Natura Impact Statement

Volume 7

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Appendix 1 - Onshore Invasive Species Management Plan

Onshore Invasive Species Management Plan for the Codling Wind Park Project

May 2024

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Cover photo: General view of the knotweed infestation at the Uisce Éireann (Irish Water) site in July 2023.

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1. INTRODUCTION

At the request of Codling Wind Park Ltd. (CWPL), INVAS Biosecurity Ltd. (INVAS) was commissioned to carry out an Invasive Alien Species (IAS) survey for the onshore development area boundary for the Codling Wind Park (CWP) Project, at Poolbeg County Dublin (53.336396, -6.202955). INVAS accessed the site on 21 July and again on 10 October 2023. The October visit coincided with access works for the initiation of a knotweed management programme by INVAS Staff.

1.1. Project background

CWPL is proposing to develop the CWP Project, an offshore wind farm (OWF) located in the Irish sea approximately 13 - 22 km off the east coast of Ireland, at County Wicklow.

The onshore transmission infrastructure (OTI) for the CWP Project is situated within the Poolbeg Peninsula and includes the transition joint bays (TJBs), the onshore export cables, the onshore substation, and the Electricity Supply Board Networks (ESBN) network cables to connect the onshore substation to the Poolbeg 220 kV substation. This report also accounts for works at the landfall (landward of the high water mark), where the offshore export cables are brought onshore and connected to the onshore export cables at the TJBs.

The onshore development area boundary is shown in Figure 2.1.

As part of ecological surveying within the onshore development area boundary in 2022, knotweed (*Reynoutria japonica* and *Reynoutria x bohemica*) was detected at several locations in proximity to the landfall site. No recent ground works have taken place in proximity to these previously reported knotweed infestations. Additionally, there are several active sites (not associated with the CWP Project) currently located throughout the onshore development area boundary. These sites and their activities were not interfering with any infestations of regulated IAS at the time of these ecological surveys.

A full IAS survey of the onshore development area boundary was required to inform a suitable management plan for the infestations. The OTI are located adjacent to the South Dublin Bay Special Area of Conservation (SAC) IE000210, South Dublin Bay proposed Natural Heritage Area (pNHA) 000210, and South Dublin Bay and River Tolka Estuary Special Protection Area (SPA) IE004024.

1.2. Objectives

The aim of this report is to provide a record of all IAS identified within the footprint of the onshore development area boundary and to generate a site map for any IAS recorded using GPS locations.

This report also outlines control and management options, taking into account proposed site clearance and excavation works associated with the future construction phase of the CWP Project. These management options will prevent any accidental spread of known IAS infestations.

1.3. National and European legislation concerning invasive alien species

Globally, IAS are regarded as one of the biggest causes of biodiversity loss next to climate change. The environmental impact of IAS was discussed at the groundbreaking international Convention on Biological Diversity in 1992, and since that time, targeted legislation to prevent introduction and spread of these harmful species has been introduced at a national and European level. The most relevant legislation that takes IAS into account in Ireland is summarised in Table 1.1.

Table 1.1: National and European legislation concerning invasive alien species.

Invasive Alien Species Regulation (EU) 1143/2014 **https://environment.ec.europa.eu/topics/nature-and-biodiversity/invasive-alien-species_en**	This EU Regulation entered into force on 1 January 2015. Central to the legislation is the establishment, and regular updating, of a list of IAS considered to be of Union concern ('the Union list'). The placing of a species on the Union list activates a number of obligations on Member States (MS) regarding those species, e.g. "Within 18 months of an IAS being included on the Union list, MS shall have in place effective management measures for those invasive alien species of Union concern…". The 49 species included on the Union list are subject to restrictions on keeping, importing, selling, breeding and growing. Member States are required to take action on pathways of unintentional introduction, take measures for early detection and rapid eradication of these species, and to manage species that are already widely spread in their territory.
Republic of Ireland: European Communities (Birds and Natural Habitats) Regulations 2011, S.I. 477 of 2011 **https://www.irishstatutebook.ie/eli/2011/si/477/**	Regulation 49 on the 'Prohibition on introduction and dispersal of certain species' makes it an offence to knowingly disperse or allow to escape species that are listed in the Third Schedule, which is the list of high impact IAS that are subject to restrictions under the Regulations.
Republic of Ireland: River Basin Management Plan for Ireland 2018-2021 and Draft River Basin Management Plan for Ireland 2022 – 2027 **(Water Framework Directive)** https://www.gov.ie/en/publication/429a79-river-basin-management-plan-2018-2021/ https://www.gov.ie/pdf/?file=https://assets.gov.ie/199144/7f9320da-ff2e-4a7d-b238-2e179e3bd98a.pdf#page=null	For the first time, invasive species have been explicitly mentioned in this latest cycle of the River Basin Management Plan (RBMP) for Ireland. A list of Principal Actions on invasive species has been included, e.g. implement the EU (European Union) IAS Regulation, develop management plans for IAS, develop national guidelines for biosecurity.
Republic of Ireland: Sustainable Use of Pesticides Directive http://www.pcs.agriculture.gov.ie/sud/	The Sustainable Use of Pesticides Directive (SUD) establishes a framework for European Community action to achieve the sustainable use of pesticides by setting minimum rules to reduce the risks to human health and the environment that are associated with pesticide use. It also promotes the use of integrated pest management. The Directive is designed to

	further enhance the high level of protection achieved through the entire regulatory system for pesticides.

2. SURVEY RESULTS

Survey points were recorded using a Garmin® GPSmap78 at a height of one metre. Points were recorded at 0.5 metre intervals around the perimeter of any infestation detected. In some cases, points may have been taken along the extremities of an infestation due to dangerous terrain, inaccessibility of sites located on neighbouring property or due to overgrowth of vegetation other than the IAS in question. Survey observations and photographs illustrating each IAS infestation have been provided in the following sections of this document and Appendix 1. A small unmanned aerial vehicle (sUAV) survey was not carried out as part of this survey.

2.1. IAS recorded

Six IAS were recorded: Bohemian knotweed (*Reynoutria x bohemica*), buddleja (butterfly bush) (*Buddleja davidii*), Japanese knotweed (*Reynoutria japonica*), old man's beard (*Clematis vitalba*), sea buckthorn (*Hippophae rhamnoides*), Three-cornered leek[1] (Allium triquetrum) and winter heliotrope (*Petasites pyrenaicus*). These species are highly invasive and can be easily dispersed as a result of poor site biosecurity and poor management practices. A more detailed description of these IAS is provided in Appendix 2.

Bohemian knotweed, Japanese knotweed, Three-cornered leek and sea buckthorn are all regulated under Schedule 3 of S.I. 477 (Appendix 3), while Bohemian knotweed and Japanese knotweed are also included in Part 3 of the same regulation, restricting the movement of vector materials containing these species. No species were recorded that are contained on the EU IAS Regulation 1143/2014 (Appendix 4).

Buddleja and winter heliotrope were locally abundant in unmanaged sections of the site. One infestation of old man's beard was recorded outside of the survey area, adjacent to Irishtown Nature Park. None of these three species are contained in any regulatory list at present (a more detailed description of these IAS is provided in Appendix 2).

[1] This IAS was identified separate to the 2023 surveys. It was identified in April 2024 by TOBIN Consulting Engineers.

