.

3488. 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.

3489. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3490. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3491. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.40.1.4 Direct impacts on habitats

3492. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3493. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3494. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3495. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3496. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.40.1.5 Presence of structures and predator aggregation

3497. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3498. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3499. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3500. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3501. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.40.2 Atlantic salmon [1106]

3502. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.40.2.1 Increase in underwater noise and vibration

3503. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3504. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3505. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3506. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[90], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3507. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3508. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.40.2.1.1 Mortality

3509. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3510. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3511. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.40.2.1.2 Recoverable injury

3512. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 m from the source for cumulative level

[90] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the more realistic fleeing model is used.

3513. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.40.2.1.3 Temporary threshold shift and behavioural responses

3514. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3515. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3516. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3517. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3518. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.40.2.1.4 Conclusions relating to underwater noise and vibration impacts

3519. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3520. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.40.2.2 Presence of EMF

3521. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3522. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3523. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3524. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-146**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-147**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-148**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-146, Plate 2-147**).

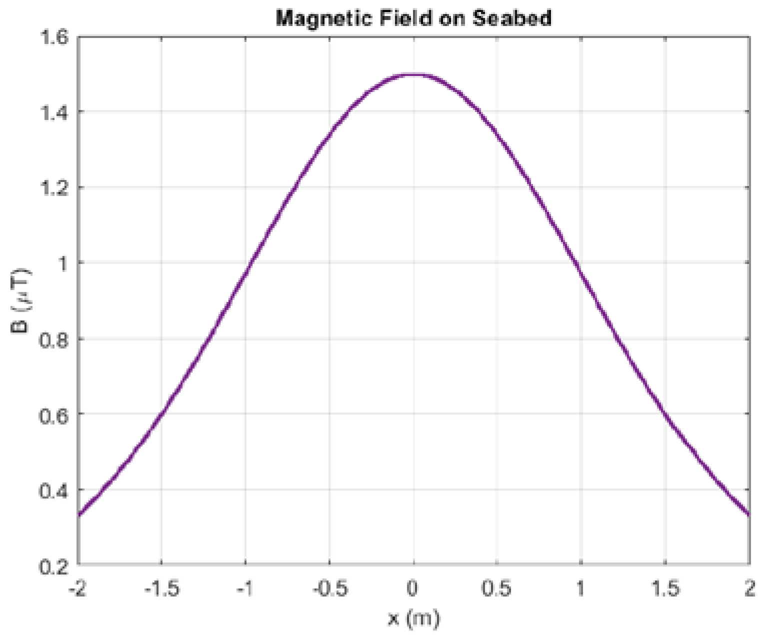

Plate 2-146 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

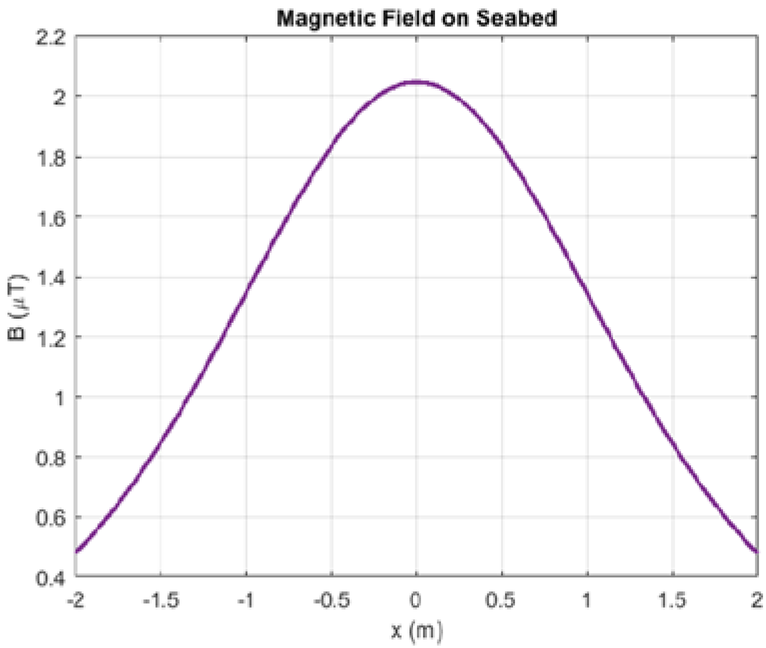

Plate 2-147 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

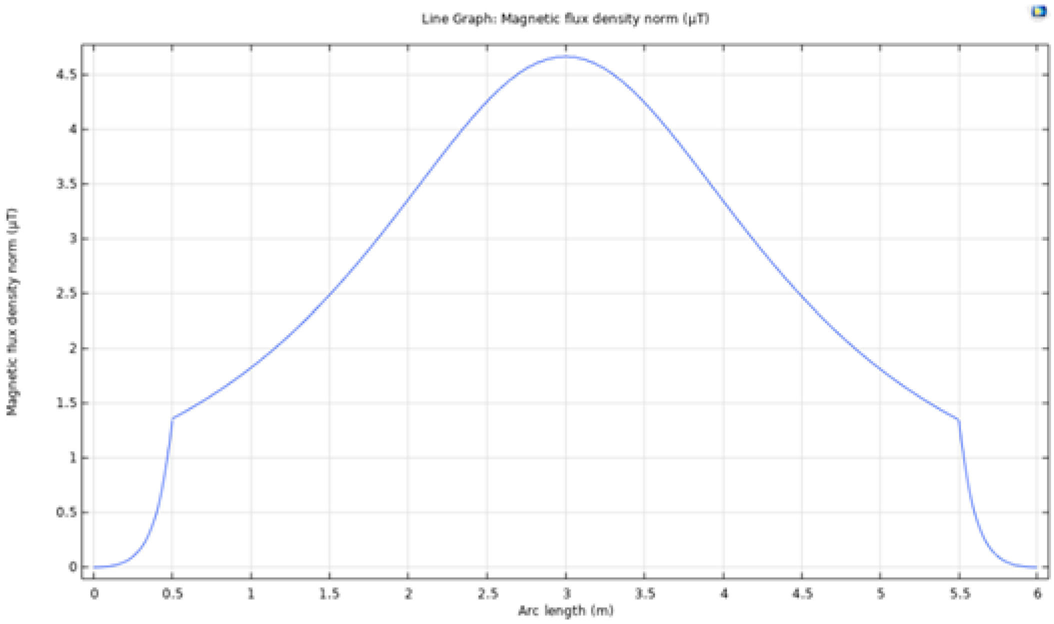

Plate 2-148 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3525. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3526. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3527. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3528. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.40.2.3 Temporary increase in SSC and contaminated sediments

3529. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3530. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3531. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3532. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.40.2.3.1 Dredging and dredge disposal

3533. 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).

3534. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3535. 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.

2.40.2.3.2 Trenching

3536. 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.

3537. Based upon the representative scenario, the modelled 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.

3538. 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.

3539. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3540. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[91]). This is considerably higher than the predicted levels of

[91]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3541. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.40.2.4 Direct impacts on habitats

3542. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3543. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3544. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3545. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3546. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.40.2.5 Presence of structures and predator aggregation

3547. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3548. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3549. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3550. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3551. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.41 River Derwent and Bassenthwaite Lake (UK0030032)

3552. This SAC is 222 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-62 Conservation Objectives, Attributes and Targets for River Derwent and Bassenthwaite Lake SAC and summary of associated assessment (NE, 2018e)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.41.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1099] River lamprey (*Lampetra fluviatilis*)				

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.41.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.41.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Direct impacts on habitats See **Section 2.41.2**			
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.41.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.41.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
The populations of qualifying species and distribution of qualifying species within the site	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.41.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.41.1 Sea lamprey [1095] and River lamprey [1099]

3553. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3554. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3555. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.41.1.1 Increase in underwater noise and vibration

3556. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3557. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3558. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3559. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[92], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3560. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.41.1.1.1 Mortality

3561. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3562. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3563. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.41.1.1.2 Recoverable injury

3564. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3565. Recoverable injury in proximity to the Liffey piling operations 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

[92] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.41.1.1.3 Temporary threshold shift and behavioural responses

3566. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3567. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3568. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3569. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3570. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.41.1.1.4 Conclusions relating to underwater noise and vibration impacts

3571. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3572. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.41.1.2 Presence of EMF

3573. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3574. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3575. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3576. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-149**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-150**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-151**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-149, Plate 2-150**).

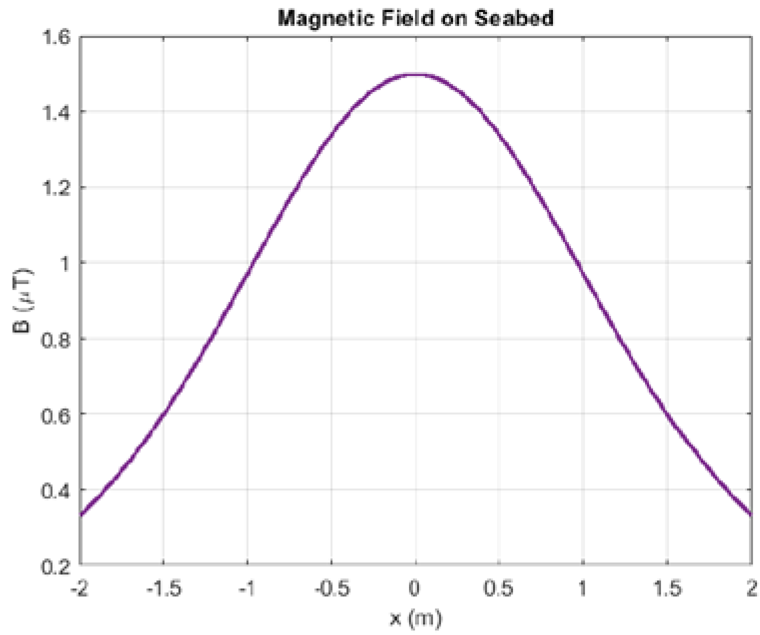

Plate 2-149 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

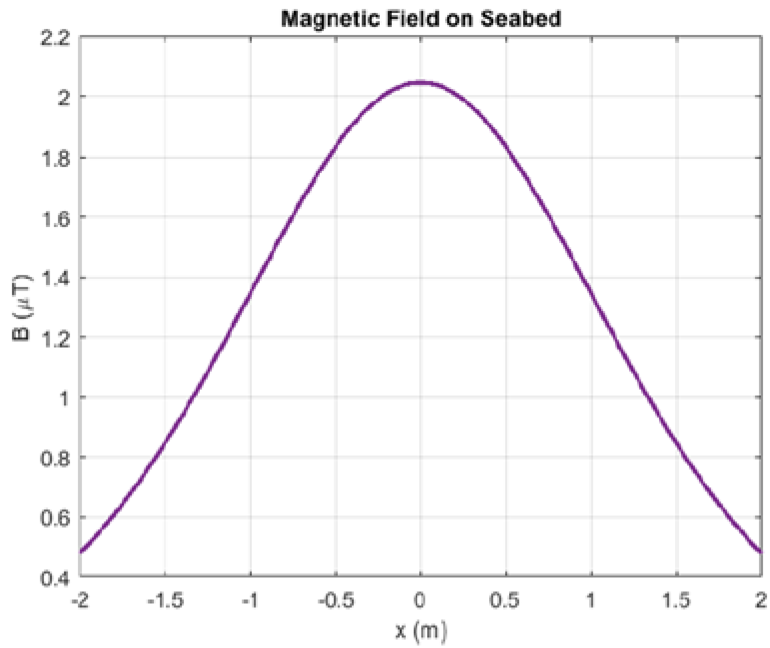

Plate 2-150 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

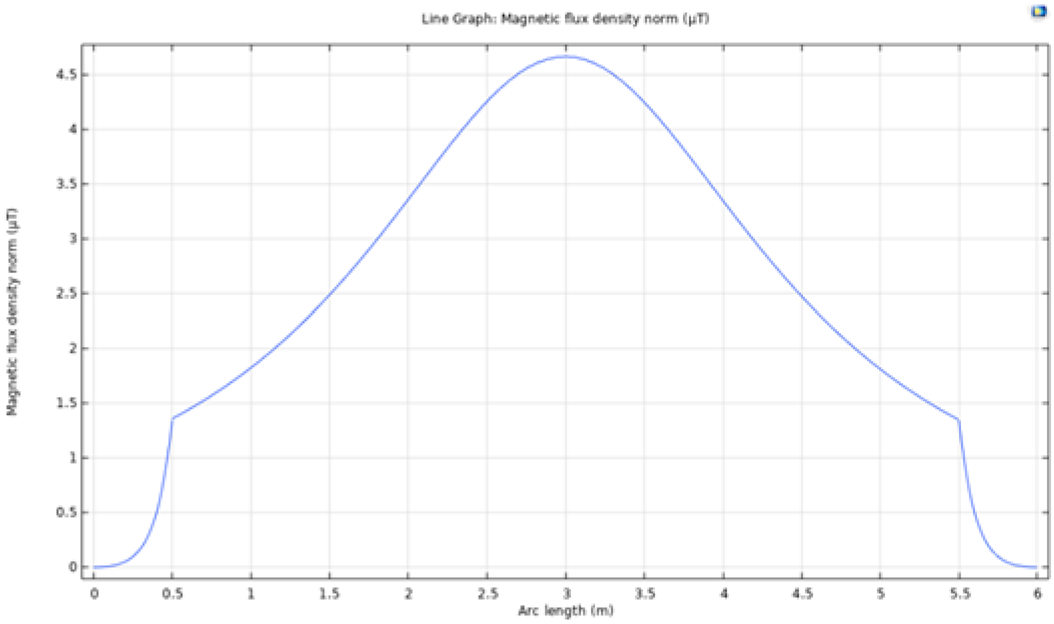

Plate 2-151 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3577. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3578. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3579. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3580. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.41.1.3 Temporary increase in SSC and contaminated sediments

3581. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3582. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3583. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3584. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.41.1.3.1 Dredging and dredge disposal

3585. 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).

3586. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3587. 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.

2.41.1.3.2 Trenching

3588. 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.

3589. Based upon the representative scenario, the modelled 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.

3590. 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.

3591. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3592. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3593. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.41.1.4 Direct impacts on habitats

3594. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3595. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3596. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3597. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3598. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.41.1.5 Presence of structures and predator aggregation

3599. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3600. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3601. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3602. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3603. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.41.2 Atlantic salmon [1106]

3604. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.41.2.1 Increase in underwater noise and vibration

3605. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3606. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3607. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3608. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[93], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3609. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3610. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.41.2.1.1 Mortality

3611. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3612. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3613. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.41.2.1.2 Recoverable injury

3614. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 m from the source for cumulative level

[93] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the more realistic fleeing model is used.

3615. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.41.2.1.3 Temporary threshold shift and behavioural responses

3616. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3617. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3618. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3619. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3620. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.41.2.1.4 Conclusions relating to underwater noise and vibration impacts

3621. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3622. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.41.2.2 Presence of EMF

3623. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3624. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3625. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3626. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-152**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-153**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-154**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-152, Plate 2-153**).