2.1.1. Bohemian knotweed and Japanese knotweed

There are three species of knotweed that are generally referred to by the public and non-specialists as 'Japanese knotweed' and two of these were recorded growing in the survey area in July and October 2023. The principal knotweed species recorded throughout the survey area during the survey was Bohemian knotweed (a hybrid of Japanese knotweed and giant knotweed), with smaller populations of one of the parent species, Japanese knotweed, also recorded. Because the broad ecology of these two knotweed species is very similar and because they are all controlled/managed in the same manner, they will be referred to collectively as knotweed throughout this report.

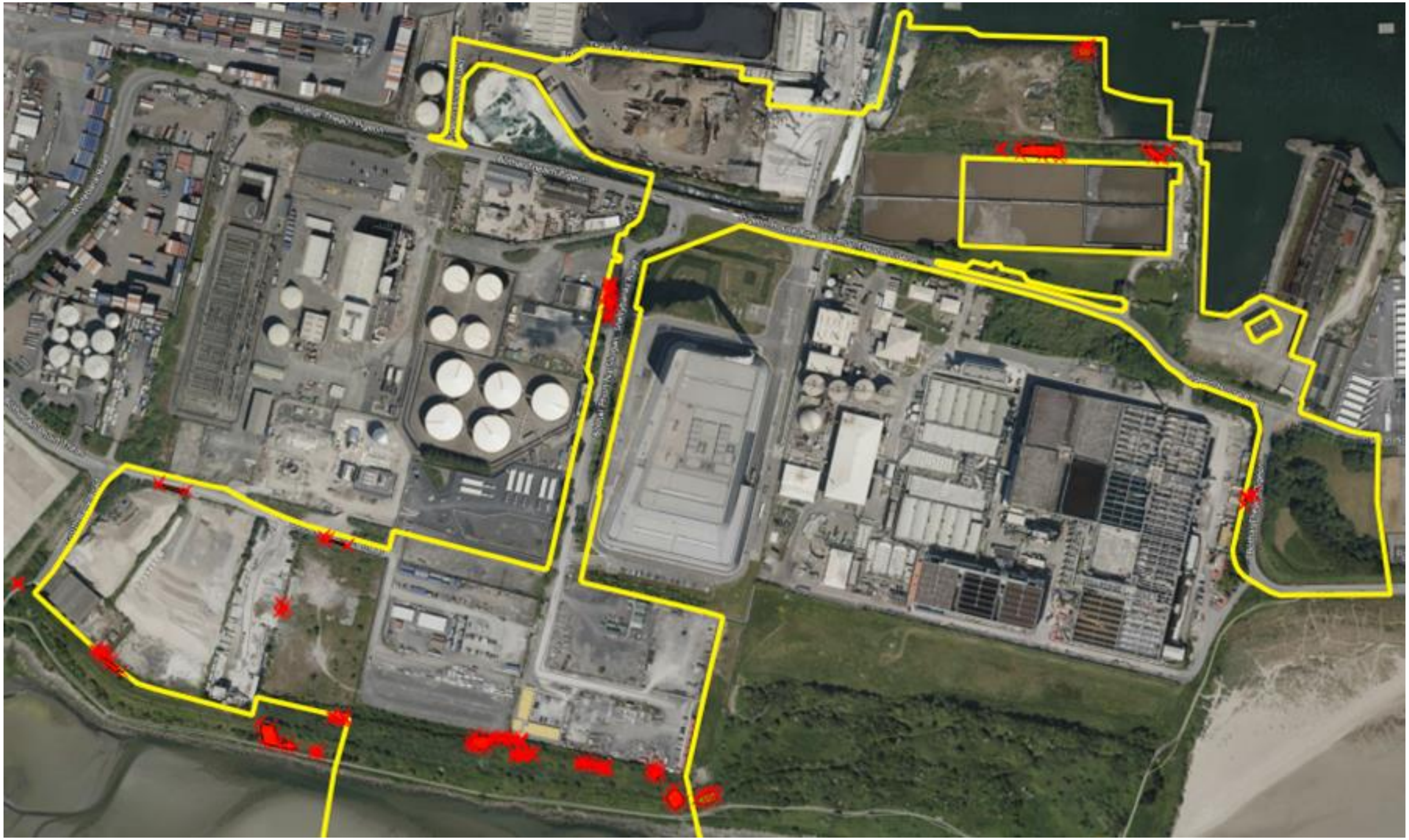

Figure 2.1: Onshore development area boundary (yellow line), with the location of all infestations of regulated species, including knotweed and sea buckthorn, recorded in July 2023 outlined by red crosses.

Knotweed was recorded in five main areas throughout the survey area (Figure 2.1-2.6). Infestations were recorded in an overgrown section to the north of the Uisce Éireann (formerly Irish Water) storm water ponds (53.341080, -6.194323) (Plate 2.1). There were two large areas of infestation, with two smaller outlier stands recorded between the storm water ponds and the north boundary fence (Figure 2.2). The infestations are recorded less than 7 metres from the Uisce Éireann site boundary, but at present they do not extend beyond the fenceline. The presence of dead canes in some areas close to the ponds indicate that herbicide treatment may have taken place in the past to prevent Knotweed rhizome growth from impacting on the adjacent structures.

Sporadic minor regrowth and evidence of previous Knotweed growth was recorded adjacent to a crash barrier on the verge of the Pigeon House Road (53.338360, -6.193027) (Figure 2.3, Plate 2.2). This area is located to the east of Ringsend Wastewater Treatment Plant.

Plate 2.1-2.2: Knotweed growing in the north of the Uisce Éireann site (2.1) and adjacent to the Pigeon House Road (2.2) in July 2023.