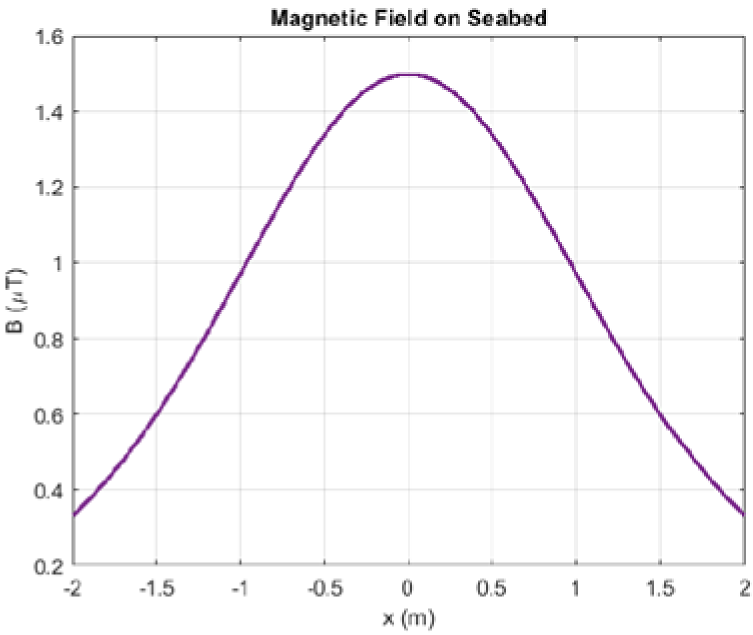

Plate 2-152 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

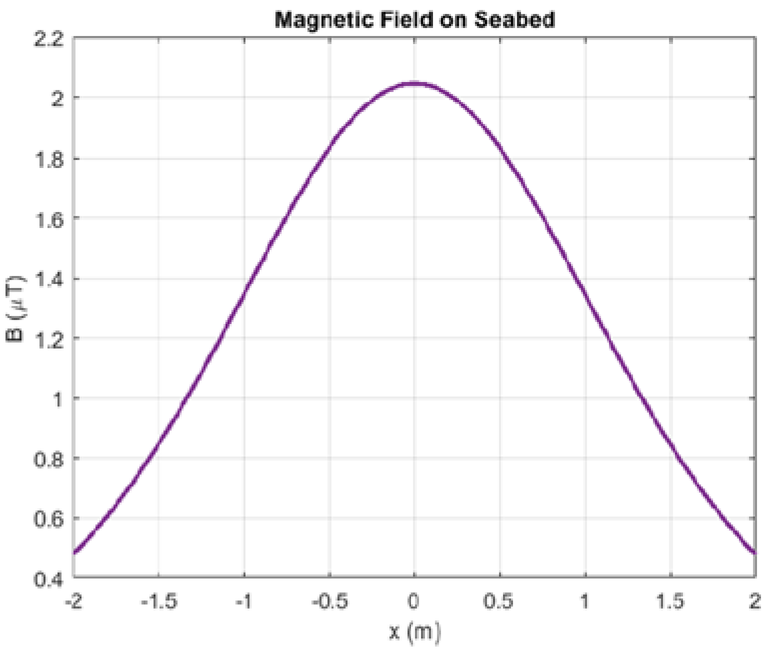

Plate 2-153 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

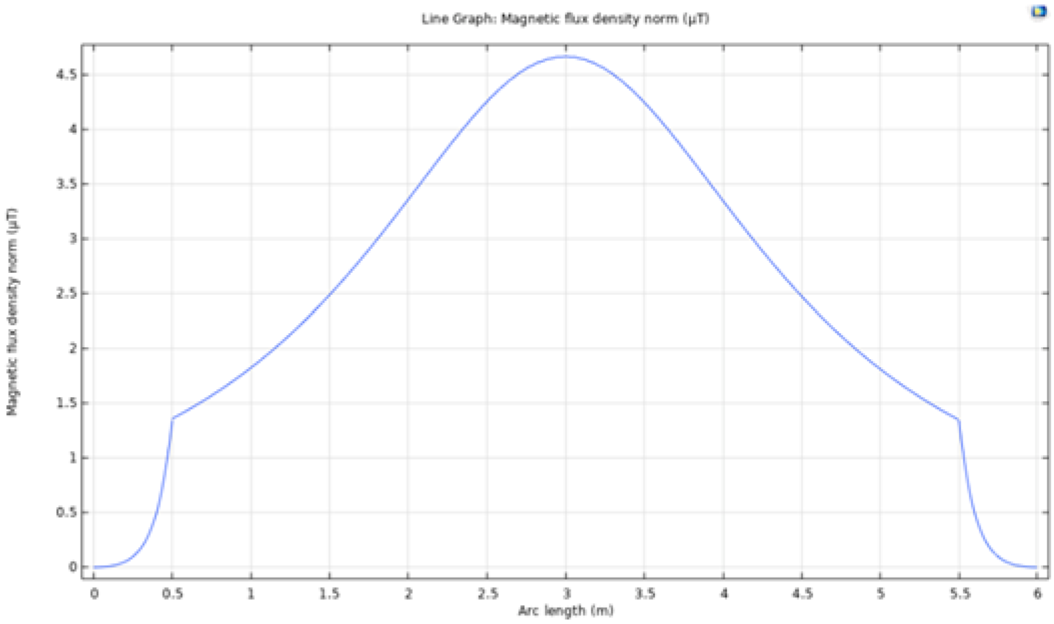

Plate 2-154 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3627. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3628. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3629. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3630. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.41.2.3 Temporary increase in SSC and contaminated sediments

3631. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3632. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3633. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3634. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.41.2.3.1 Dredging and dredge disposal

3635. 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).

3636. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3637. 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.

2.41.2.3.2 Trenching

3638. 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.

3639. Based upon the representative scenario, the modelled 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.

3640. 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.

3641. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3642. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[94]). This is considerably higher than the predicted levels of

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[94]In https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3643. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.41.2.4 Direct impacts on habitats

3644. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3645. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3646. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3647. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3648. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.41.2.5 Presence of structures and predator aggregation

3649. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3650. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3651. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3652. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3653. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.42 Solway Firth (UK0013025)

3654. This SAC is 231 km from the offshore development area and is screened in for Sea lamprey and River lamprey.

Table 2-63 Conservation Objectives, Attributes and Targets for Solway Firth SAC and summary of associated assessment (NE, 2018f)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.42.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.42.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.42.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.42.1 Sea lamprey [1095] and River lamprey [1099]

3655. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3656. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3657. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.42.1.1 Increase in underwater noise and vibration

3658. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3659. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3660. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3661. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[95], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3662. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.42.1.1.1 Mortality

3663. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3664. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3665. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.42.1.1.2 Recoverable injury

3666. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3667. Recoverable injury in proximity to the Liffey piling operations 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

[95] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.42.1.1.3 Temporary threshold shift and behavioural responses

3668. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3669. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3670. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3671. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3672. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.42.1.1.4 Conclusions relating to underwater noise and vibration impacts

3673. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3674. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.42.1.2 Presence of EMF

3675. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3676. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3677. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3678. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-155**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-156**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-157**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-155, Plate 2-156**).

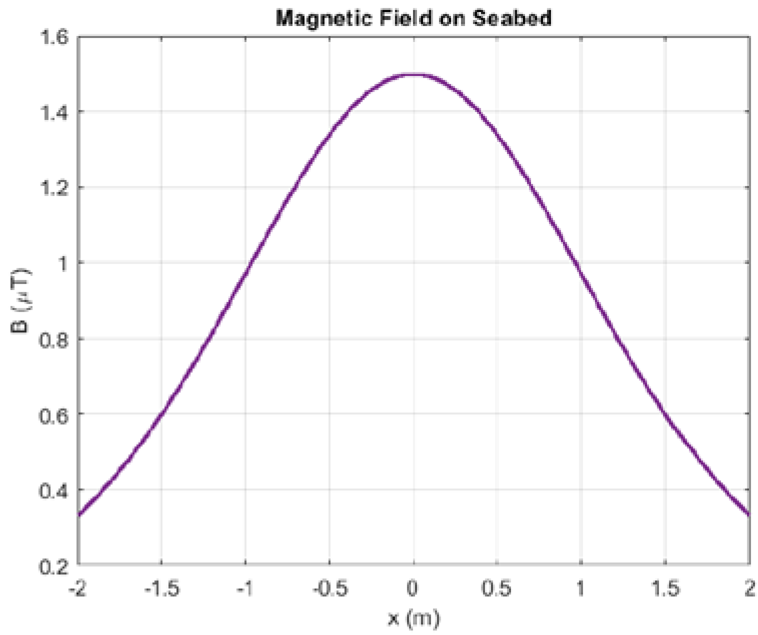

Plate 2-155 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

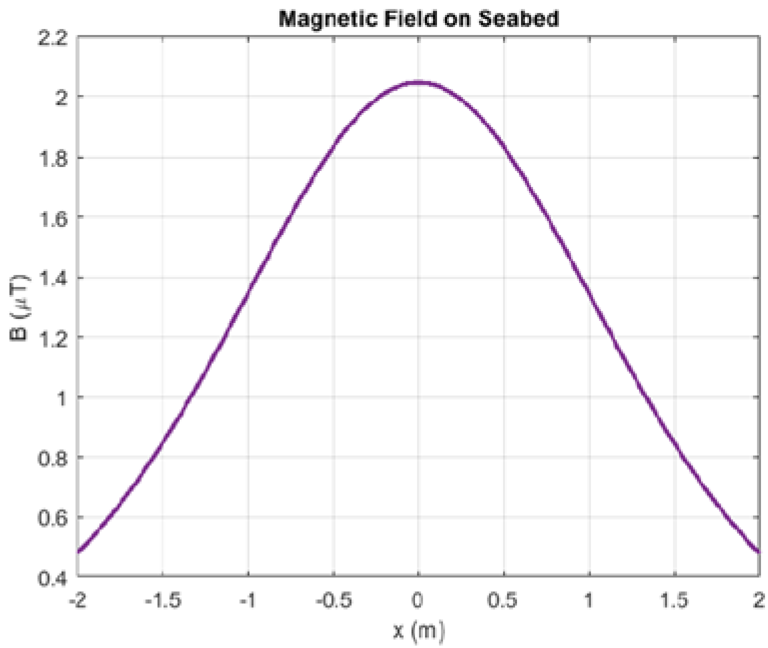

Plate 2-156 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

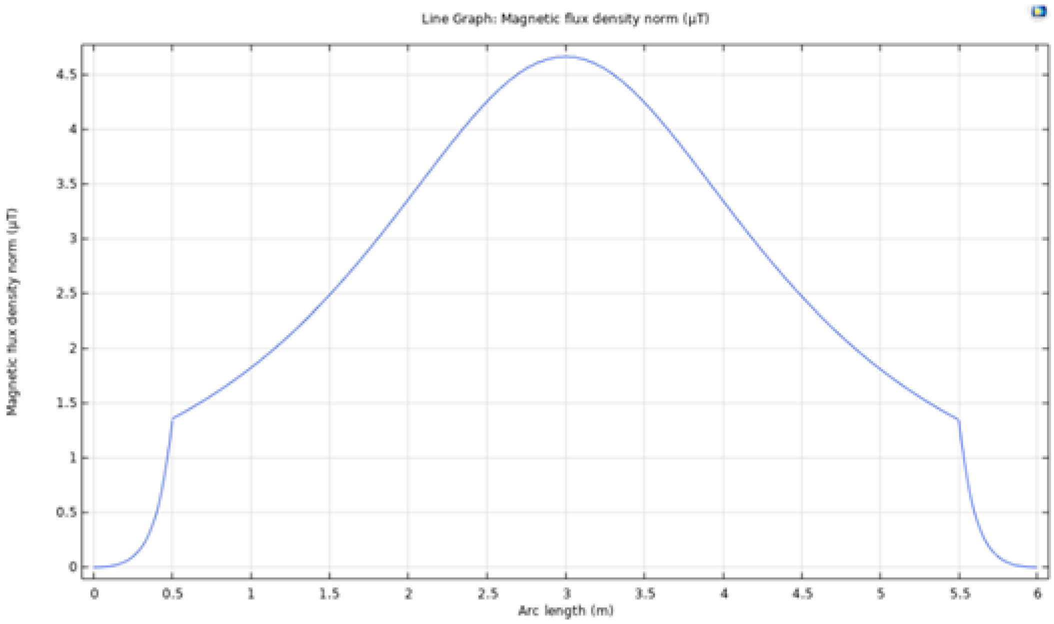

Plate 2-157 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3679. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3680. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3681. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3682. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.42.1.3 Temporary increase in SSC and contaminated sediments

3683. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3684. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3685. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3686. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.42.1.3.1 Dredging and dredge disposal

3687. 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).

3688. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3689. 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.

2.42.1.3.2 Trenching

3690. 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.

3691. Based upon the representative scenario, the modelled 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.

3692. 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.

3693. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3694. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3695. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.42.1.4 Direct impacts on habitats

3696. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3697. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3698. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3699. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3700. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.42.1.5 Presence of structures and predator aggregation

3701. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3702. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3703. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3704. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3705. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.43 River Eden (UK0012643)

3706. This SAC is 280 km from the offshore development area and is screened in for Sea lamprey, River lamprey and Atlantic salmon.

Table 2-64 Conservation Objectives, Attributes and Targets for River Eden SAC and summary of associated assessment (NE, 2018g)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.43.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1099] River lamprey (*Lampetra fluviatilis*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.43.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.43.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1106] Atlantic salmon (*Salmo salar*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.43.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.43.2**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.43.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species and distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.43.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.43.1 Sea lamprey [1095] and River lamprey [1099]

3707. Due to similarities in morphology and sensitivity to the relevant impacts, Sea lamprey and River lamprey are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

3708. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

3709. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to River lamprey:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.43.1.1 Increase in underwater noise and vibration

3710. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3711. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3712. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3713. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[96], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3714. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.43.1.1.1 Mortality

3715. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3716. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3717. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.43.1.1.2 Recoverable injury

3718. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3719. Recoverable injury in proximity to the Liffey piling operations 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

[96] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

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 more realistic fleeing model is used.

2.43.1.1.3 Temporary threshold shift and behavioural responses

3720. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3721. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3722. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3723. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3724. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.43.1.1.4 Conclusions relating to underwater noise and vibration impacts

3725. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will

be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3726. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.43.1.2 Presence of EMF

3727. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3728. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3729. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3730. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-158**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-159**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-160**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-158, Plate 2-159**).

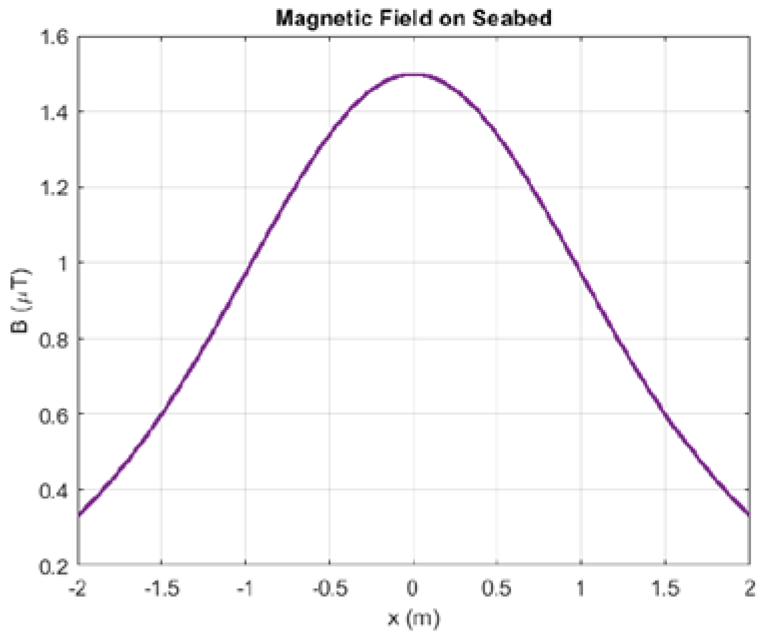

Plate 2-158 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

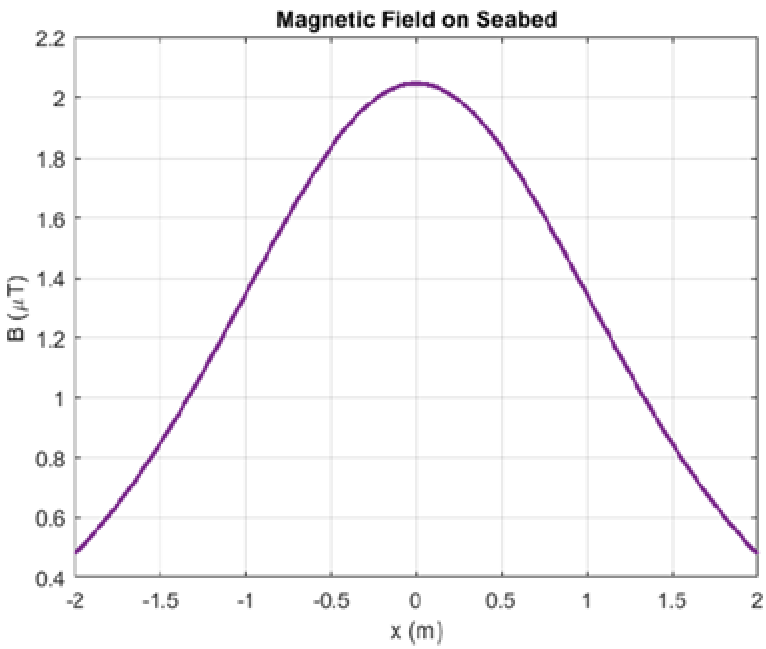

Plate 2-159 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

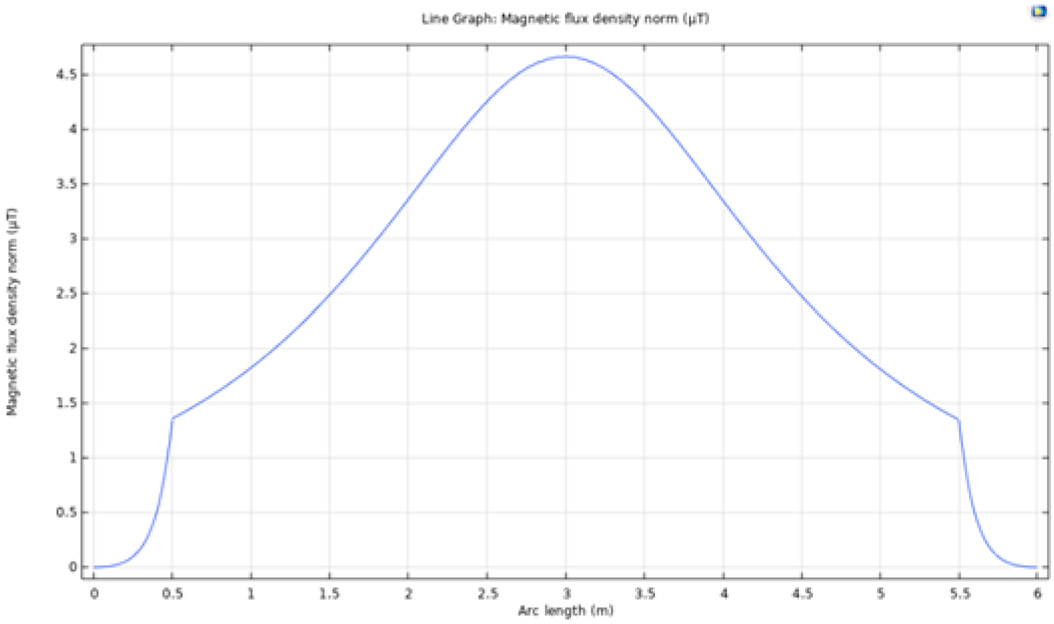

Plate 2-160 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3731. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3732. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3733. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3734. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.43.1.3 Temporary increase in SSC and contaminated sediments

3735. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3736. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3737. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3738. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.43.1.3.1 Dredging and dredge disposal

3739. 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).