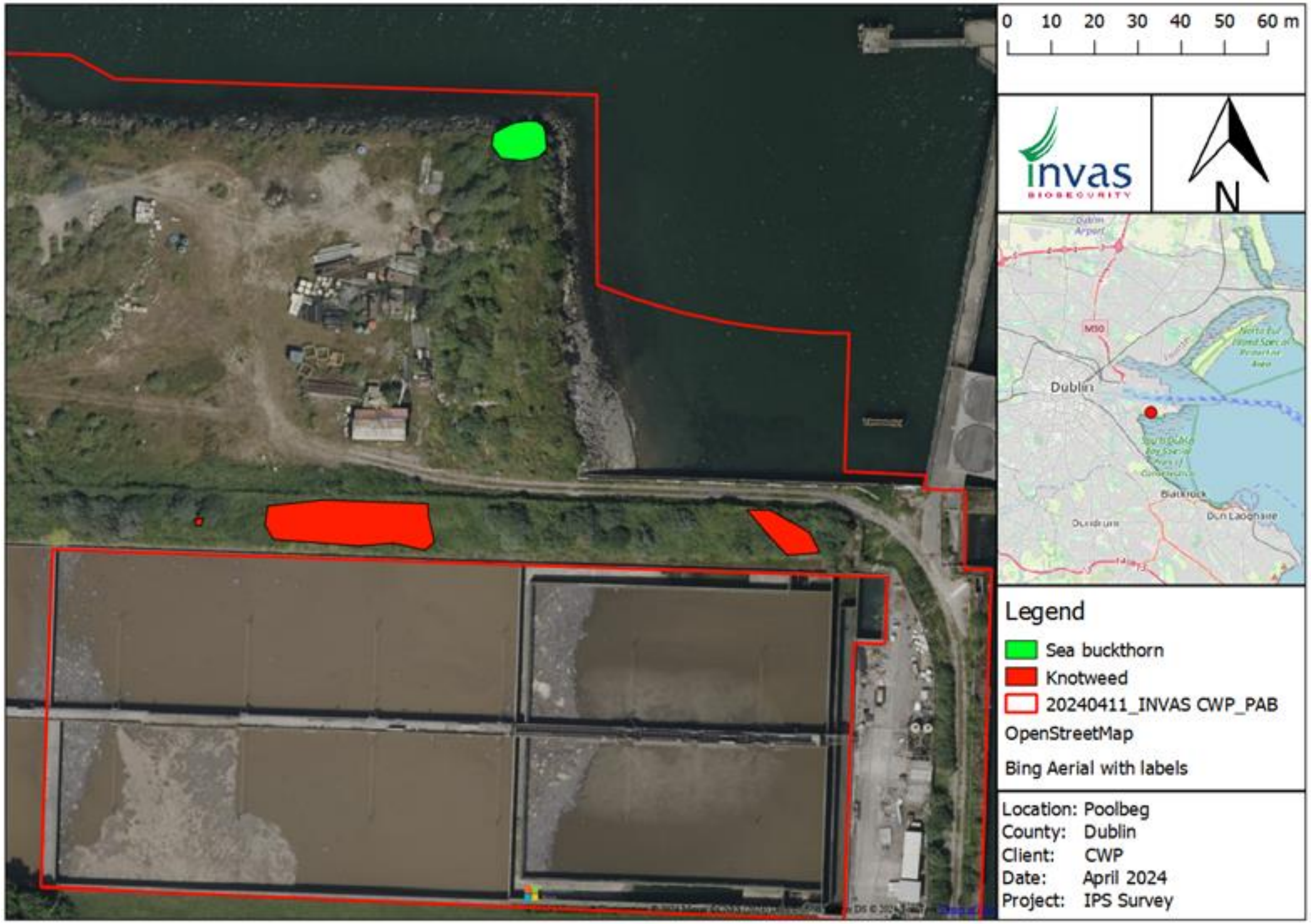

Figure 2.2: A view of knotweed (red) within the Uisce Éireann site and sea buckthorn (green) within the onshore development area boundary in July 2023.

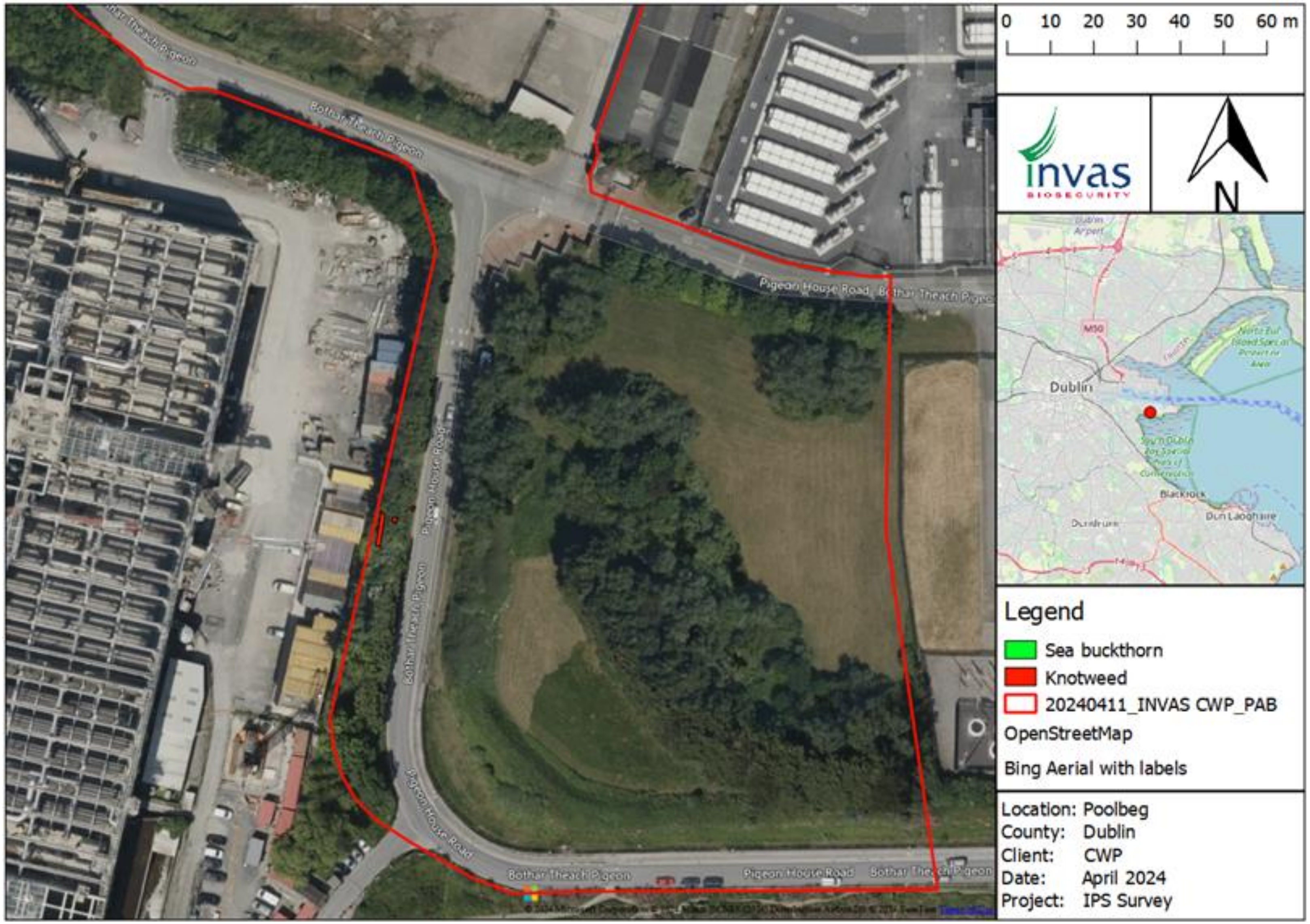

Figure 2.3: A view of knotweed (red) adjacent to Pigeon House Road, adjacent to the onshore development area boundary in July 2023.

Knotweed was recorded throughout the berm at the landfall location (53.336408, -6.202905) in the south of the survey area and east to the boundary with Irishtown Nature Park. These are dense infestations and form impenetrable stands in close proximity to brambles and buddleja (Figure 2.4, Plates 2.3-2.5). This area could not be accessed on foot in July due to site fencing and dense overgrowth, but was then extensively surveyed during manual clearance works in early October 2023. A large infestation was also recorded adjacent to the pedestrian path on the south sea wall, growing from the top of the berm down to the edge of the pathway (Figure 2.5, Plate 2.6).

Plate 2.3-2.6: Knotweed growing in the south of the onshore development area throughout the berm and adjacent to the south sea wall pedestrian pathway in July 2023.