3740. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3741. 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.

2.43.1.3.2 Trenching

3742. 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.

3743. Based upon the representative scenario, the modelled 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.

3744. 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.

3745. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3746. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3747. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.43.1.4 Direct impacts on habitats

3748. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3749. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3750. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3751. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3752. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.43.1.5 Presence of structures and predator aggregation

3753. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3754. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3755. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3756. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3757. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.43.2 Atlantic salmon [1106]

3758. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and distribution of qualifying species within the site.

2.43.2.1 Increase in underwater noise and vibration

3759. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3760. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3761. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3762. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[97], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3763. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3764. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.43.2.1.1 Mortality

3765. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3766. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3767. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.43.2.1.2 Recoverable injury

3768. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 m from the source for cumulative level

[97] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

exposure. These values drop significantly to less than 0.1 km^2 or a maximum distance of 100 m from the source when the more realistic fleeing model is used.

3769. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.43.2.1.3 Temporary threshold shift and behavioural responses

3770. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3771. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3772. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3773. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3774. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.43.2.1.4 Conclusions relating to underwater noise and vibration impacts

3775. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3776. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.43.2.2 Presence of EMF

3777. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3778. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3779. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3780. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-161**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-162**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-163**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-161, Plate 2-162**).

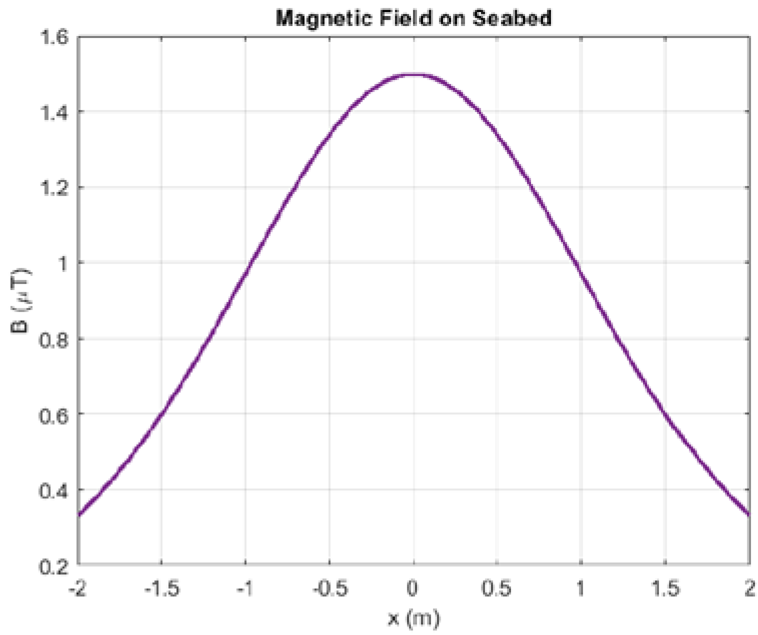

Plate 2-161 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

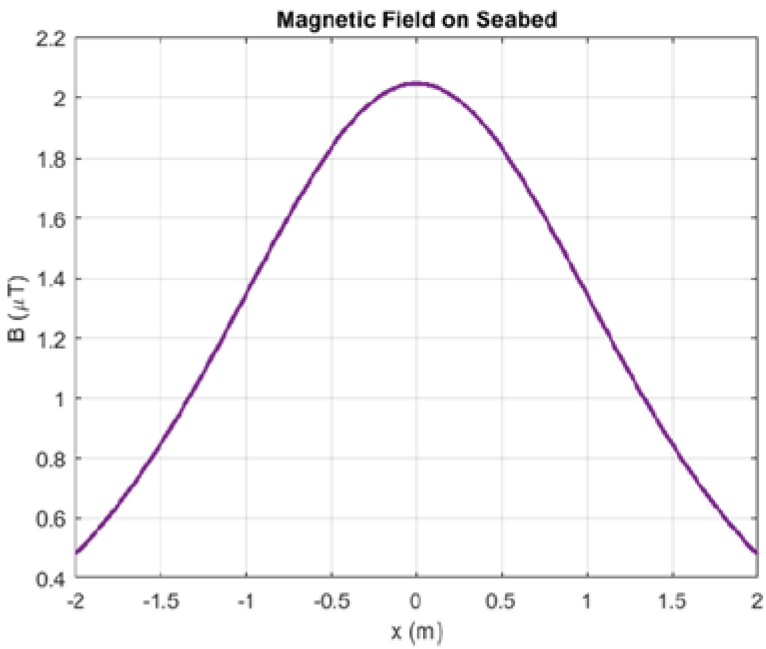

Plate 2-162 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

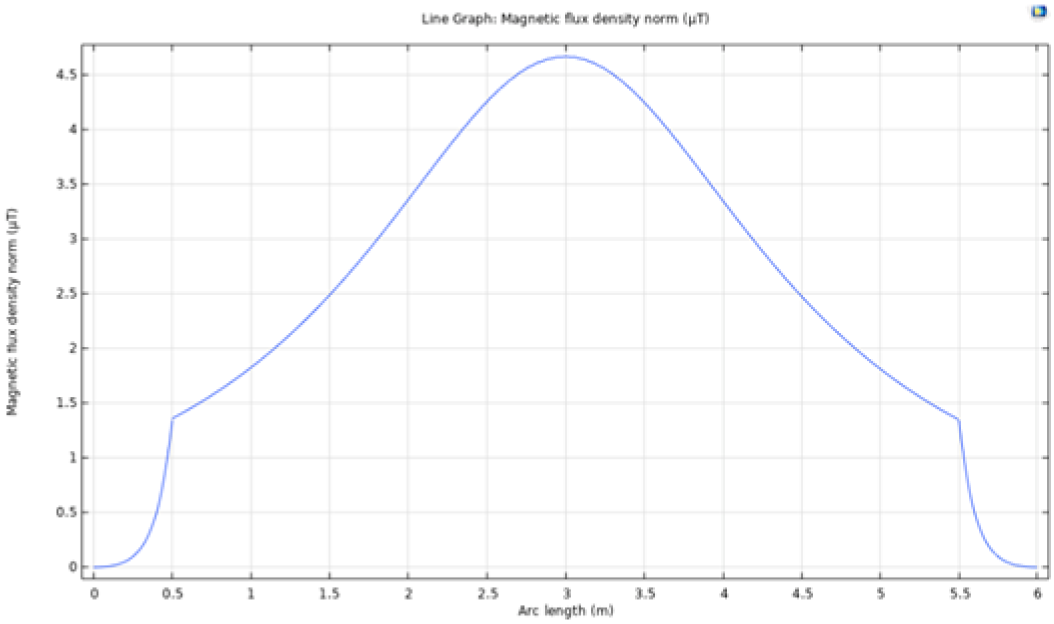

Plate 2-163 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3781. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3782. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3783. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3784. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is

concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.43.2.3 Temporary increase in SSC and contaminated sediments

3785. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3786. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3787. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3788. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.43.2.3.1 Dredging and dredge disposal

3789. 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).

3790. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3791. 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.

2.43.2.3.2 Trenching

3792. 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.

3793. Based upon the representative scenario, the modelled 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.

3794. 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.

3795. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3796. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[98]). This is considerably higher than the predicted levels of

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[98]In: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3797. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.43.2.4 Direct impacts on habitats

3798. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3799. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3800. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3801. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3802. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.43.2.5 Presence of structures and predator aggregation

3803. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3804. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3805. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3806. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3807. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.44 River Axe (UK0030248)

3808. This SAC is 568 km from the offshore development area and is screened in for Sea lamprey.

Table 2-65 Conservation Objectives, Attributes and Targets for River Axe SAC and summary of associated assessment (NE, 2018h)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.44.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.44.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.44.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The population of qualifying species and the distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.44.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.44.1 Sea lamprey [1095]

3809. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The population of qualifying species and the distribution of qualifying species within the site.

2.44.1.1 Increase in underwater noise and vibration

3810. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3811. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3812. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3813. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[99], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into

[99] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3814. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.44.1.1.1 Mortality

3815. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3816. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3817. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.44.1.1.2 Recoverable injury

3818. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3819. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.44.1.1.3 Temporary threshold shift and behavioural responses

3820. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3821. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3822. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3823. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3824. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.44.1.1.4 Conclusions relating to underwater noise and vibration impacts

3825. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3826. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.44.1.2 Presence of EMF

3827. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3828. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3829. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3830. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-164**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-165**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-166**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-164, Plate 2-165**).

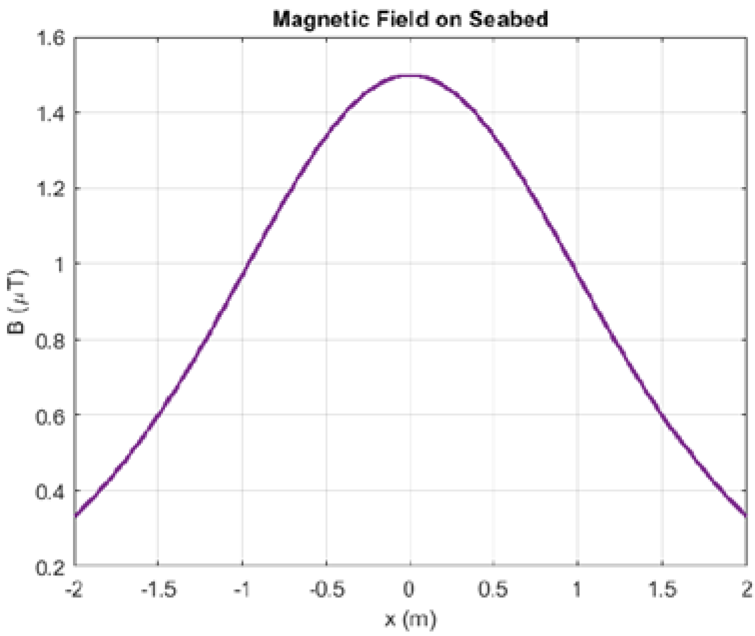

Plate 2-164 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

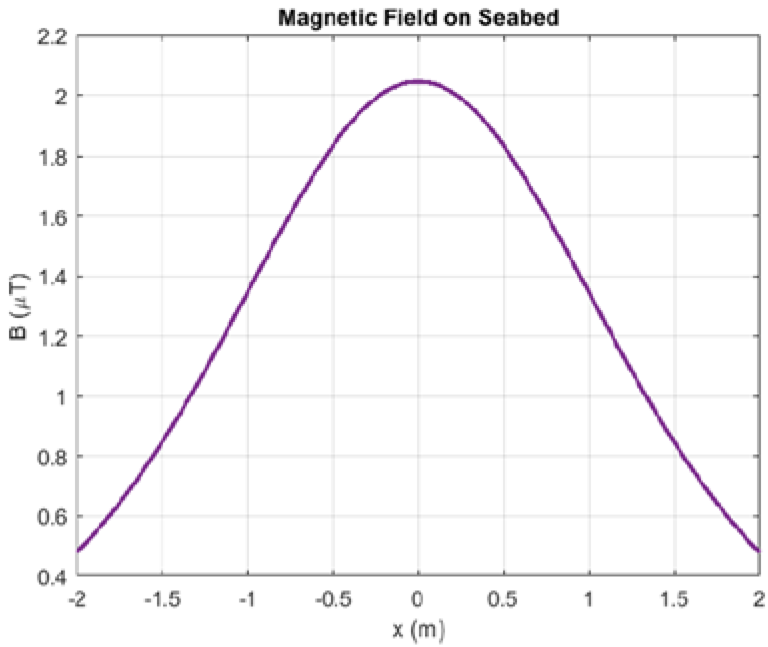

Plate 2-165 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

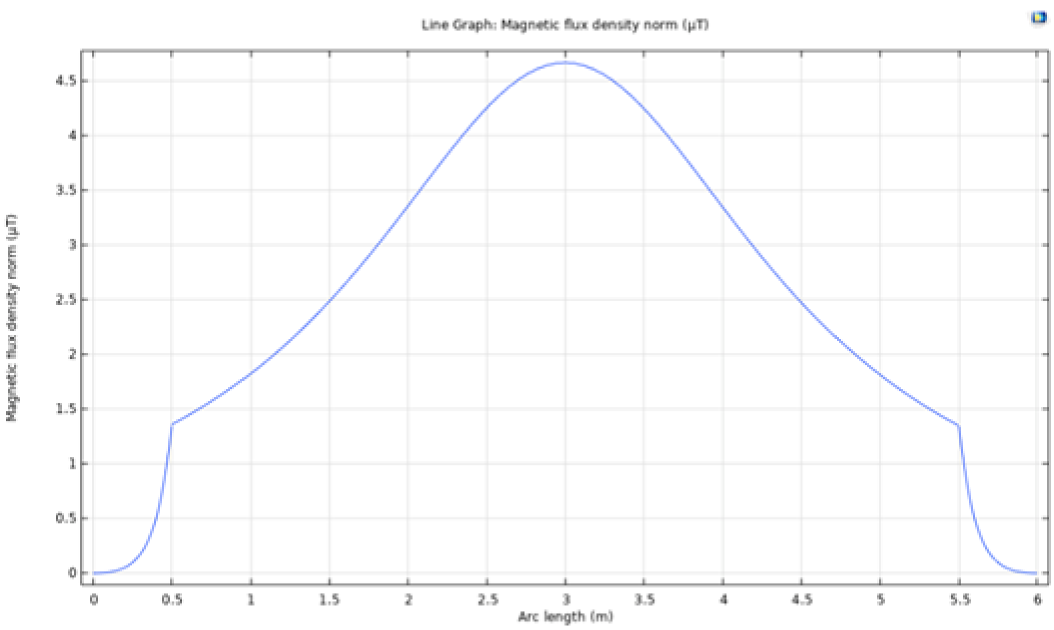

Plate 2-166 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3831. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3832. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3833. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3834. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.44.1.3 Temporary increase in SSC and contaminated sediments

3835. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3836. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3837. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3838. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.44.1.3.1 Dredging and dredge disposal

3839. 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).

3840. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3841. 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.

2.44.1.3.2 Trenching

3842. 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.

3843. Based upon the representative scenario, the modelled 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.

3844. 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.

3845. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3846. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3847. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, temporary increases in SSC and contaminated sediments arising from the CWP Project will not adversely impact the population structure of juveniles, or juvenile density in fine sediment, in respect of Sea lamprey and River lamprey. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.44.1.4 Direct impacts on habitats

3848. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3849. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3850. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3851. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3852. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.44.1.5 Presence of structures and predator aggregation

3853. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3854. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3855. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3856. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3857. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.45 River Avon (UK0013016)

3858. This SAC is 643 km from the offshore development area and is screened in for Sea lamprey and Atlantic salmon.

Table 2-66 Conservation Objectives, Attributes and Targets for River Avon SAC and summary of associated assessment (NE, 2018i)

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
[1095] Sea lamprey (*Petromyzon marinus*) Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.45.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	Presence of structures and predator aggregation. See **Section 2.45.1**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.45.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species, and the distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.45.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1106] Atlantic salmon (*Salmo salar*)				

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
Conservation Objective*: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the FCS of its Qualifying Features, by maintaining or restoring:*				
The extent and distribution of qualifying natural habitats and habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats See **Section 2.45.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function (including typical species) of qualifying natural habitats	CWP Project has no direct connectivity to the SAC and as such no potential to affect this attribute and target	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The structure and function of the habitats of qualifying species	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation.	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect	Conclusion
	See **Section 2.45.2**			
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely	Temporary increase in SSC and contaminated sediments Presence of structures and predator aggregation. See **Section 2.45.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
The populations of qualifying species, and the distribution of qualifying species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.45.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.45.1 Sea lamprey [1095]

3859. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and the distribution of qualifying species within the site.