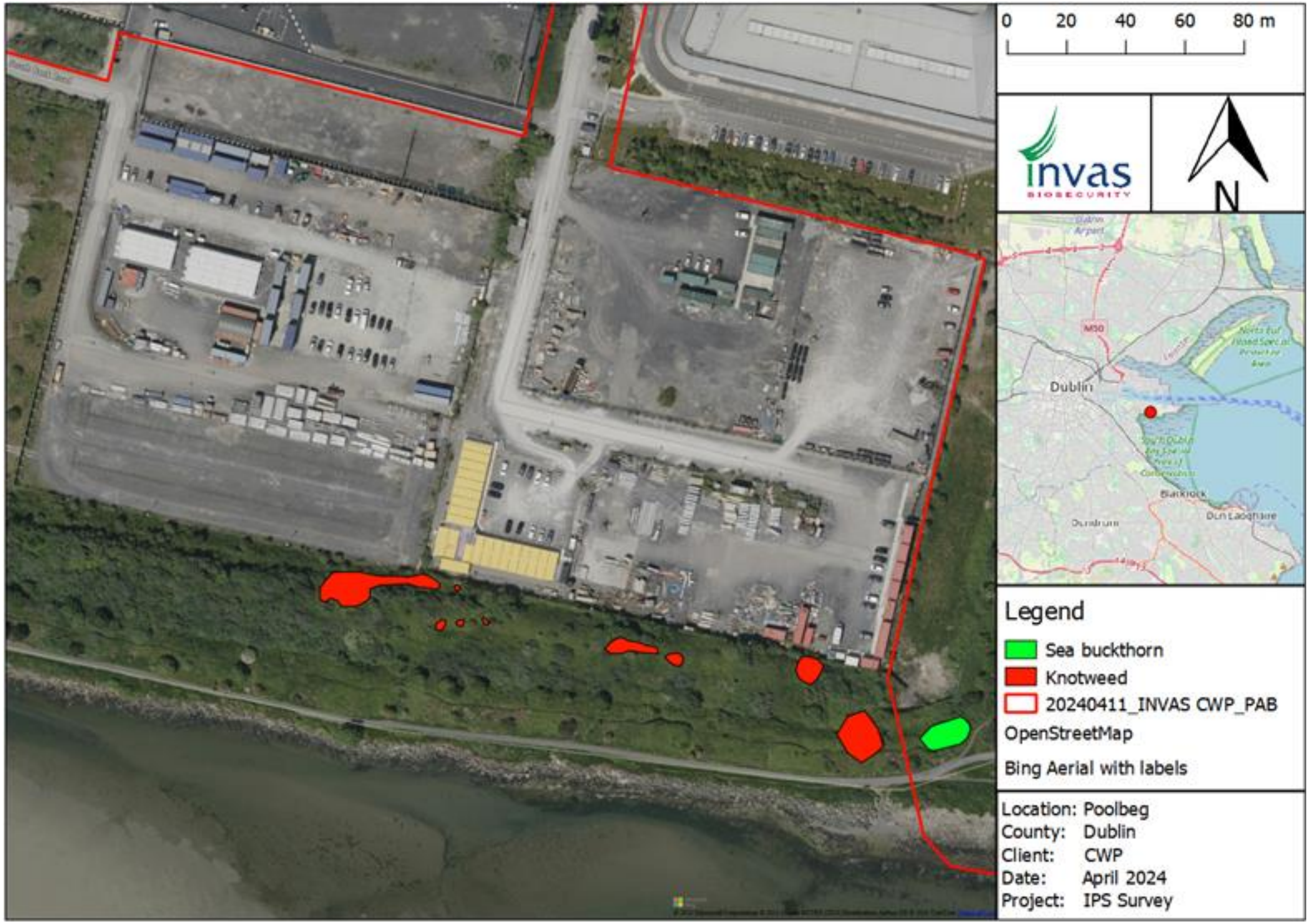

Figure 2.4: A view of knotweed (red) at the embankment, near landfall within the onshore development area boundary, and sea buckthorn (green) outside of the boundary in July 2023.

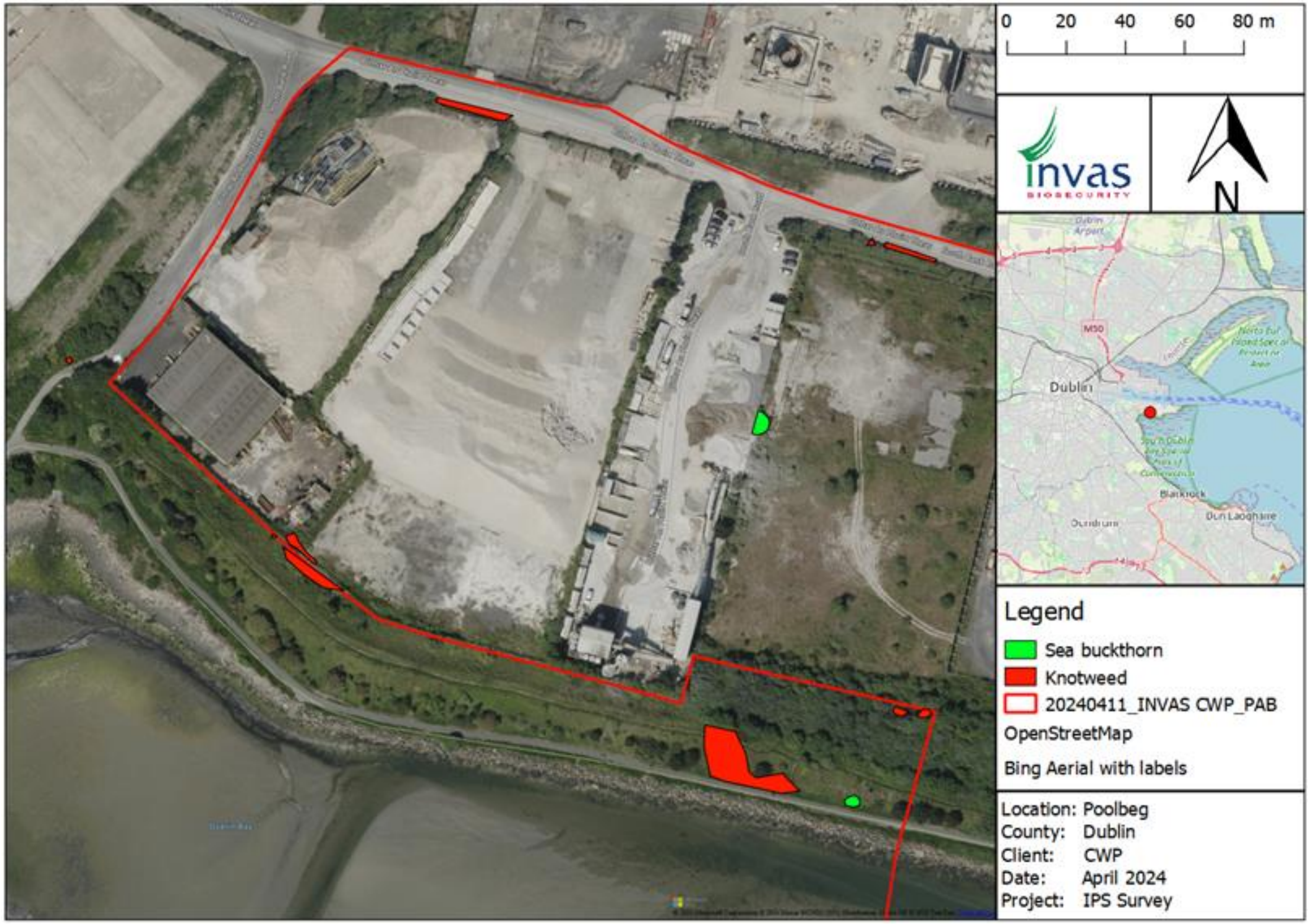

Figure 2.5: A view of knotweed (red) near South Bank Road and sea buckthorn (green) infestations in July 2023.

Infestations were recorded on other adjacent active sites in the west of this area (Figure 2.5), near Bisset Engineering (Plate 2.7), Kilsaran Concrete (Plate 2.8) and to the north of the sites along the South Bank Road (53.338419, -6.207446) (Plate 2.9). The final area of infestation was on the west of the South Bank Road (53.339797, -6.201648), adjacent to the Dublin Waste to Energy Plant (Figure 2.6, Plate 2.10).

Plate 2.7-2.10: Knotweed growing in the south of the onshore development area near Bisset (2.7) and Kilsaran Concrete (2.8) and along the South Bank Road (2.9-2.10) in July 2023.