2.45.1.1 Increase in underwater noise and vibration

3860. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014).). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3861. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3862. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3863. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[100], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Underwater Noise Assessment – **Appendix 9.4** of the EIAR for detail on thresholds and modelling approach and rationale). The assessment takes into

[100] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3864. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.45.1.1.1 Mortality

3865. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3866. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3867. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.45.1.1.2 Recoverable injury

3868. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3869. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.45.1.1.3 Temporary threshold shift and behavioural responses

3870. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3871. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3872. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3873. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3874. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.45.1.1.4 Conclusions relating to underwater noise and vibration impacts

3875. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3876. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.45.1.2 Presence of EMF

3877. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3878. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3879. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3880. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-167**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-168**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-169**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-167, Plate 2-168**).

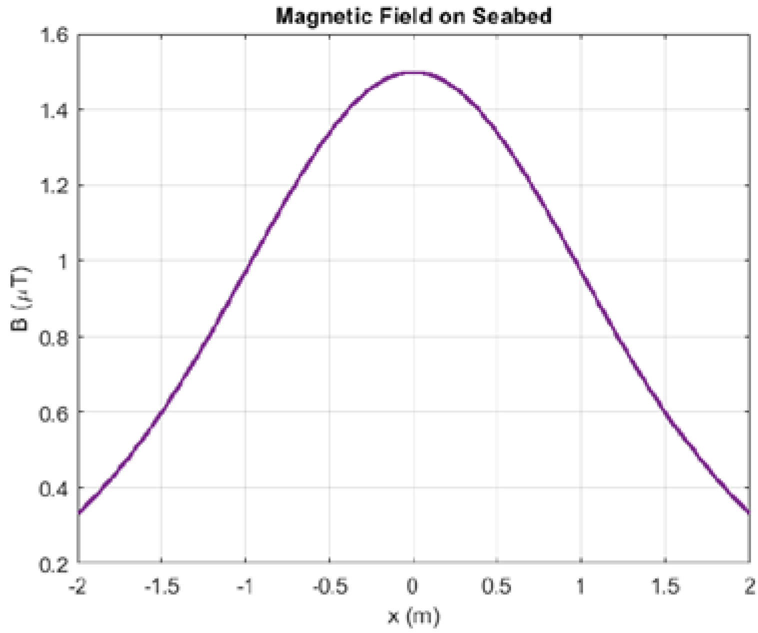

Plate 2-167 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

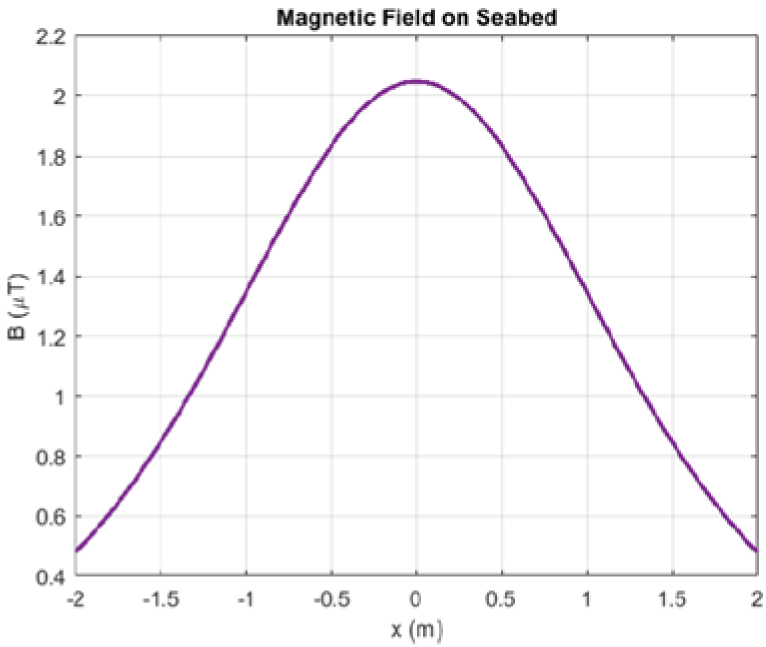

Plate 2-168 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

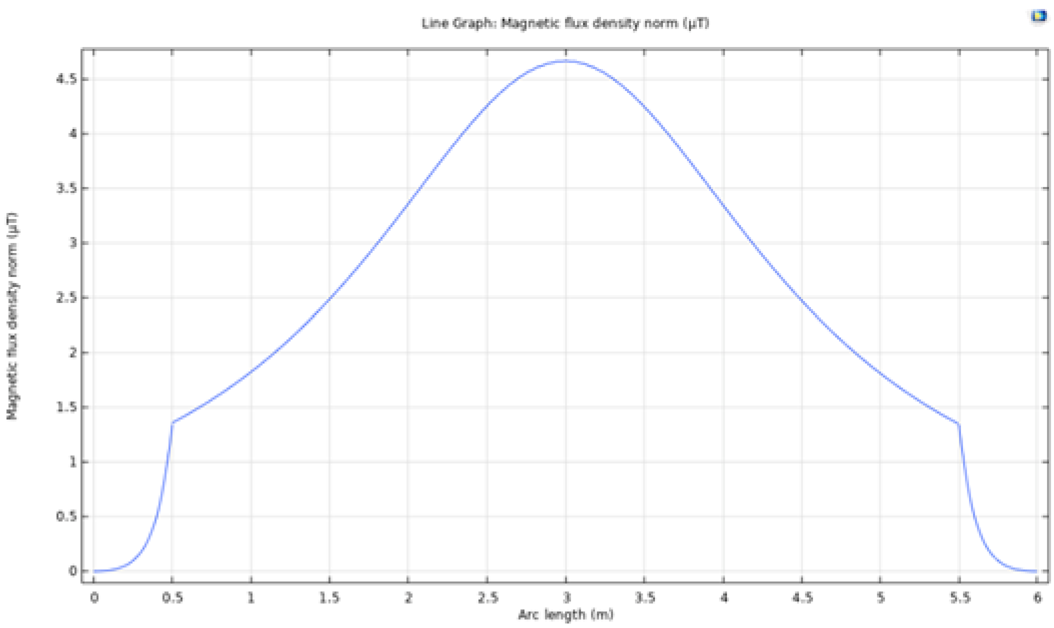

Plate 2-169 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3881. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3882. 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 the cables is 4.9 μT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3883. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3884. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.45.1.3 Temporary increase in SSC and contaminated sediments

3885. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3886. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3887. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore

development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3888. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.45.1.3.1 Dredging and dredge disposal

3889. 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).

3890. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3891. 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.

2.45.1.3.2 Trenching

3892. 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.

3893. Based upon the representative scenario, the modelled 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.

3894. 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.

3895. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3896. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3897. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.45.1.4 Direct impacts on habitats

3898. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3899. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3900. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3901. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3902. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish

Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.45.1.5 Presence of structures and predator aggregation

3903. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3904. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3905. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3906. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3907. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.45.2 Atlantic salmon [1106]

3908. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to this QI:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; and
- The populations of qualifying species and the distribution of qualifying species within the site.

2.45.2.1 Increase in underwater noise and vibration

3909. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Atlantic salmon have a swim bladder and are considered to be sensitive to the pressure component of sound.

3910. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3911. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3912. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[101], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3913. Salmon possess a swim bladder, but do not have any special morphological adaptations which assist in sound detection, which uses a combination of sound pressure and particle motion detection (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3914. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-21**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours. Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

[101] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

2.45.2.1.1 Mortality

3915. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and mortal injury for salmon from piling operations under the stationary model may 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 2,300 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 more realistic fleeing model is used.

3916. Mortality in proximity to the Liffey 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 more realistic fleeing model is used.

3917. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.45.2.1.2 Recoverable injury

3918. Recoverable injury from piling operations under the stationary model may 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 34 km^2 or a maximum distance of 3,500 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 more realistic fleeing model is used.

3919. Recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.45.2.1.3 Temporary threshold shift and behavioural responses

3920. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3921. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3922. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3923. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3924. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.45.2.1.4 Conclusions relating to underwater noise and vibration impacts

3925. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). Atlantic salmon are known to undertake long distance migrations, and recent studies found populations move offshore towards oceanographic fronts, with individuals from Irish rivers migrating towards the Atlantic via routes that do not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3926. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.45.2.2 Presence of EMF

3927. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric

fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3928. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3929. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3930. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-170**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-171**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-172**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-170, Plate 2-171**).

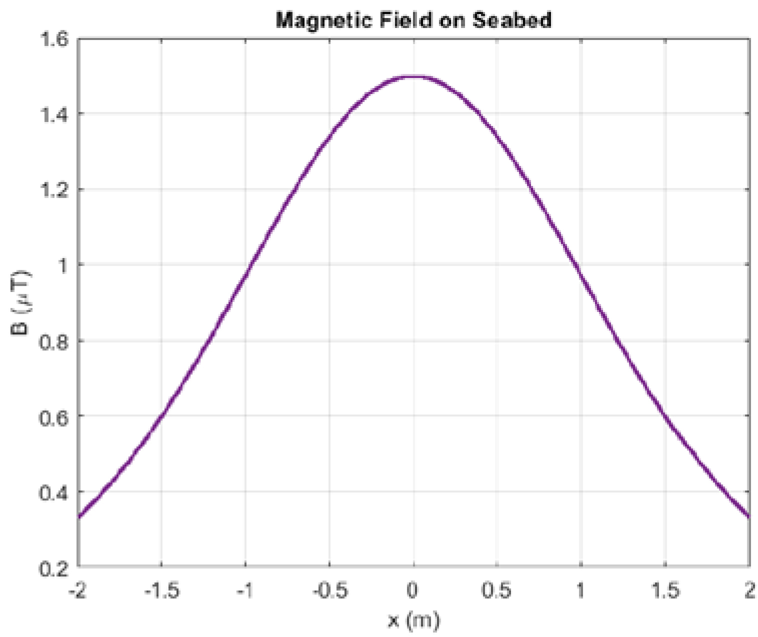

Plate 2-170 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

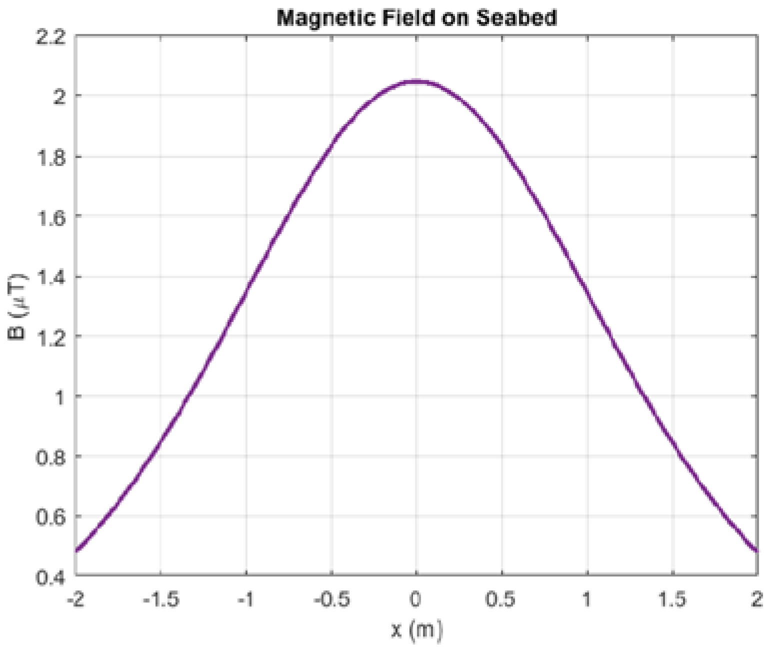

Plate 2-171 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

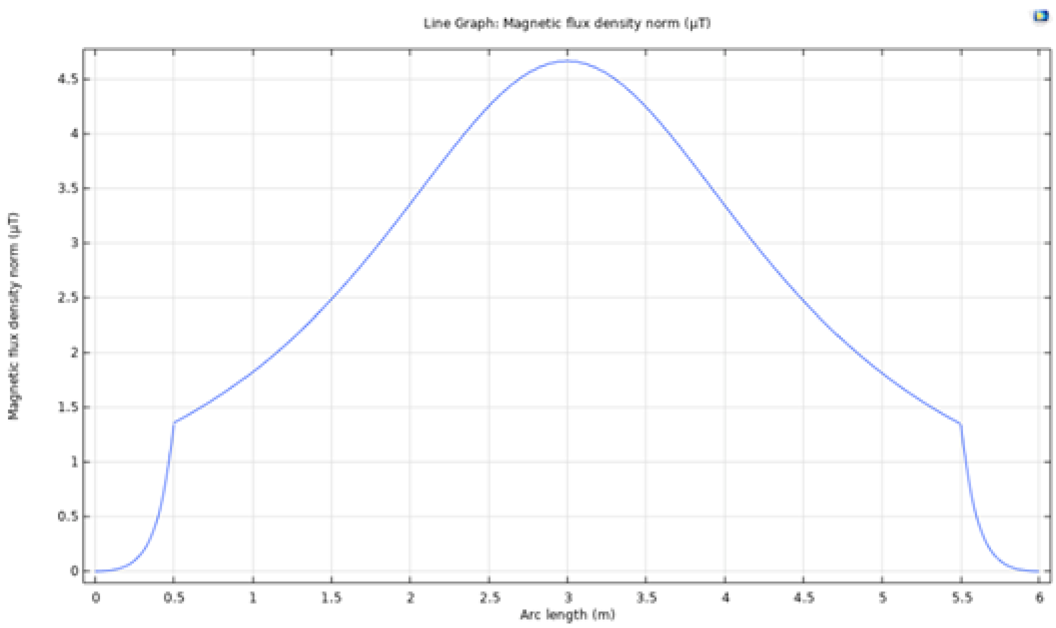

Plate 2-172 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3931. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Armstrong et al. (2015) conducted a review of the potential effects of EMF on Atlantic salmon for Marine Scotland. It determined that salmonids did not exhibit behavioural responses when exposed to EMF levels (up to 95 µT; Armstrong et al., 2015). Furthermore, as a pelagic species that mainly travels in the top levels of the marine environment, interaction with cabling infrastructure is considered highly unlikely for salmon.

3932. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3933. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described above is predicted to be negligible.

3934. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.45.2.3 Temporary increase in SSC and contaminated sediments

3935. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3936. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3937. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of salmon with the impacts described is predicted to be negligible.

3938. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.45.2.3.1 Dredging and dredge disposal

3939. 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).

3940. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3941. 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.

2.45.2.3.2 Trenching

3942. 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.

3943. Based upon the representative scenario, the modelled 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.

3944. 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.

3945. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3946. The effect on salmon from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). For example, although Atlantic salmon may react behaviourally to SSC levels above 20 mg/l, injurious effects and major physiological stress only occurred at levels of 1,100 mg/l and above after 24 hours of exposure (Newcombe and Jensen, 1996[102]). This is considerably higher than the predicted levels of increased SSC that may arise from the project. As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3947. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.45.2.4 Direct impacts on habitats

3948. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

3949. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the

[102]In: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effects-analysis-turbidity-greater-atlantic-region.

sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

3950. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

3951. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of salmon connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), and information on migratory routes for salmon indicates that they will not pass through the offshore development area (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

3952. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.45.2.5 Presence of structures and predator aggregation

3953. Due to the presence of structures, there is potential for predator aggregation (e.g., piscivorous fish, birds, or mammals), and thus increased predatory pressure in such areas on migratory fish species.

3954. It should be noted that any impact from predator aggregation around structures will only be present in the marine environment within the CWP Project area and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described herein will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration, or concentrate predator density in constrained waterways such as in rivers or river mouths.

3955. The presence of infrastructure may lead to some attraction of fish species to the local area due to the increased biodiversity likely to be present on and around such structures in the marine environment, and the increased refugia they provide. As with the other impacts described above however, it should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI that are connected to the SAC will be present in the offshore development area on which predation pressure could increase.

3956. It should also be considered that during key migratory periods, i.e., when individuals are travelling to feeding grounds or toward natal rivers, that individuals are highly driven to reach these specific locations and are unlikely to spend large amounts of time focussed on alternative activities (i.e., foraging or looking for refugia). Increased predator pressure on migratory species in such scenarios, when there is likely to be greater numbers of other species present, is considered to be negligible at most.

3957. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, the lack of importance of the area for migratory species, and the low likelihood of any increase in predation being encountered by individuals, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for this SAC. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in predation around structures.

2.46 French ZSCs – Migratory Fish

3958. 30 ZSCs have been screened into this NIS for migratory Fish QIs. They are:

- Rade de Brest, Estuaire de l'Aulne (FR5300046) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Côte de Granit Ros Sept-Îles (FR5300009) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Rivière Léguer, forts de Beffou, Coat an Noz et Coat an Hay (FR5300008) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Tregor Golo (FR5300010) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Valle de l'Aulne (FR5300041) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Rivière Scorff, Fort de Pont Calleck, Rivière Sarre (FR5300026) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Baie de Saint-Brieuc - Est (FR5300066) screened in for *Twaite shad and Allis shad;*
- Estuaire de la Rance (FR5300061) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Golfe du Morbihan, côte ouest de Rhuys (FR5300029) screened in for *Twaite shad and Allis shad;*
- Estuaire de la Vilaine (FR5300034) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Baie de Seine occidentale (FR2502020) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Estuaire de la Loire Nord (FR5202011) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Baie du Mont Saint-Michel (FR2500077) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Estuaire de la Loire Sud - Baie de Bourgneuf (FR5202012) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Pertuis Charentais (FR5400469) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Marais de Vilaine (FR5300002) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Estuaires de la Loire (FR5200621) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Baie de Seine orientale (FR2502021) screened in for *Twaite shad, Allis shad and Sea lamprey;*
- Rivière Elorn (FR5300024) screened in for *Allis shad and Sea lamprey;*
- Rivière Lata, Pointe du Talud, tangs du Loc'h et de Lannenec (FR5300059) screened in for *Allis shad and Sea lamprey;*
- Rivière Elle (FR5300006) screened in for *Allis shad and Sea lamprey;*
- Littoral Ouest du Cotentin de Brhal Pirou (FR2500080) screened in for *Allis shad and Sea lamprey;*
- Marais du Cotentin et du Bessin - Baie des Veys (FR2500088) screened in for *Allis shad and Sea lamprey;*
- Rivière le Douron (FR5300004) screened in for *Sea lamprey;*
- Ria d'Etel (FR5300028) screened in for *Sea lamprey;*
- Havre de Saint-Germain-sur-Ay et Landes de Lessay (FR2500081) screened in for *Sea lamprey;*
- Bassin de l'Airou (FR2500113) screened in for *Sea lamprey;*
- Vallée de la Sée (FR2500110) screened in for *Sea lamprey;*
- Valle de l'Arz (FR5300058) screened in for *Sea lamprey; and*
- Lac de Grand-Lieu (FR5200625) screened in for *Sea lamprey.*

3959. These SACs are designated for Twaite shad [1103], Allis shad [1102] and Sea lamprey [1095]. Conservation Objectives for these sites are presented in **Table 2-67** below. As site specific Conservation Objectives are not available for French sites, proxy objectives, attributes and targets are assumed for each of the above sites, based upon those presented for Pembrokeshire Marine SAC which shares common QIs with all the above listed ZSCs

Table 2-67 Conservation Objectives, Attributes and Targets for migratory fish ZSCs and summary of associated assessment

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
[1095] Sea lamprey (*Petromyzon marinus)*				
Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site.	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.1**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.1**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Twaite shad [1103]				
Conservation Objective: *To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**			
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone
[1102] Allis shad (Alosa alosa) Conservation Objective*: To achieve FCS all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve FCS.*				
Population. The population is maintaining itself on a long-term basis as a viable component of	Increase in underwater noise and vibration	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
its natural habitat. Important elements are population size, structure, production and condition of the species within the site.	Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**			site integrity predicted from the project alone
Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing	Increase in underwater noise and vibration Presence of EMF Temporary increase in SSC and contaminated sediments Direct impacts on habitats Presence of structures and predator aggregation. See **Section 2.31.2**	None required	N/A	No impediment to the Conservation Objective being met, and no adverse effect on site integrity predicted from the project alone

2.46.1 Sea lamprey [1095]

3960. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Sea lamprey:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2.46.1.1 Increase in underwater noise and vibration

3961. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). In addition, species with a swim bladder (a gas filled chamber used to maintain buoyancy) have a greater potential to suffer barotrauma from sudden large pressure changes than those without swim bladders (Popper et al., 2014). Lamprey species have no gas filled organs, and as such are not considered sensitive to changes in sound pressure level (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022).

3962. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

3963. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

3964. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[103], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the

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[103] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

3965. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-19**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

2.46.1.1.1 Mortality

3966. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality and recoverable injury areas for lamprey species from piling operations 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 more realistic fleeing model is used.

3967. Mortality and potential mortal injury in the proximity to the Liffey piling operations 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 more realistic fleeing model is used.

3968. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.46.1.1.2 Recoverable injury

3969. Recoverable injury from piling operations under the stationary model may 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 more realistic fleeing model is used.

3970. Recoverable injury in proximity to the Liffey piling operations 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 more realistic fleeing model is used.

2.46.1.1.3 Temporary threshold shift and behavioural responses

3971. TTS (based upon cumulative exposure) for all migratory species during the piling operations under the stationary model may occur within an area of approximately 3,500 km^2 or a maximum distance of 47 km from the source. These values drop significantly to 1,300 km^2 or a maximum of 31 km from the source when the more realistic fleeing model is used.

3972. TTS in proximity to the Liffey 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 more realistic fleeing model is used.

3973. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

3974. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

3975. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.46.1.1.4 Conclusions relating to underwater noise and vibration impacts

3976. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020). The closest SACs for lamprey are *c*. 75 km distant from the CWP Project; therefore, in the event of any displacement from the local area there are large areas of alternative habitat available and numbers of individuals within the offshore development area will be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration for any species.

3977. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in underwater noise and vibration.

2.46.1.2 Presence of EMF

3978. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

3979. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

3980. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

3981. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-173**), 2 µT for a 1800 Cu mild steel cable (**Plate 2-174**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-175**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-173, Plate 2-174**).

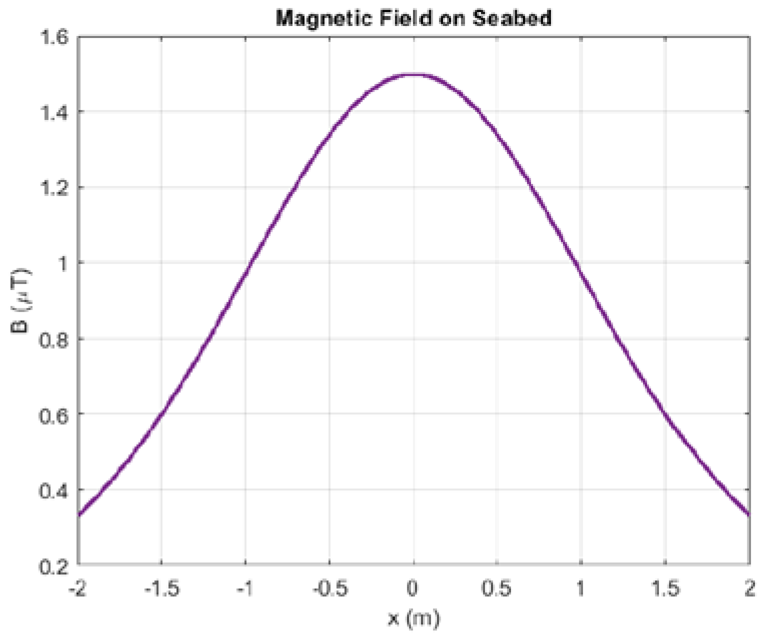


Plate 2-173 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

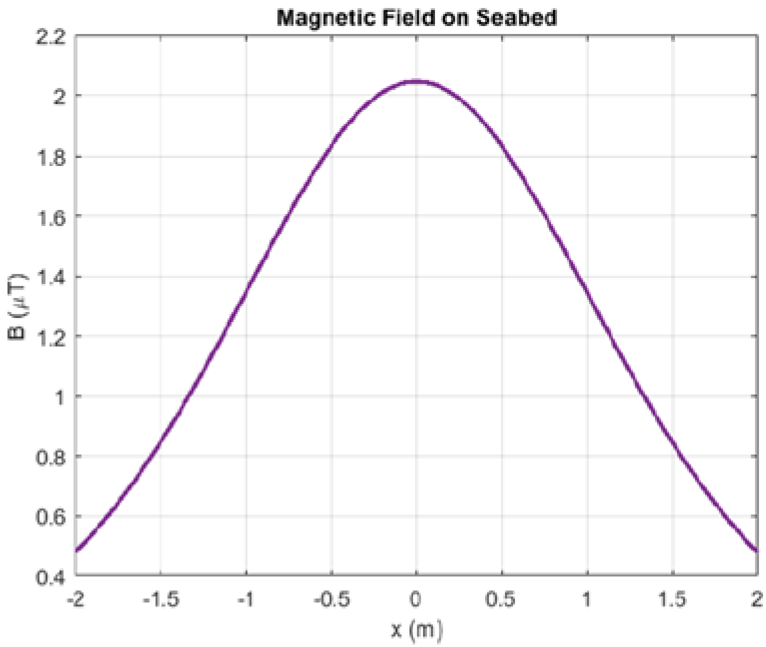


Plate 2-174 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

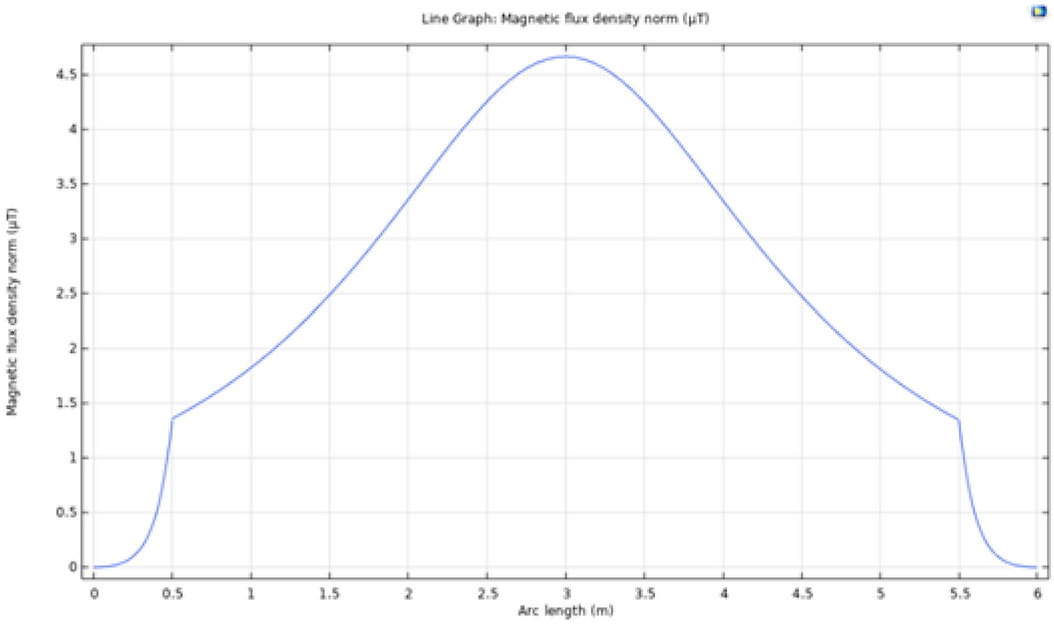


Plate 2-175 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

3982. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). Though lampreys are known to be able to detect weak electric fields (Bodznick and Preston, 1983), there is no evidence that lampreys possess an ability to detect magnetic fields (Gill & Bartlett 2010) and no evidence that EMF detection plays any role during migration, with lampreys known to use olfactory cues to navigate to suitable rivers (Vrieze et al., 2011, Bjerselius et al., 2000, Polkinghorne et al., 2001).

3983. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

3984. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

3985. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.46.1.3 Temporary increase in SSC and contaminated sediments

3986. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI and no effects on Conservation Objectives from such contaminated sediments are predicted.

3987. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

3988. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect this QI within and beyond the offshore development area. It should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area. Therefore, the potential interaction of lamprey with the impacts described is predicted to be negligible.

3989. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.46.1.3.1 Dredging and dredge disposal

3990. 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).

3991. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

3992. 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.

2.46.1.3.2 Trenching

3993. 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.

3994. Based upon the representative scenario, the modelled 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.

3995. 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.

3996. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

3997. The effect on lamprey from increased SSC 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. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours and no barrier to migration. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals.

3998. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.46.1.4 Direct impacts on habitats

3999. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

4000. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

4001. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

4002. As with the other impacts described above, it should however be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of lamprey connected to the SAC will be present in the offshore development area.

4003. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall habitat available to salmon that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.46.2 Twaite shad [1103] and Allis shad [1102]

4004. Due to similarities in morphology and sensitivity to the relevant impacts, Twaite shad and Allis shad are considered here together. Conclusions drawn are considered relevant to each individual QIs attributes and targets within this SAC.

4005. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Twaite shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

4006. The following Conservation Objective attributes and targets are considered to have impact pathways arising from the CWP Project in relation to Allis shad:

- Population. The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production and condition of the species within the site;
- Range. The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future; and
- Supporting habitats and species. The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and population dynamics of the species within the site and population beyond the site is stable or increasing.

2.46.2.1 Increase in underwater noise and vibration

4007. Fish vary in their abilities to detect and utilise sound as well as their potential susceptibility to damage by sound (Popper et al., 2014; Popper & Hawkins, 2019; Popper et al., 2022). All fish detect and use kinetic sound energy in the form of particle motion; however, some species have hearing specialisations that enable them to also detect sound pressure. Sound pressure detection is thought to broaden bandwidth and increase noise sensitivity in fishes as well as potentially contribute to sound source localisation (Popper et al., 2022). Twaite shad are a member of the clupeid family, and due to morphological adaptations and the presence of a swim bladder are considered to be sensitive to the pressure component of sound.

4008. The following activities have the potential to contribute to underwater noise in the vicinity of the offshore development area:

- Geophysical and geotechnical surveys;
- Geotechnical surveys;
- Piling (percussive, or vibro-piling), in both the array site and Liffey;
- Drilling;
- UXO clearance; and
- Other construction activities such as cable installation or seabed preparation, including vessel activity.

4009. It should be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of this QI will be present in the offshore development area or surrounding waters. As such, the potential for interaction with the impacts described herein is predicted to be low. Furthermore, considering the nature of the works and the distance to the SAC, there is considered to be no barrier to coastal migration or entry / exit of the estuary for this SAC.

4010. Popper et al. (2014) provides the most up to date and authoritative sound exposure guidelines on the quantification of effects arising from sound producing activities on fish receptors, noting other recent work by NOAA[104], and that modelling of sound pressure is considered to remain best practice for assessment of impacts noting that there is an element of particle motion detection also present in fish species. Modelling of underwater noise propagation for percussive piling and UXO against the thresholds provided by Popper et al. (2014), considered to be the activities that may have the greatest level of impact, has been undertaken for the CWP Project to provide an indication of the distances over which such effects could be observed (See Noise Modelling technical report (**Appendix 9.4** of the EIAR) for detail on thresholds and modelling approach and rationale). The assessment takes into

[104] https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf.

account whether the individuals affected may be stationary or fleeing, which affects the noise levels they are exposed to and thus the extent of the relevant areas.

4011. Shad are a member of the herring family (Clupeidae) and are considered to be hearing specialists due to the presence of a swim bladder and the coupling of the swim bladder to the inner ear which extends their hearing sensitivity (Teague et al., 2011).

4012. Modelled outputs for the various impact thresholds are provided below, and shown in **Figure 2-20**. Fish are expected to flee from sources of noise when not engaged in active spawning or other life critical behaviours (Popper et al., 2014; McQueen et al., 2022). Considering the distance to the SAC and its estuary, it is expected that individuals are not constrained or engaged in any other behaviour that would prevent them fleeing the source of noise. As such, impacts are only predicted to apply over the fleeing distances described below, noting that the model outputs from the stationary model are also presented.

4013. It is considered that increases in underwater noise and vibration arising from the CWP Project will not adversely affect the population structure of Twaite shad. Having regard to these factors, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration

2.46.2.1.1 Mortality

4014. Piling is a temporary impact of maximum 78 days over the construction period. It is however a reoccurring event which produces sound levels that may result in the mortality of species. Mortality arising from the array 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 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 more realistic fleeing model is used.

4015. Mortality in proximity to the Liffey piling operations under the stationary model 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 more realistic fleeing model is used.