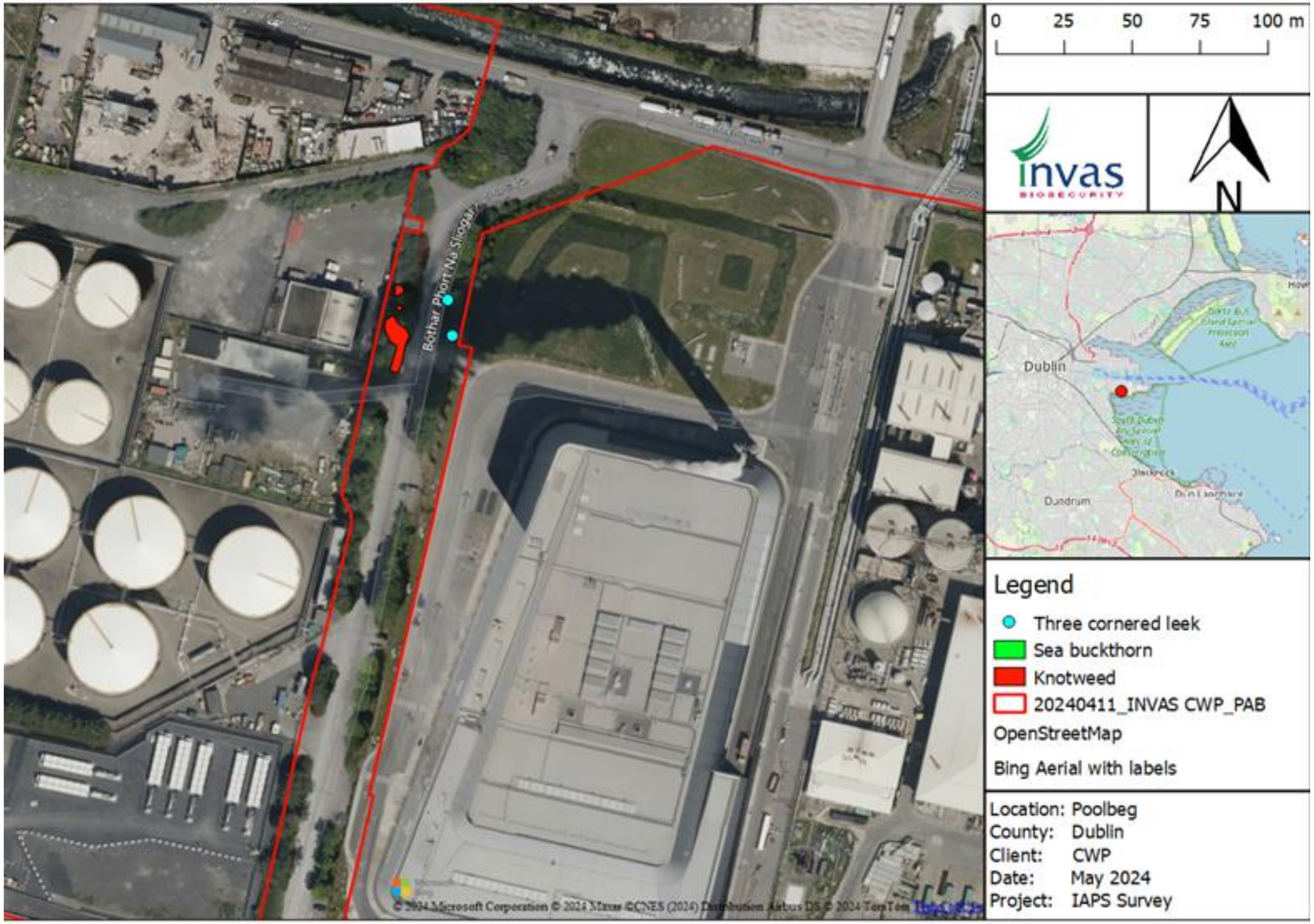

Figure 2.6: A view of knotweed (red) and Three-cornered leek (light blue) adjacent to the Shellybanks Road within the onshore development area boundary in July 2023.

2.1.2. Sea buckthorn

Sea buckthorn was recorded in the north of the onshore development area boundary (Figure 2.2) (Plate 2.11 at the onshore substation site) and adjacent to the Kilsaran Concrete site (Figure 2.5) (Plate 2.12) in July 2023.

The infestation within the onshore substation site is located in an area that will be modified as part of the overall project works on the banks of the Liffey estuary (Plate 2.12).

Two other notable infestations were recorded in areas off site but in close proximity to the onshore development area boundary (see Figures 2.4-2.5).

Plate 2.11-2.12: Sea buckthorn growing in the northeast corner of the onshore substation site (2.11) and in the berm (outside of the onshore development area) (2.12) in July 2023.

2.1.3. Three-cornered leek

Three cornered leek was recorded as two small infestations (Figure 2.6) in April 2024 by TOBIN Consulting Engineers. The infestations were located in two places on the road verge of South Bank Road (Plate 2.13-2.14).

Plate 2.13-2.14: Three-cornered leek recorded in two places on the road verge of South Bank Road in April 2024.

2.1.4. Winter heliotrope

Winter heliotrope was observed throughout the berm area in the south of the onshore development area and in small pockets throughout the rest of the survey site in July and October 2023 (Plate 2.15-2.16).

Plate 2.15-2.16: Winter heliotrope throughout the onshore development area boundary in July 2023.

2.1.5. Buddleja

Buddleja was ubiquitous throughout the onshore development area boundary in July 2023, with notable dense infestations in the southern berm area and along the Shellybanks Road (Plate 2.17-2.22).

Plate 2.17-2.22: Buddleja was detected throughout the onshore development area boundary in July 2023.

2.1.6. Old man's beard

A small infestation of old man's beard was recorded beside the sea buckthorn at the edge of the Irishtown Nature Park in July 2023. The infestation is currently beyond the onshore development area boundary, but can spread rapidly once established.

3. CONTROL, TREATMENT AND MANAGEMENT OPTIONS

3.1. Introduction

Within the onshore development area boundary, construction activities will be required at the landfall where the offshore export cables are brought onshore, for the installation of the underground onshore export cables, the construction of the onshore substation and installation of the network cables to connect the onshore substation to the Poolbeg 220 kV substation. These activities will require soil clearance, excavation and management which has the potential to result in the spread of IAS.

Knotweed, Three-cornered leek and sea buckthorn are regulated under Schedule 3 of S.I. 477, while knotweed is also included in Part 3 of the same regulation, restricting the movement of vector materials containing these species. On this basis, control and management of these IAS is required by the CWP Project and suitable options are presented in the sections below. These management options will prevent any accidental spread of the IAS infestations.

Buddleja, old man's beard and winter heliotrope were locally abundant but are not contained in any regulatory list at present. Although there is no legal requirement to manage these species at present, general guidelines for the control and management of each of these IAS are included.

3.1.1. Site Specific Management Plan for IAS

In advance of construction work commencing within the onshore development area, Site Specific Management Plans will be prepared for each IAS infestation where any ground works or access is required in these areas and their associated buffer zones. Buffer zones will be determined based on root or rhizome growth associated with visible plants within the groundworks areas. These plans will provide guidance on biosecurity, traffic management, excavation and disposal methods to be employed in each case.

The plans shall be designed, implemented and supervised by suitably qualified personnel in advance of any site access.

3.2. Management of knotweed in advance of construction activities

3.2.1. Chemical management in October 2023

Due to the extent of underground rhizome growth and its highly invasive capacity, control of knotweed following herbicide treatment in a single season is rarely possible. It generally takes three to four seasons of herbicidal treatment to deplete the rhizome reserves and to effectively control the target vegetation. Treatment using a glyphosate-based herbicide has proved to be highly effective.

Herbicide application was carried out in October 2023 by INVAS staff on knotweed within the onshore development area, to the manufacturer's guidelines with staff wearing suitable PPE and in possession of the relevant qualifications.

Records of herbicide use have been kept by INVAS staff in accordance with relevant legislation and will be retained after any future treatment. Further details have been provided in a separate knotweed treatment report from December 2023.

3.2.2. Monitoring post treatment

Following herbicide management, the treatment site and any other possible areas of infestation will be resurveyed for knotweed growth for the next three to four years (through to the proposed commencement of construction activities in 2026). This will be carried out in June/July each year, with any required follow-up herbicide treatment taking place between August and October of the same year. Herbicide treatment will follow the same process as outlined above. Strict biosecurity protocols will be adhered to in all follow-up surveys and treatments.

3.2.3. Conclusion on management in advance of construction activities

Based on INVAS's considerable experience in dealing with the control of all three knotweed species countrywide, its preferred management option for knotweed within the onshore development area boundary, prior to the commencement of construction activities, is continued chemical treatment with an approved herbicide with monitoring post treatment. Refer to the proposed scheduled for treatment in Table 3.2.

Any infestations beyond the onshore development area boundary will be considered as part of any access requirements and will not be interfered with by the CWP Project.

This will follow all manufacturer's guidelines and be applied by suitably qualified personnel wearing the correct PPE.

3.2.4. Proposed schedule for herbicide treatment

Table 3.2: Proposed management schedule for knotweed within the onshore development area boundary.

Year	Timing	Description of works	Treatment
2023	August/October	Survey and treatment	Foliar or stem injection herbicide application (completed by the CWP Project)
2024	June/July	Survey	None
2024	August/October	Assessment of regrowth and retreatment	Foliar or stem injection herbicide application
2025	June/July	Survey	None
2025	August/October	Assessment of regrowth and retreatment	Foliar or stem injection herbicide application
2026*	June/July	Survey	None
2026*	August/October	Assessment of regrowth and retreatment	Foliar or stem injection herbicide application
2027+*	June/July	Survey and retreatment as necessary	Foliar or stem injection herbicide application

* Treatment undertaken as required; any treatment requirements will be aligned with commencement of construction activities within the onshore development area.

3.3. Options for knotweed during the construction phase

Herbicide management will provide an adequate level of control to prevent the 'spread and dispersal' of knotweed on-site, provided no other interference takes place. If infested areas or their buffer zones must be accessed by personnel or machinery, additional measures will be required to prevent any unintentional movement of knotweed vector material. Below is a description of the subsequent control options for the knotweed infestations recorded on-site where development will take place, or additional access or interference with knotweed infestations is required.

For the client's preferred control option, a full Site Specific Management Plan outlining the specific actions for each stage of the operation will be provided, in advance of the works and when the specific works programme is known for each area within the onshore development area.

3.3.1. Excavation and disposal off-site option

This would require site operations to excavate all knotweed plants and associated contaminated soil. The soil and plant material would be carefully loaded onto biosecure trucks that would transport the contaminated material to the appropriately licenced landfill. Strict biosecurity protocols would be adhered to at all times during this process.

It is deemed prudent to remove soil in the infested areas to a depth of at least 1.8 metres and 7 metres from the last visible plant in order to be certain that no rhizomes remain in the soil following excavation operations. Where the site boundaries restrict the removal of a 7 metre buffer zone, vertical root barrier membrane must be put in place to remove the risk of regrowth from contaminated soil remaining on-site or on adjacent sites.

In the case of buildings and boundaries close to knotweed infestations, excavation depths and distances would be authorised by a suitably qualified engineer. The material would be disposed of at a licenced landfill subject to acquiring a licence for soil movement from the National Parks and Wildlife Service (NPWS).

Detailed records of all operations will be maintained throughout the CWP Project. These records will specifically focus on the exact areas excavated, the method of excavation, the depth of excavation, the volume of material (as numbers of truck loads) removed, an inventory of personnel and equipment entering and leaving the knotweed demarcated areas, and the operation of cleaning and disinfection facilities provided at each area.

3.3.2. Excavation and disposal on-site option

Deep burial in an on-site containment cell can be used in certain scenarios e.g. in the event of a suitable green area being identified as part of the final specific works programme. Excavation must remove all knotweed rhizome material and would be carried out in the same manner as for the '*excavation and disposal off-site'* method. If the infested area and deep burial area are both contained within the onshore development area, no licence would be required.

The site selection would take into account services, landscaping, transport routes, possibility of erosion and the future use of the site. The distance for contaminated material to be transported through the site would be minimised, with the deep burial site located as close as possible to the site of infestation. If the burial site is located in a different area to the infestation, biosecurity measures would be put in place, including decontamination facilities and designated work and haulage areas.

Prior to excavation, the invasive plant material would be treated with a non-persistent herbicide and left in situ for the herbicide's prescribed "active" period. The disposal site would require the construction of a containment cell made from root barrier membrane. The membrane used must carry a guarantee of integrity for 50 years. Once filled with knotweed-contaminated material, the cell will be sealed and then buried beneath 5 metres of inert backfill or uncontaminated soil. This method would map the location of the containment cell using GPS, and details would be retained in appropriate records to avoid accidental interference. This method would not require an ongoing management plan.

3.3.3. Excavation and bunding option

Disposal of knotweed-contaminated waste using deep burial in a licenced landfill can be expensive. A preferred method may be to use a knotweed bund where suitable land is available. A bund is an area of ground that is cordoned off and where the contaminated soil is placed on top of a root barrier membrane, to a depth not exceeding 1 metre. The bund would be constructed using a proprietary root barrier membrane, which is a reinforced, impermeable polyethylene membrane and should have a life expectancy of at least 50 years. The aim of this disposal method is to isolate contaminated soil and encourage knotweed regrowth, which can then be treated with approved herbicides. A tracked excavator would be used to remove the soil and plant material from the infested areas to a depth of at least 1.8 metres below ground level. The soil and plant material would be carefully loaded onto bio secure trucks that would transport the material to the appropriate location on the bund site. Strict biosecurity protocols will be adhered to at all times during this process and a long-term herbicide management plan would be put in place. A protective fence would be placed around the bund and fitted with appropriate warning or information signage. This fence may be put in place before or after the bund construction operation. Access to the completed bund would be restricted to authorised persons. Any knotweed plant material or contaminated soil that is to be removed from an infested site can only be done so under a licence issued by the NPWS.

3.3.4. Excavation and soil screening option

Screening is a process that is offered by some companies in the United Kingdon (UK). This method involves excavating all of the contaminated soil before passing it through a screening machine that extracts the heavy rhizomes. The second phase of this process would pass the soil along a belt where the remaining fragments are extracted by hand. This method can greatly improve the site and is far less intrusive, as there is no transfer of soil from the infested site.

However, this method does not carry a guarantee of eradication and can be a time consuming, expensive process.

An eradication guarantee cannot be provided with this method as not all minor rhizome fragments may be removed from the soil. This may result in the regrowth of rhizomes throughout the site which would necessitate further treatment. An ongoing management plan (herbicide/further screening) would also be required for this option.