4016. Injurious effects from UXO clearance are predicted to be observable at distances between 490–810 m from any clearance works. Considering the low number of expected clearance events, the likelihood of QI individuals being present in the affected area is very low, and the area of impact is considered to be negligible in the context of the wider availability of habitat for the QIs.

2.46.2.1.2 Recoverable injury

4017. Recoverable injury effects 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 more realistic fleeing model is used.

4018. Group three fish at risk of recoverable injury in proximity to the Liffey 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 more realistic fleeing model is used.

2.46.2.1.3 Temporary threshold shift and behavioural responses

4019. TTS during the array piling operations under the stationary model is 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 more realistic fleeing model is used.

4020. 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 more realistic fleeing model is used.

4021. It is also recognised that there may be behavioural responses which extend beyond the threshold of the TTS areas, and it is considered that behavioural responses may also arise from other project activities such as surveys, drilling, vessel activity, or other construction activities such as cable installation. 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 rapid on cessation of the impact (or as the QI increases distance from the source), with potential for habituation over the term of the duration of the impact.

4022. Instantaneous rather than cumulative assessments are considered more suitable for mobile surveys as the noise source is not static and thus determining cumulative exposure includes considerable margin for uncertainty (Popper et al., 2014). Though this has not been modelled here, in studies of where TTS was observed during survey work (e.g., fish exposed to seismic sources), a return to full hearing ability was seen within 18–24 hours (Popper et al., 2014).

4023. For non-pulsed (i.e., continuous) sound, such as that produced by the geotechnical surveys or operational turbines, recoverable injury is considered to occur if exposed to levels in excess of 170 dB re 1 µPa (root mean square (rms) value) over 48 hours, or TTS from exposure to 158 dB re 1 µPa (rms) over 12 hours. Source levels for geotechnical surveys are expected to be in the region of 160–170 dB (rms) (Nedwell et al., 2011), with operational turbine noise considered to be low, and less than that generated by commercial shipping (Tougaard et al., 2020 suggests noise levels of up to *c*. 130 dB within 40 meters of the turbine). Considering the low levels of noise emitted from these activities, the stationary nature of the sources and the short duration of geotechnical survey work, fish are predicted to be able to move away from the source in sufficient time that no TTS is predicted from these activities. Furthermore, it is 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.

2.46.2.1.4 Conclusions relating to underwater noise and vibration impacts

4024. With regards to impacts arising from underwater noise, the marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and thus considerable habitat will remain available to these species in the event any individual is displaced from the small areas around project activities. Furthermore, considering the distance between this SAC and the CWP Project, the numbers of individuals within the ZoI is expected to be limited. Any individuals that are present in the area of activities are not predicted to be widely displaced by any activity, though in the event displacement does occur there are large areas of alternative habitat available and there will be no barrier to migration established.

4025. Considering the low likelihood of interaction with QIs of SACs, the negligible distances over which injurious effects may be seen (less than 100 m for piling activities, and less than 810 m for UXO clearance), rapid recovery or likely habituation in the event TTS or behavioural effects, and lack of any barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from increases in underwater noise and vibration.

2.46.2.2 Presence of EMF

4026. Transmission of electricity through subsea cables will lead to the generation of electric (E) and magnetic (B) fields (Gill et al., 2009). The manufacturing process for modern cables shields against the emission of any E field, and as such it is only magnetic fields that are detectable outside of the cables' shielding. The rotational nature of the magnetic field associated with AC cables induces electric fields in the surrounding marine environment (CMACS, 2003). Additionally, motionally induced electric fields may also arise from an animal or water body moving through the magnetic field produced by both AC and DC cables (Gill et al., 2014).

4027. Cables installed in the marine environment can also produce a low level of heat emissions, as a result of the resistance of the cable as electricity flows through it. However, heat losses reduce the efficiency of a cable, and as a result the cables will be designed to minimise thermal losses.

4028. There is a maximum of approximately 145.8 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 which will provide an equivalent level of attenuation of EMF. Burial or protection of a marine cable acts as a buffer between the potential source of EMF and the receptor.

4029. Based upon the predicted cable arrangements, the magnetic field strength at the sediment surface (assuming a 2 m burial depth) is predicted to be 1.5 µT for a 1400 Cu mild steel cable (**Plate 2-176**, 2 µT for a 1800 Cu mild steel cable (**Plate 2-177**) and 4.7 µT for an 1800 Cu stainless steel cable (**Plate 2-178**). These values fall sharply as distance from the cable increases, with levels back to near zero within 2 m of the cable (**Plate 2-176, Plate 2-177**).

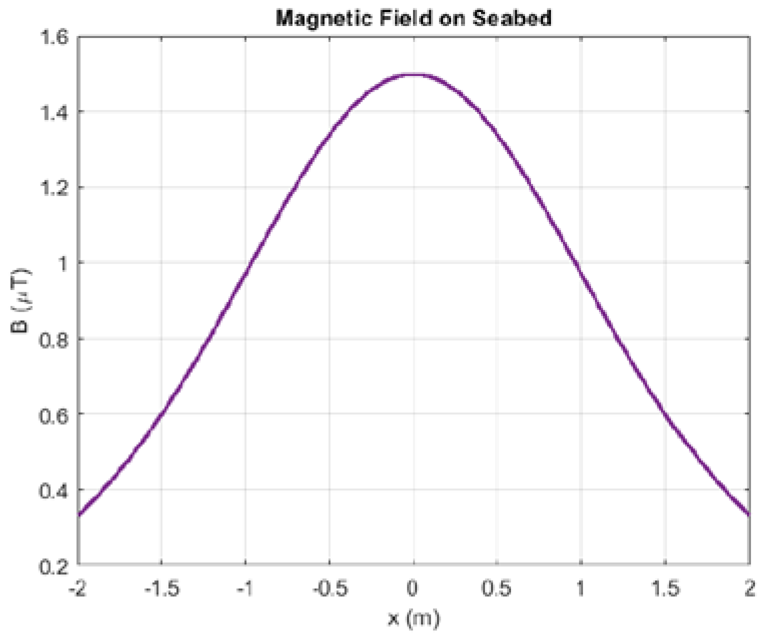


Plate 2-176 OECC magnetic field at seabed surface – 1400 Cu, mild steel – 1064A – 2 m depth of burial

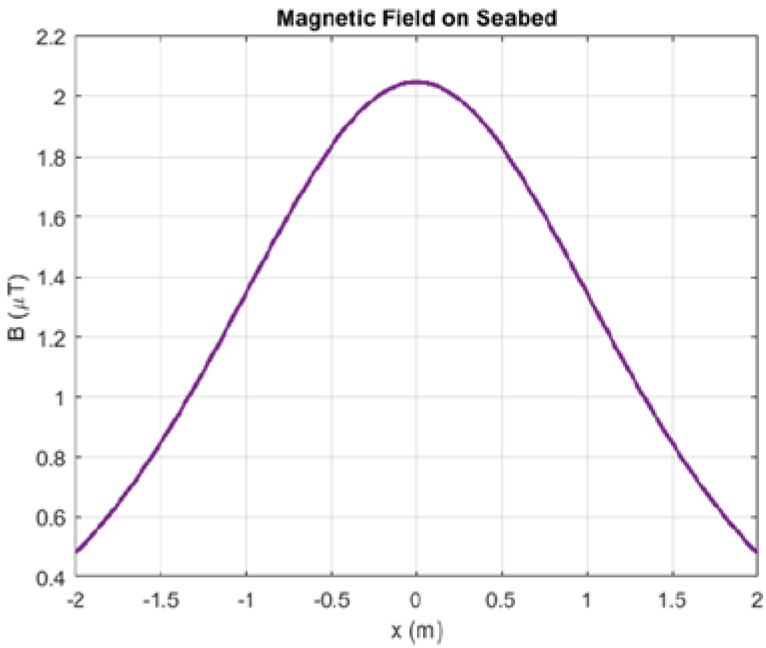


Plate 2-177 OECC magnetic field at seabed surface – 1800 Cu, mild steel – 1083A – 2 m depth of burial

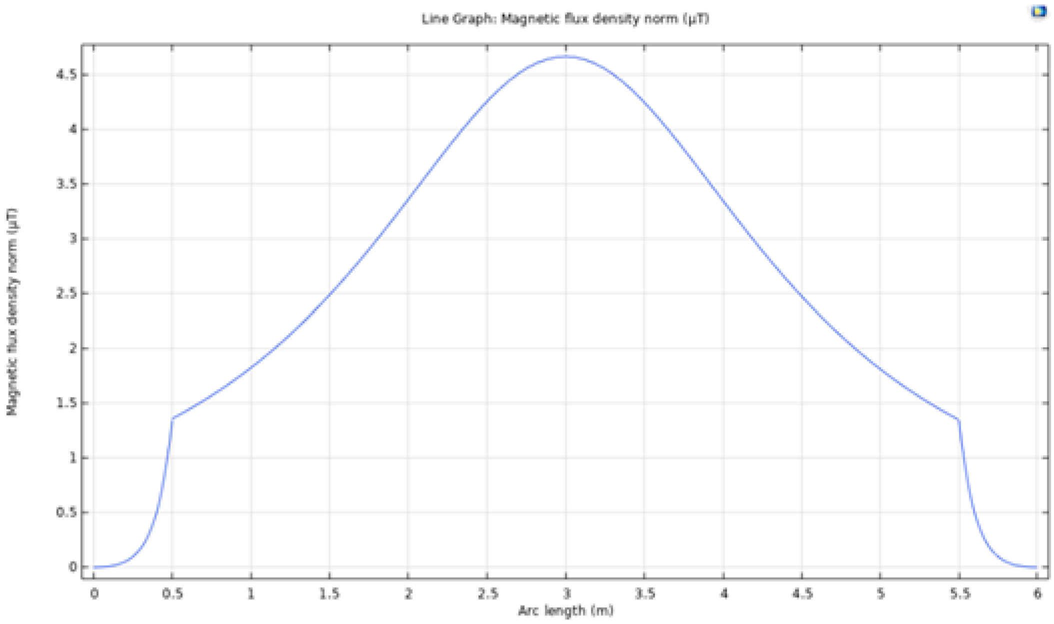


Plate 2-178 Inter-array cable magnetic field at seabed surface – 1800 Cu, stainless steel – 1083A – 2 m depth of burial

4030. 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). 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 fish at a site or population level, and little uncertainty remains (MMO, 2014). It is considered that shad may be able to detect low level induced electric fields; however, there is no evidence to suggest that EMF plays a role in migration for these species. Furthermore, as a pelagic species, interaction with cable infrastructure is considered highly unlikely for shad.

4031. 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 the cables is 4.9 µT, well below the background levels all the QIs experience and utilise for normal behaviours. As such, any responses in fish QIs are only anticipated to occur within the immediate vicinity of the cable and no effect on migration or overall health and function is predicted.

4032. It should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of shad connected to the SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited, and the potential interaction of this QI with the impacts described above is predicted to be negligible.

4033. Therefore, considering the very low likelihood of interaction, the negligible areas over which impacts present, and the lack of or minimal behavioural response predicted with no consequence on normal behaviours including migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it is concluded beyond reasonable scientific doubt that there will be no adverse effects on site integrity from EMF.

2.46.2.3 Temporary increase in SSC and contaminated sediments

4034. Cable installation, installation of WTGs and associated works such as dredging, the deposit of dredged material, trenching, or O&M activities may result in a temporary increase in SSC. Such resuspended sediments may also contain levels of contamination; however, in the baseline site specific survey, contaminated sediment results showed low levels of chemical contaminants at stations sampled within the offshore development area. The majority of contaminants levels at sampled stations were below the Irish Lower AL and Cefas AL1 (**Appendix 8.3 Benthic Baseline Report** of the EIAR). Typically, contaminated sediments are only associated with finer sediments as they do not bind effectively with the coarse sands and gravels that are mainly present across the offshore development area. Published marine sediment contaminant data in the area also indicates a general low background level of contamination, with no patterns of consistently high levels of contaminants recorded spatially or temporally (data.gov.ie, 2007). As such, it is considered highly unlikely that high levels of contamination will arise that may affect this QI, and no effects on Conservation Objectives from such contaminated sediments are predicted.

4035. It should be noted that any effects of increased SSC and contaminated sediments will only affect the marine environment, and will not have any interaction with the riverine or estuarine environment through which this QI will pass during its migratory phase. As such, effects described below will only affect the at sea portion of the QI life cycle, and will not form any barrier to migration.

4036. The extent over which this impact may affect receptors can extend beyond the offshore development area and could therefore potentially affect QIs within and beyond the offshore development area. However, it should also be noted that due to the distance of the project from the SAC, it is not expected that large numbers of this QI will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers (Barry et al., 2020; Rikardsen et al., 2021). Therefore, numbers of individuals within the offshore development area will be limited.

4037. There are two activities that will result in the largest levels of SSC, dredging and trenching, these are fully described in **Appendix 6.3 Modelling Report** of the EIAR, including all modelled outputs described and summarised below.

2.46.2.3.1 Dredging and dredge disposal

4038. 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).

4039. The predicted transport of sediment plumes and subsequent deposition during dredge disposal activities within the offshore development area can be summarised as follows:

4040. 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.

2.46.2.3.2 Trenching

4041. 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.

4042. Based upon the representative scenario, the modelled 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.

4043. 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.

4044. 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 SSCs predicted, in the representative scenario, to reduce to baseline levels within *c*. 15 days following trenching operations.

4045. The effect on shad from increased SSC may include an increase of energetic costs (decreased ability to find prey, increased metabolic cost for removing sediment from gills), temporary loss of available offshore habitat that may be used during migration or time at sea, or behavioural responses leading to avoidance of the area thereby reducing the overall available habitat that can be used in the marine environment. However, given the highly mobile nature of the QIs, it is considered that most individuals will be able to avoid the affected area if required, and that there will be sufficient suitable alternative habitat available to ensure no effect on individuals normal behaviours, and no barrier to migration created. In addition, migratory species are able to tolerate a degree of suspended sediment owing to frequent exposure to storm induced fluctuations in sediment concentrations, and their life history traits that expose them to high levels of SSC (e.g., they migrate through estuarine environments, feed on organisms within the sediment, or live on or in the seabed sediments). As such, only behavioural avoidance, at most, is predicted for all species and individuals and there will be no impediment to migration behaviours.

4046. Therefore, given the large area over which this QI is present, the considerable distance between the CWP Project and the SAC and therefore minimal potential interaction with the impact, and the high degree of tolerance of this QI to the impact with behavioural or avoidance effects predicted at most and no barrier to migration, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity from increases in SSC and contaminated sediments.

2.46.2.4 Direct impacts on habitats

4047. Habitat disturbance may be short or long term; however, it should be noted here that there will be no impact on any of the SAC habitats, or on the estuary through which fish will migrate in order to reach the SAC. All direct impacts on habitats will only affect a relatively small area of ex situ offshore habitat that may be used during the marine phase of this species life cycle only.

4048. Within the offshore development area, up to approximately 11,931,840 m^2 of habitat will be disturbed by construction related activities with up to 157,000 m^2 potentially disturbed in the intertidal area. The overall total area of temporary seabed habitat disturbance is anticipated to be up to 12,088,840 m^2. However, it should be noted that several activities will take place in the same area, e.g., where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint, and such the extent of the areas with the potential to be impacted by temporary seabed habitat disturbance is significantly lower than those presented above.

4049. For longer term loss within the array site, approximately 0.49 km^2 of currently available habitat will be lost by operation related activities, with 0.11 km^2 potentially lost over the full length of the OECC, for a total area of long term loss of approximately 0.60 km^2. It is also acknowledged that maintenance activities may require the use of jack-up vessels, as well as physical repairs to the cable / other infrastructure and as such there is the potential for ongoing habitat disturbance in such areas.

4050. As with the other impacts described above, it should also be noted that due to the distance of the CWP Project from the SAC and its estuary, it is not expected that large numbers of any migratory fish connected to this SAC will be present in the offshore development area. The marine distribution and migratory routes of migratory fish are very large (Davis, 2020), for example shad may migrate up to 950 km from their natal rivers, and therefore numbers of individuals using the CWP Project will be limited.

4051. Accordingly, the area of habitat affected by direct effects represents such a negligible proportion of the overall marine habitat available to shad that there can be no adverse effect on any Conservation Objectives of the SAC from this impact. Furthermore, the offshore development area does not constitute critical habitat for migration, with the habitats present being ubiquitous and wide ranging throughout the Irish Sea, and there is therefore substantial alternative habitat that may be used as part of normal life history behaviours (e.g., feeding) in the immediate and wider area. As such, it is considered that such impacts arising as a result of the CWP Project will not impede the Conservation Objectives for these SACs. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effect on site integrity arising from direct impacts on habitats.