3.3.5. Currently recommended knotweed management option for the construction phase

Knotweed throughout the onshore development area will continue to be managed by foliar herbicide application to prevent any immediate 'spread or dispersal' of these species. This will follow all manufacturer's guidelines and be carried out by suitably qualified personnel wearing the correct PPE.

While ongoing herbicide control will deplete the underground rhizome reserves and reduce the risk of accidental spread, additional management options will be required in advance of any construction works. As the CWP project progresses and development of onshore infrastructure is required, the recommended management option for soils infested with knotweed is excavation for disposal off-site. Key areas, such as the open cut excavation at landfall, access ramp in the embankment and clearance works in the Uisce Éireann site will require all areas with knotweed-infested soils to be managed using this method.

A plan of targeted herbicidal treatment will then be implemented following the completion and reinstatement of any construction activities.

Whilst all the options are considered suitable for managing knotweed, excavation for disposal off-site is currently the most suitable option. This will be reviewed in advance of any construction activities and final site-specific requirements for each area will be confirmed, depending on the extent of infestation and proposed development in each area.

This management option for knotweed will also be aligned with any final landscape reinstatement plans for the onshore development area.

The final management option for knotweed will be reviewed and agreed upon with input from the relevant stakeholders, including Dublin City Council (DCC), Dublin Port Company (DPC) and the NPWS.

3.4. Options for the management of sea buckthorn

The distribution of sea buckthorn within the onshore development area is limited to two areas of infestation: at the location of the onshore substation in the north (Figure 2.2) and the infestation adjacent to the existing Kilsaran site (Figure 2.5).

3.4.1. Herbicide management option

Chemical control can be highly successful in managing sea buckthorn, in combination with other mechanical methods. Prior to the site clearance works the sapling growth of the sea buckthorn would be targeted and spot sprayed with suitable glyphosate-based herbicide solution. Spraying is carried out at a rate of 5 l/ha using knapsacks fitted with low pressure drift beta nozzles. Treatment will be carried out when plants are in active growth. Extra care will be taken where infestations are located among or near non-target plant species. Where an infestation is located adjacent to a watercourse (within 5 metres), only one glyphosate-based product (Roundup Pro Biactive) is cleared for use.

3.4.2. Manual / mechanical option

All mature growth would be uprooted (grubbed) with a mechanical digger or excavator and removed to a designated area, where it would be mulched and rendered suitable for removal to a licenced landfill or through deep burial on site. All material to be retained on site for deep burial must be at least three metres below finished ground level. No impermeable root barrier membranes would be required for this method, as Sea buckthorn spreads by seed and suckering and not by roots or rhizomes. The methodology would have the advantage of removing the entire root system of the plant thereby reducing the risk of cross-contamination with other soils.

3.4.3. Combined mechanical and herbicide option

Herbicide application combined with manual methods has proven highly successful in the management of sea buckthorn. This method involves causing damage to the stem of the plant and directly applying herbicide solution. This can result in the complete death of the target plant without the need for foliar spraying. Control using herbicide application would be required at least four weeks prior to any mechanical control works.

3.4.4. Monitoring post treatment

Monitoring will be required in the areas where works took place 12 months after the completion of mechanical removal works on-site. Any plants or sapling growth that are observed at this time will be recorded, mapped and scheduled for retreatment (Table 3.4).

3.4.5. Recommended management option for sea buckthorn

Sea buckthorn throughout the onshore development area will be managed by the combined manual and direct herbicide application method. The direct herbicide method in advance of the construction phase will prevent any immediate ‘spread or dispersal’ of this species. This will follow all manufacturer's guidelines and be carried out by suitably qualified personnel wearing the correct PPE.

While herbicide control may reduce the risk of accidental spread, additional management options will be required in advance of any construction works. As the CWP Project progresses and the development of onshore infrastructure is required, the recommended management option for soils infested with sea buckthorn is excavation for disposal on-site. At the onshore substation, the sea buckthorn will be excavated, mulched and disposed on-site within the area proposed for reclamation to the south-east of the site. In the event that direct interaction is required with the sea buckthorn at the boundary of the current Kilsaran site, this will be excavated, mulched and also considered for disposal on-site. Strict biosecurity procedures will be required throughout the management works, including the use of covered biosecure trucks during transport of any sea buckthorn plant material. Where disposal on-site is not deemed achievable, the material can be disposed off-site in an appropriately licensed landfill.

Although ‘excavation for disposal on-site’ is the most suitable option, this will be reviewed in advance of any construction activities and final site-specific requirements will be confirmed, depending on the extent of infestation and proposed development in each area.

This management option for sea buckthorn will also be aligned, as relevant, with any final landscape reinstatement plans for the onshore development area.

The final management option for sea buckthorn will be reviewed and agreed upon with input from the relevant stakeholders, including DCC, DPC and NPWS.

3.4.6. Schedule for herbicide treatment

Table 3.3: Proposed management schedule for sea buckthorn at Poolbeg.

Year	Timing	Description of works	Treatment
2024	All year round	Manual control with direct herbicide application	Combined manual and herbicide application
2025	All year round	Manual control with direct herbicide application	Combined manual and herbicide application
2026*	4 weeks prior to mechanical control	Manual control with direct herbicide application	Combined manual and herbicide application
2026*	4 weeks post herbicide application	Mechanical management	Grubbing out of plants and root systems before on-site chipping and disposal off-site or deep burial
2027*	12 months post mechanical control	Survey and herbicide retreatment as necessary	Herbicide treatment of sapling growth with follow-up mechanical control 4 weeks post treatment
2027*	4 weeks post herbicide application	Mechanical management (if required)	Grubbing out of plants and root systems before on-site chipping and disposal off-site or deep burial
2028*	12 months post mechanical control	Survey and retreatment as necessary if additional regrowth was recorded in 2027	Herbicide treatment and mechanical management if required

* Treatment undertaken as required and any treatment requirements will be aligned with commencement of construction activities within the onshore development area.

3.5. Management of Three-cornered leek in advance of construction activities

3.5.1. Chemical management

Due to the extent of underground bulbs and its highly invasive capacity, control of Three-cornered leek following herbicide treatment in a single season is rarely possible. It can take several seasons of herbicidal treatment to deplete the bulb reserves and to effectively control the target vegetation. Treatment using a glyphosate-based herbicide has proved to be highly effective. Herbicide application should be carried out on Three-cornered leek within the onshore development area to the manufacturer's guidelines and by staff wearing suitable PPE and in possession of the relevant qualifications. Records of herbicide use should be kept in accordance with relevant legislation and will be retained after any future treatment.

3.5.2. Monitoring post-treatment

Following herbicide management, the treatment site and any other possible areas of infestation will be resurveyed for Three-cornered leek growth for the next three to four years (through to the proposed commencement of construction activities in 2026). This will be carried out in February to April each year with any required follow up herbicide treatment taking place between at the time of survey. Herbicide treatment will follow the same process as outlined above. Strict biosecurity protocols will be adhered to in all follow up surveys and treatments.

3.5.3. Conclusion on management in advance of construction activities

Based on INVAS's considerable experience dealing with the control of Three-cornered leek countrywide, its preferred management option for Three-cornered leek within the onshore development area boundary, prior to the commencement of construction activities is continued chemical treatment with an approved herbicide and also monitoring post treatment. Refer to the proposed scheduled for treatment in Table 3.4.

Any infestations beyond the onshore development area boundary will be considered as part of any access requirements and will not be interfered with by the CWP Project.

This shall follow all manufacturers guidelines and be applied by suitably qualified personnel wearing the correct PPE.

3.5.4. Proposed schedule for herbicide treatment

Table 3.4: Proposed management schedule for Three-cornered leek within the onshore development area boundary.