2.47 French ZSCs – harbour porpoise

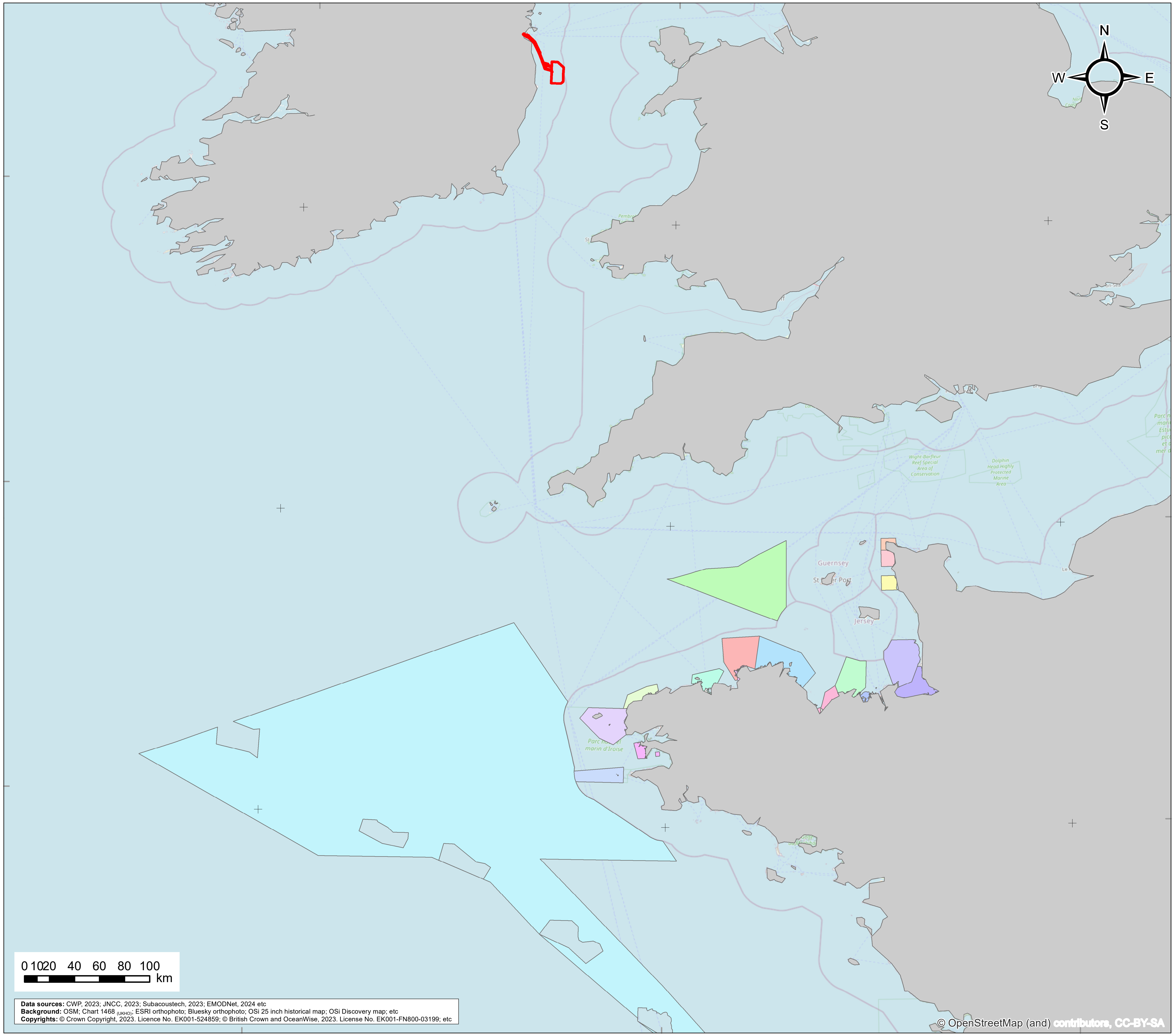
2.47.1.1 Site summary(s)

4052. There are 18 ZSCs designated for harbour porpoise in the French waters of the Celtic and Irish Seas MU (**Figure 2-22**):

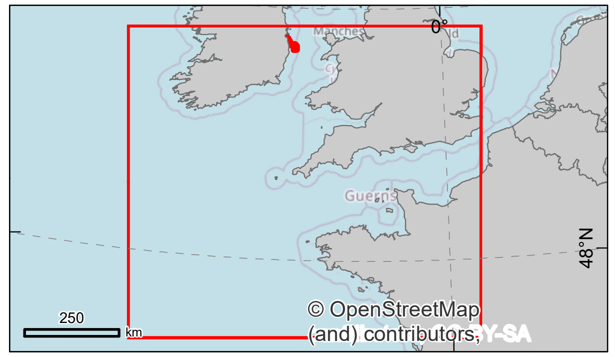
- Récifs et Landes de la Hague ZSC (FR2500084);
- Anse de Vauville ZSC (FR2502019);
- Banc et récifs de Surtainville ZSC (FR2502018);
- Chausey ZSC (FR2500079);
- Baie du Mont Saint-Michel ZSC (FR2500077);
- Estuaire de la Rance ZSC (FR5300061);

- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard ZSC (FR5300012);
- Cap d'Erquy-Cap Fréhel ZSC (FR5300011);
- Baie de Saint-Brieuc – Est ZSC (FR5300066);
- Tregor Goëlo ZSC (FR5300010);
- Côte de Granit rose-Sept-Iles ZSC (FR5300009);
- Nord Bretagne DH ZSC (FR2502022);
- Baie de Morlaix ZSC (FR5300015);
- Abers – Côte des légendes ZSC (FR5300017);
- Ouessant-Molène ZSC (FR5300018);
- Côtes de Crozon ZSC (FR5302006);
- Chaussée de Sein ZSC (FR5302007); and
- Mers Celtiques – Talus du golfe de Gascogne ZSC (FR5302015).

4053. Given their distance from the CWP Project, they have been assessed together here as impacts will be the same to each ZSC. For each SAC, a site description is provided in **Table 2-68**.



Data sources: CWP, 2023; JNCC, 2023; Subacoustech, 2023; EMODNet, 2024 etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc



Legend

- Planning application boundary

French ZSCs

- Abers - Côte des légendes
- Anse de Vauville
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard
- Baie de Morlaix
- Baie de Saint-Brieuc - Est
- Baie du Mont Saint-Michel
- Banc et récifs de Surtainville
- Cap d'Erquy-Cap Fréhel
- Chausey
- Chaussée de Sein
- Cote de Granit Rose-Sept Iles
- Côte de Granit rose-Sept-Iles
- Côtes de Crozon
- Estuaire de la Rance
- Mers Celtiques - Talus du golfe de Gascogne
- Nord Bretagne DH
- Ouessant-Molène
- Récifs et landes de la Hague
- Tregor Goëlo

Project: Codling Wind Park

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Figure 2.22:
Codling Wind Park in relation to the French ZSCs designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1616

Internal descriptive code: IRE.ECH - PAB - FRENCH.ZSCs - (NIS.Vol.04.Ch.02.FIG.27)

Size: A3
Scale: 1:3,000,000

CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Table 2-68 French ZSC site descriptions

ZSC	Site description
Récifs et Landes de la Hague	The Natura 2000 Standard Data Form[105] states the following: porpoise are listed as being present in a 'concentration', though no population size is provided. They are listed as being 'present' within the site with a 'Good' data quality (e.g., based on surveys).
Anse de Vauville	The Natura 2000 Standard Data Form[106] states the following: porpoise are listed as being present in a 'concentration', though no population size is provided. They are listed as being 'present' within the site with a 'Good' data quality (e.g., based on surveys).
Banc et récifs de Surtainville	The Natura 2000 Standard Data Form[107] states the following: porpoise are listed as being present in a 'concentration', though no population size is provided. They are listed as being 'present' within the site with a 'Good' data quality (e.g., based on surveys).
Chausey	The Natura 2000 Standard Data Form[108] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site with a 'Good' data quality (e.g., based on surveys).
Baie du Mont Saint-Michel	The Natura 2000 Standard Data Form[109] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site with a 'Moderate' data quality (e.g., based on partial data with Data quality: some extrapolation).
Estuaire de la Rance	The Natura 2000 Standard Data Form[110] states the following: porpoise are listed as being present in a 'concentration', with a population size of 2 individuals. They are listed as being 'rare' within the site with a 'Moderate' data quality (e.g., based on partial data with Data quality: some extrapolation).

[105] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2500084.
[106] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502019.
[107] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502018.
[108] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2500079.
[109] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2500077.
[110] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300061.

ZSC	Site description
Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard	The Natura 2000 Standard Data Form[111] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site but are listed as 'Data Deficient'.
Cap d'Erquy-Cap Fréhel	The Natura 2000 Standard Data Form[112] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site with a 'Moderate' data quality (e.g., based on partial data with Data quality: some extrapolation).
Baie de Saint-Brieuc - Est	The Natura 2000 Standard Data Form[113] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site but are listed as 'Data Deficient'.
Tregor Goëlo	The Natura 2000 Standard Data Form[114] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site with a 'Good' data quality (e.g., based on surveys).
Côte de Granit rose-Sept-Iles	The Natura 2000 Standard Data Form[115] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'present' within the site but are listed as 'Data Deficient'.
Nord Bretagne DH	The Natura 2000 Standard Data Form[116] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'common' within the site with a 'Poor' data quality (e.g., rough estimation).
Baie de Morlaix	The Natura 2000 Standard Data Form[117] states the following: porpoise are listed as being present, although no population size is provided. They are listed as being 'common' within the site with a 'Good' data quality (e.g., based on surveys).

[111] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300012.
[112] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300011.
[113] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300066.
[114] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300010.
[115] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR5300009.
[116] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.
[117] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.

ZSC	Site description
Abers – Côte des légendes	The Natura 2000 Standard Data Form[118] states the following: porpoise are listed as being present, although no population size is provided. They are listed as being 'common' within the site with 'Moderate' data quality (e.g., based on partial data with Data quality: some extrapolation).
Ouessant-Molène ZSC	The Natura 2000 Standard Data Form[119] states the following: porpoise are listed as being present, although no population size is provided. They are listed as being 'common' within the site but are listed as 'Data Deficient'.
Côtes de Crozon ZSC	The Natura 2000 Standard Data Form[120] states the following: porpoise are listed as being present, although no population size is provided. They are listed as being 'common' within the site but are listed as 'Data Deficient'.
Chaussée de Sein ZSC	The Natura 2000 Standard Data Form[121] states the following: porpoise are listed as being present, although no population size is provided. They are listed as being 'common' within the site but are listed as 'Data Deficient'.
Mers Celtiques – Talus du golfe de Gascogne ZSC	The Natura 2000 Standard Data Form[122] states the following: porpoise are listed as being present in a 'concentration', no population size is provided. They are listed as being 'common' within the site with a 'Poor' data quality (e.g., rough estimation).

[118] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.
[119] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.
[120] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.
[121] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.
[122] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502022.

2.47.1.2 Conservation Objectives

4054. It was not possible to access any of the Conservation Objectives or Management Plans for any of the French ZSC sites. Therefore, it is assumed that the Conservation Objectives at the Rockabill to Dalkey Island SAC apply here.

4055. The Conservation Objective for the Rockabill to Dalkey Island SAC (used here as a proxy) is to maintain the favourable conservation condition of harbour porpoise in the SAC, which is defined by the following list of attributes and targets (as listed in NPWS (2013b)):

- Attribute 1: Access to suitable habitat:
  - Target 1: Species range within the site should not be restricted by artificial barriers to site use:
    - This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
    - It does not refer to short-term or temporary restriction of access or range.
    - Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.
- Attribute 2: Disturbance:
  - Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site:
    - Proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the population of harbour porpoise community within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
    - This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
    - Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

Table 2-69 Summary of assessment, Conservation Objectives, Attributes and Targets for French ZCSs

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
Range Species range within the site should not be restricted by artificial barriers to site use.	Increased underwater noise			There will be no adverse effects on the integrity of any of the French ZSCs as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site(s) and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site(s) and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to collision risk.	
	Changes in prey availability			
	There is no potential impact pathway between changes in	N/A	N/A	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	prey availability and this Conservation Objective.			
	Changes in available habitat			
	Changes in habitat are not expected to result in the permanent exclusion of harbour porpoise from part of its range within the site(s) and will not permanently prevent access for the species to suitable habitat.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) range due to changes in available habitat.	
Population Human activities should occur at levels that do not adversely affect the harbour porpoise population at the site.	Increased underwater noise			There will be no adverse effects on the integrity of any of the French ZSCs as a result of impacts on harbour porpoise arising from the CWP Project.
	The CWP Project has committed to implementing both a UXO MMMP and a piling MMMP. Increased underwater noise is not expected to result in a significant negative impact (disturbance and death / injury) on harbour porpoise population within the site(s) or deterioration of key resources upon which harbour porpoise depend.	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to increased underwater noise.	
	Collision risk			
	The CWP Project has committed to implementing an EVMP. Collision risk is not expected to result in a significant negative impact	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species	

Attributes and Targets	Predicted Effect	Mitigation	Residual Effect (Project alone)	Conclusion
	(death / injury) on harbour porpoise population within the site(s).		(harbour porpoise) population due to collision risk.	
	Changes in prey availability			
	Changes in prey availability are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in prey availability.	
	Changes in available habitat			
	Changes in available habitat are not expected to result in deterioration of key resources upon which harbour porpoise depend to the extent that could affect harbour porpoise population at the site(s).	No additional mitigation is required.	There is no potential for an AESI associated with maintaining the species (harbour porpoise) population due to changes in available habitat.	

2.47.1.2.1 Impact 1: Increased underwater noise

4056. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not introduce man-made energy (e.g., aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and / or the community of harbour porpoise within the site’, and ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

4057. For marine mammals, the main potential impacts from the CWP Project are associated with underwater noise. Therefore, a detailed assessment has been provided for this impact pathway within the EIAR, **Chapter 11 Marine Mammals**.

4058. Increased underwater noise levels are anticipated to occur through:

- Pre-construction geophysical surveys (Multibeam Echo Sounder (MBES), Sub-bottom Imager (SBI), Side Scan Sonar (SSS), Sub-bottom Profiler (SBP), Ultra High Resolution Seismic (UHRS), Ultra-short Baseline (USBL));
- Unexploded Ordnance (UXO) clearance;
- Pile driving (WTGs and onshore / landfall substation);
- Other construction activities (dredging, drilling, cable laying, trenching, rock placement);
- Operational noise; and
- Vessel presence.

4059. The generation of underwater noise has the potential to result in both auditory injury impacts (i.e., Permanent Threshold Shift (PTS)-onset) and disturbance, each of which have been assessed below. Each of the impacts assessed below are presented as a representative scenario and unmitigated, whilst the final conclusions draw upon the implementation of primary embedded mitigation measures.

Auditory injury (PTS)

Pre-construction geophysical surveys

4060. The underwater noise assessment concluded that for pre-construction geophysical surveys, PTS-onset ranges were considered negligible, with a very low potential for PTS-onset given the implementation of primary embedded mitigation (which includes a marine mammal watch of a 1 km radius mitigation zone as per DAHG (2014a)). There will be no overlap between PTS-onset ranges and any of the French ZSCs for porpoise.

UXO clearance

4061. For UXO clearance, the maximum PTS-onset impact range for harbour porpoise from unmitigated high-order clearance of a 525 kg UXO + donor) is 12 km. Low-order clearance is preferred over high-order clearance, for which the maximum unmitigated impact range is 990 m. The CWP Project is committed to implementing a UXO-specific MMMP which will reduce the risk of PTS to negligible. There will be no overlap between PTS-onset ranges and any of the French ZSCs for porpoise.

Piling at the onshore substation

4062. For piling at the onshore substation, PTS impact ranges will not overlap with the French ZSCs for porpoise. The small injury ranges (max 3 km for concurrent vessels) will impact at most 1 porpoise. The piling MMMP will ensure the risk of injury is further minimised (see **Chapter 11 Marine Mammals** of the EIA).

Piling of WTGs

4063. For piling of WTGs, the largest cumulative PTS impact range for harbour porpoise is 4.7 km at the SE monopile location. For the nearest piling location to the SAC (NW monopile location) the largest cumulative PTS impact range for harbour porpoise is 2.2 km. There will be no overlap between PTS-onset ranges and any of the French ZSCs for porpoise.

Other construction activities

4064. For other construction activities, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and any of the French ZSCs for porpoise.

Operational noise

4065. For operational noise, the maximum PTS-onset impact range for harbour porpoise was <100 m resulting in no porpoise being impacted. There will be no overlap between PTS-onset ranges and any of the French ZSCs for porpoise.

Primary mitigation

4066. The CWP Project has committed to implementing UXO-specific and piling-specific MMMPs to reduce the risk of auditory injury (PTS) to negligible levels (**Appendix 6**).

Conclusion

4067. The proposed activities at the CWP Project will not cause (auditory) injury to individuals at any of the French ZSCs for porpoise. Therefore, there will be no impediment to the Conservation Objectives of the harbour porpoise feature at any of the French ZSCs for porpoise from PTS-onset (underwater noise) from the CWP Project alone. Having regard to these considerations, it can be concluded beyond reasonable scientific doubt that there will be no adverse effects on the integrity of any of the French ZSCs arising from this impact.

Disturbance

Pre-construction geophysical surveys

4068. The underwater noise assessment concluded that for pre-construction geophysical surveys, disturbance impact ranges are very small and therefore are not considered a disturbance impact with respect to the Habitats Regulations. Explicitly, the JNCC et al. (2010) EPS Guidance, which is considered appropriate best practice guidance in the absence of Irish guidance, concludes that the use of sub-bottom profilers (SBPs) in geophysical surveys '*Could, in a few cases, cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in terms of the Regulations'.* There will be no overlap between disturbance impact ranges and any of the French ZSCs for porpoise.

UXO clearance

4069. The underwater noise modelling which supports the impact assessment details impacts from both high- and low-order UXO clearance. For high order clearance of a 525 kg UXO (+ donor), the disturbance range is 23 km (using TTS as a proxy for disturbance) or 26 km (using the EDR approach). There will be no overlap between disturbance impact ranges and any of the French ZSCs for porpoise.

Piling at the onshore substation

4070. For piling at the onshore substation, disturbance impact ranges will not overlap with any of the French ZSCs for porpoise.

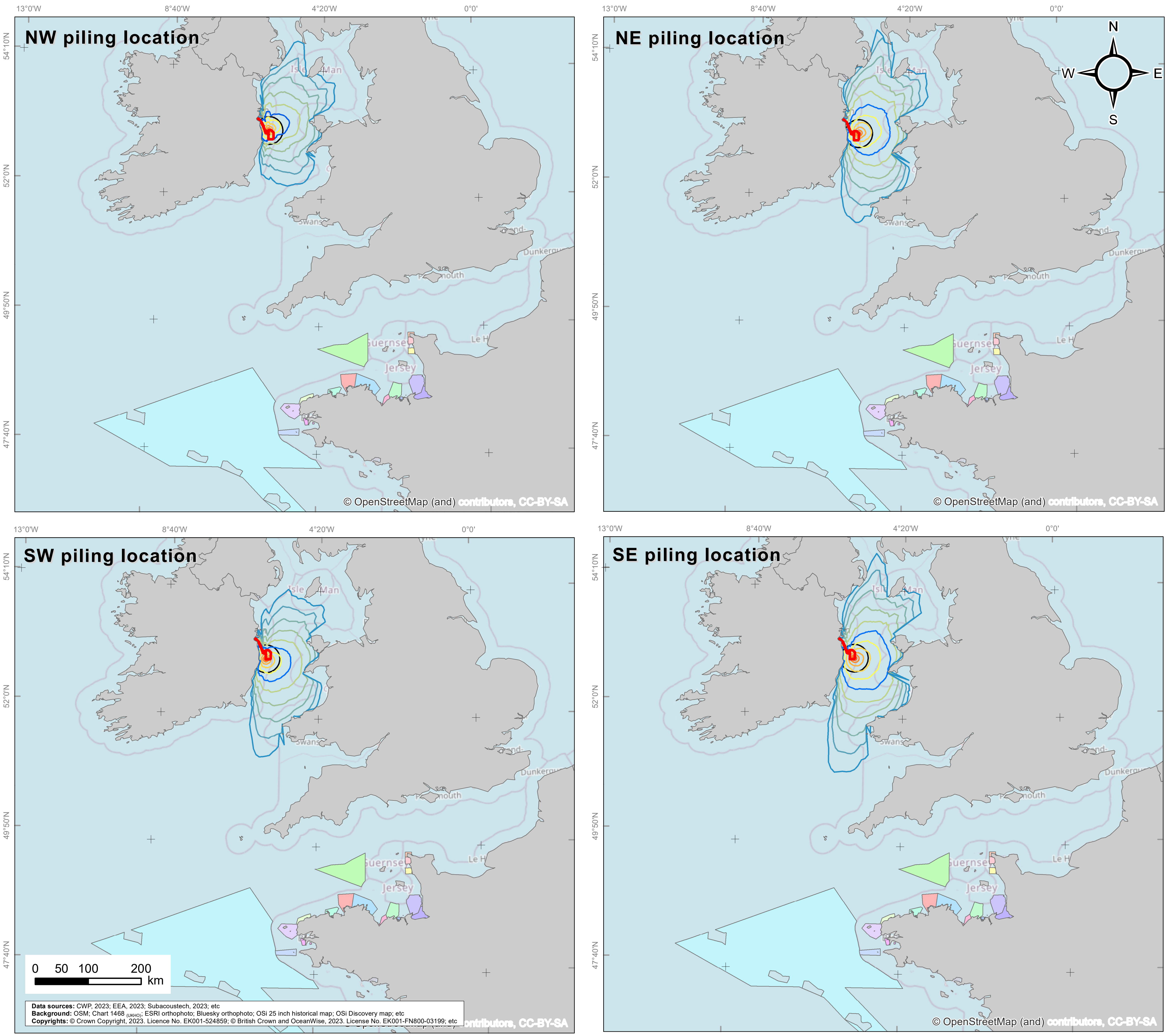
Operational noise

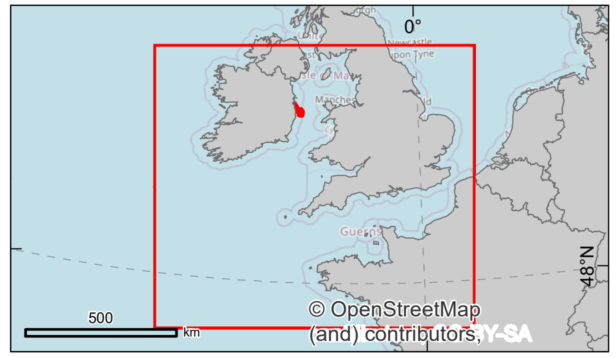
4071. For operational noise, the disturbance ranges are expected to be a few hundred metres (Bellmann et al., 2023). Disturbance impact ranges, if they occur at all, will be limited to within the array site and thus there will be no overlap with any of the French ZSCs for porpoise.

Piling of WTGs

4072. For piling of WTGs, the disturbance assessment using the harbour porpoise dose-response function presented in (Graham et al., 2017). There is no guidance from NPWS on what constitutes a *'significant negative impact on individuals and / or the community of harbour porpoise within the site'*. Therefore, existing advice from NRW (the Welsh statutory nature conservation authority) on the assessment of disturbance for harbour porpoise SACs in Wales (NRW, 2023) and existing advice from JNCC on the assessment of disturbance at harbour porpoise SACs in Wales and England (JNCC, 2020) has been followed here. This approach presents multiple disturbance thresholds: the 145 dB SEL_{ss} threshold from Lucke et al. (2009), whereby noise levels above 145 dB SEL_{ss} cause disturbance to harbour porpoise, and the 26 km EDR approach as outlined by JNCC (2020).

4073. None of the disturbance contours overlap with any of the French ZSCs for porpoise (**Figure 2-23**).





Legend

- Planning application boundary
- SEL_{ss} 145 dB re µPa ^{2}s threshold
- 26 km EDR

SEL_{ss} dB re µPa^{2}s (5dB contours)

- 120 dB
- 125 dB
- 130 dB
- 135 dB
- 140 dB
- 145 dB
- 150 dB
- 155 dB
- 160 dB
- 165 dB
- 170 dB
- 175 dB
- 180 dB

French ZSCs

- Abers - Côte des légendes
- Anse de Vauville
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard
- Baie de Morlaix
- Baie de Saint-Brieuc - Est
- Baie du Mont Saint-Michel
- Banc et récifs de Surtainville
- Cap d'Erquy-Cap Fréhel
- Chausey
- Chaussée de Sein
- Cote de Granit Rose-Sept Iles
- Côte de Granit rose-Sept-Iles
- Côtes de Crozon
- Estuaire de la Rance
- Mers Celtiques - Talus du golfe de Gascogne
- Nord Bretagne DH
- Ouessant-Molène
- Récifs et landes de la Hague
- Tregor Goëlo

Data sources: CWP, 2023; EEA, 2023; Subacoustech, 2023; etc
Background: OSM; Chart 1468 (UKHO); ESRI orthophoto; Bluesky orthophoto; OSi 25 inch historical map; OSi Discovery map; etc

Project: Codling Wind Park

SMRU Consulting
understand • assess • mitigate

Figure 2.23:
Disturbance thresholds for piling at all modelling locations and the French ZSCs designated for harbour porpoise

CWP doc. number: CWP-SMR-ENG-08-01-MAP-1617

Internal descriptive code: IRE.ECH - PAB..DPNM.CONT.CORNERS..THRESH.SEL.26EDR.CONT.WTGs.CORNERS - FRENCH.ZSCs - (NIS.Vol.04.Ch.02.FIG.28)

Size: A3
Scale: 1:7,000,000
CRS: EPSG 25830

Rev.	Updates	Date	By	Chk'd	App'd
A	Final version	2024/08/01	JC	RRS/EA	EA

Disturbance from vessels

4075. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased underwater noise is the presence of vessels. For disturbance from construction vessels, short-term behavioural responses have been recorded, where, at a mean vessel distance of 2 km, porpoise occurrence decreased by up to 35.2%, at 3 km porpoise occurrence decreased by up to 24% and by 4 km there was no apparent response (Benhemma-Le Gall et al., 2021). Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1 km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel was an important factor, with the greatest reaction occurring just 200 m from the vessel (Oakley et al., 2017).

4076. The project has committed to the adoption of a EVMP to determine vessel routing to and from construction sites and ports and to include a code of conduct for vessel operators, in order to minimise the risk of disturbance to marine mammals. When considering the impact of disturbance from vessel presence and noise, it is predicted to be of local spatial extent, short-term and temporary. While disturbance from vessels can result in short-term changes to porpoise behaviour, it is unlikely to result in permanent exclusion, alterations in vital rates in the longer term and no population-level impacts are expected in situ or ex situ.

4077. Vessels associated with the CWP Project are not expected to operate within any of the French ZSCs for porpoise. Disturbance impact ranges will not overlap with any of the French ZSCs for porpoise.

Conclusion

4078. Considering the impact pathways described above, disturbance effects from increased underwater noise are anticipated to be below levels that may adversely affect the harbour porpoise community at any of the French ZSCs for porpoise. Therefore, there is expected to be no potential for AESI to any of the French ZSCs for porpoise from the CWP Project alone.

Exclusion

4079. Target 1 of the Conservation Objectives states that there should be no permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.

4080. None of the activities associated with the construction, O&M and decommissioning of WTGs at the array site are expected to result in the permanent exclusion of harbour porpoise from part of their range within the SAC. Therefore, there is expected to be no potential for AESI to any of the French ZSCs for porpoise from the CWP Project alone.

Proposed mitigation

4081. The primary mitigation already includes the UXO MMMP and a piling MMMP to reduce the risk of auditory injury (PTS) to negligible levels as well as the EVMP to reduce the risk of disturbance from vessels. The assessment has concluded no AESI to any of the French ZSCs for porpoise from the CWP Project alone from increased underwater noise.

4082. No additional mitigation is required.

Residual impacts

4083. There is expected to be no change to the FCS, no potential for an AESI and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with the French ZSCs from increased underwater noise from the CWP Project alone.

2.47.1.2.2 Impact 2: Collision risk

4084. Target 2 of the Conservation Objectives states that ‘proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site’.

Assessment of the project alone

4085. During construction, O&M and decommissioning phases of the CWP Project, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. Vessel activity associated with the CWP Project will be mainly restricted to transit routes to and from ports, the array area and the OECC.

4086. The CWP Project has committed to the implementation of a EVMP as primary mitigation. With the adoption of industry best practice with regard to vessel management and the commitment that all vessels will be required to follow the guidelines outlined under the Marine Notice No. 15 of 2005 ‘Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters’, the already low risk of vessel collisions will be further reduced.

4087. Vessels associated with the CWP Project are not expected to operate within any of the French ZSCs for porpoise. No harbour porpoise within any of the French ZSCs for porpoise are expected to experience death or injury from vessel collisions and as such, risk of collision will not adversely affect the harbour porpoise community at any of the French ZSCs for porpoise. Therefore, there is expected to be no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community at any of the French ZSCs for porpoise from collision risk from the CWP Project alone.

Proposed mitigation

4088. The primary mitigation already includes an EVMP to reduce the risk of vessel collisions. The assessment has concluded no AESI to any of the French ZSCs for porpoise from the CWP Project alone from collision risk.

4089. No additional mitigation is required.

Residual impacts

4090. There is expected to be no change to the FCS and no impediment to the Conservation Objectives being achieved at any of the French ZSCs for porpoise. Furthermore, there is no potential for an AESI on any of the French ZSCs for porpoise from vessel collisions from the CWP Project alone.

2.47.1.2.3 Impact 3: Changes in prey availability

4091. Target 2 of the Conservation Objectives states that 'Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g., water quality, feeding, etc.) upon which harbour porpoise depend'.

Assessment of the project alone

4092. Given that harbour porpoise are dependent on fish prey, there is the potential for indirect effects as a result of impacts to fish species or the habitats that support them, during the construction, O&M and decommissioning phases of the CWP Project. While there may be certain species that comprise the main part of their diet, harbour porpoise are considered to be generalist feeders (Booth, 2020, Carmen et al., 2021, Eerkes-Medrano et al., 2021) and are thus not reliant on a single prey species. To inform this NIS, **Chapter 9 Fish, Shellfish and Turtle Ecology** of the EIAR prepared for the Project was referred to, for the purposes of establishing whether adverse effects on the integrity of any of the French ZSCs could arise as a result of the impacts of changes in prey availability on harbour porpoise as a qualifying feature of the French ZSCs for porpoise. The EIAR concludes that there will be no significant impact to any fish species from any impact pathway during the construction, operation or decommissioning of the CWP Project alone (this includes direct damage or disturbance resulting in temporary or permanent habitat loss, increased SSC and sediment deposition, release of seabed contaminants, underwater noise etc). Overlap between the area affected by the project and spawning or nursery areas is extremely low, representing ≤0.1% of the available spawning and nursery areas within the national study area for all species assessed, including important prey species of harbour porpoise (e.g., whiting, herring, cod, sandeel).

4093. Considering the above, there is expected to be no change to harbour porpoise prey species presence, abundance, condition, or diversity; as such, there will be no deterioration of key resources (feeding) upon which harbour porpoises depend. There is therefore no potential for AESI, and no impediment to the Conservation Objectives of the harbour porpoise community at any of the French ZSCs for porpoise from changes in prey availability from the CWP Project alone.

Proposed mitigation

4094. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the French ZSCs for porpoise as a result of changes in prey availability.

Residual impacts

4095. There is expected to be no change to the FCS, no potential for AESI, and no impediment to the Conservation Objectives being achieved for the harbour porpoise community associated with any of the French ZSCs for porpoise as a result of changes to prey availability from the CWP Project alone.

2.47.1.2.4 Impact 4: Changes in available habitat

4096. Target 1 of the Conservation Objectives states that 'Species range within the site should not be restricted by artificial barriers to site use. This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein'.

Assessment of the project alone

4097. None of the activities associated with the construction, operation and decommissioning of the CWP Project are expected to result in the permanent exclusion of harbour porpoise from part of their range within any of the French ZSCs for porpoise nor will they permanently remove, or prevent access for harbour porpoise to, suitable habitat therein.

4098. Considering the above, there is expected to be no potential for AESI to the Conservation Objectives of the harbour porpoise community at any of the French ZSCs for porpoise from changes in available habitat from the CWP Project alone.

Proposed mitigation

4099. No specific mitigation is required in respect of this impact, as there will not be any adverse impacts on the integrity of any of the French ZSCs for porpoise as a result of changes in available habitat.

Residual impacts

4100. There is expected to be no change to the FCS, no potential for an AESI, and no impediment to the Conservation Objectives of the harbour porpoise community associated with any of the French ZSCs for porpoise from changes in available habitat from the CWP Project alone.

3 NIS CONCLUSION

4101. The purpose of this document, which will accompany the application for development of the CWP Project, was to inform the AA process in determining whether the CWP Project would adversely affect the integrity of any European sites.

4102. The Stage 2, NIS concluded that following application of suitable mitigation where required, the CWP Project alone would not have an adverse effect on the integrity of any European site as a result of ex situ or in situ effects.

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