Year	Timing	Description of works	Treatment
2024	February/May	Survey and treatment	Foliar herbicide application
2025	February/April	Survey, assessment of regrowth and retreatment	Foliar herbicide application
2026	February/April	Survey, assessment of regrowth and retreatment	Foliar herbicide application
2027+*	February/April	Survey, assessment of regrowth and retreatment	Foliar herbicide application

*: Treatment undertaken as required and any treatment requirements will be aligned with commencement of construction activities within the onshore development area

3.6. Options for Three-cornered leek During the Construction Phase

Herbicide management will provide an adequate level of control to prevent the 'spread and dispersal' of Three-cornered leek on site provided no other interference takes place. If infested areas or their buffer zones must be accessed by personnel or machinery additional measures will be required to prevent any unintentional movement of Three-cornered leek vector material. Below is a description of the subsequent control options for the Three-cornered leek infestations recorded on site where development will take place or additional access or interference with Three-cornered leek infestations is required.

For the client's preferred control option, a full site-specific Management Plan outlining the specific actions for each stage of the operation will be provided, in advance of the works.

3.6.1. Excavation and disposal off-site option

This would require site operations to excavate all Three-cornered leek plants and associated contaminated soil. The soil and plant material would be carefully loaded onto bio secure trucks that would transport the contaminated material to the appropriately licenced landfill. Strict biosecurity protocols would be adhered to at all times during this process.

It is deemed prudent to remove soil in the infested areas to a depth of at least 300mm and 1 metre from the last visible plant in order to be certain that no bulbs remain in the soil following excavation operations. Where the site boundaries restrict the removal of a 1 metre buffer zone, vertical root barrier membrane must be put in place to remove the risk of regrowth from contaminated soil remaining on site. In the case of buildings and boundaries close to Three-cornered leek infestations, excavation depths and distances would be authorised by a suitably qualified engineer. The material would be disposed of at a licenced landfill subject to acquiring a licence for soil movement from the NPWS.

Detailed records of all operations will be maintained throughout the CWP Project. These records will specifically focus on the exact areas excavated, the method of excavation, the depth of excavation, the volume of material (as numbers of truck loads) removed, an inventory of personnel and equipment entering and leaving the Three-cornered leek demarcated areas, and the operation of cleaning and disinfection facilities provided at each area.

3.6.2. Excavation and disposal on-site option

Deep burial in an on-site containment cell can be used in certain scenarios. Excavation must remove all Three-cornered leek material and would be carried out in the same manner as for the '*Excavation and disposal off-site'* method.

The site selection would take into account services, landscaping, transport routes, possibility of erosion and the future use of the site. The distance for contaminated material to be transported throughout the site would be minimised with the deep burial site located as close as possible to the site of infestation. If the burial site is located in a different area to the infestation, biosecurity measures would be put in place including decontamination facilities and designated work and haulage areas.

Prior to excavation, the invasive plant material would be treated with a non-persistent herbicide and left in situ for the herbicide's prescribed "active" period. The disposal site would require the construction of a containment cell made from root barrier membrane. Once filled with Three-cornered leek contaminated material the cell shall be sealed and then buried beneath 5 metres of inert backfill or uncontaminated soil. This method would map the location of the containment cell but would not require an ongoing management plan.

3.6.3. Currently recommended Three-cornered leek management option for the construction phase

Three-cornered leek throughout the onshore development area will continue to be managed by foliar herbicide application to prevent any immediate ‘spread or dispersal’ of these species. This will follow all manufacturers guidelines and be carried out by suitably qualified personnel wearing the correct PPE.

While ongoing herbicide control will deplete the underground rhizome reserves and reduce the risk of accidental spread, additional management options will be required in advance of any construction works. As the CWP Project progresses and development of onshore infrastructure is required, the recommended management option for soils infested with Three-cornered leek, is excavation for disposal off-site. At present, it is possible that the area will not be disturbed by the works as they are up on the verge, however any possible interference will require a suitable Management and Biosecurity Plan.

Although ‘excavation for disposal off-site’ is currently the most suitable option, this will be reviewed in advance of any construction activities and final site-specific requirements for each area will be confirmed, depending on the extents of infestations and proposed development in each area. This management option for Three-cornered leek will also be aligned with any final landscape reinstatement plans for the onshore development area.

The final management option for Three-cornered leek will be reviewed and agreed upon with input from the relevant stakeholders including Dublin City Council (DCC), Dublin Port Company (DPC) and the National Parks and Wildlife Service (NPWS).

3.7. Options for the management of other non-regulated IAS including buddleja, old man's beard and winter heliotrope

As noted previously, buddleja, old man’s beard and winter heliotrope were locally abundant but are not contained in any regulatory list at present. Although there is no legal requirement to manage these species at present, general guidelines for the control and management of each of these IAS are included below.

3.7.1. Options for the management of buddleja

3.7.1.1. Mechanical removal for disposal on- or off-site

All mature growth will be uprooted (grubbed) with a mechanical digger or excavator and removed to a designated area where it will be mulched and rendered suitable for removal to a licenced landfill or through deep burial on-site. Buddleja is not included in the ‘Third Schedule’ of the EC (Birds and Natural Habitats) Regulations (S.I. 477) and, therefore, does not require a licence or specific landfill disposal procedures. No impermeable root barrier membranes will be required for this method. The methodology will have the advantage of removing the entire root system of the plant, thereby reducing the risk of cross-contamination with other soils. All cut plant material should be chipped and buried on-site or disposed of at a licenced green waste facility. During transport, trailers or other transport vehicles should be sealed or covered with a tarpaulin to prevent the loss of any plant material.

3.7.1.2. Foliar herbicidal treatment

Long-term plant control can be achieved by the application of herbicide (glyphosate) to the leaves of buddleja plants during the summer months, before seeding. Where large seedbanks are present, multiple applications may be required over 2 to 3 years. Herbicide application will always follow the manufacturer's guidelines and only be carried out by staff wearing suitable PPE and in possession of the relevant qualifications. Records of herbicide use will be kept in accordance with all relevant legislation and must be retained after each treatment. Suitable PPE including boots, durable gloves and full-length overalls will be worn by all staff involved in herbicide management works.

3.7.1.3. Recommendations for the management of buddleja

The foliar herbicidal treatment of buddleja is still undergoing research and on this basis, mechanical removal for disposal on- or off-site is the recommended approach. All management works will require post-treatment monitoring and follow-up treatment, where required.

3.7.2. Options for the management of old man’s beard

3.7.2.1. Combined herbicide and mechanical removal with disposal on- or off-site

A combination of chemical and manual control methods can be highly successful in the management of old man’s beard. This species is not included in the ‘Third Schedule’ of the EC (Birds and Natural Habitats) Regulations (S.I. 477) and, therefore, does not require a licence or specific landfill disposal procedures.

Seedlings will be manually removed once visible in May/June and disposed of at a licenced green waste facility. Old man’s beard will be treated by the foliar application of a glyphosate-based herbicide. Treatment will be carried out in June, when foliage is present during the growth season and before flowering has begun. The vines will be cut back to ground level or waist height in winter or spring and the subsequent regrowth can be then foliar sprayed as outlined above. Following herbicide treatment, plant material will be manually removed in late July or when systemic herbicide application has effectively killed all foliage and stems have dried out. Plant material will be removed along with any further seedlings that have emerged and disposed of as outlined above. All clematis stumps will be drilled and treated with a 5:1 dilution of a glyphosate-based herbicide. Stump treatment should only be required in year one, but could be considered as a precautionary measure in year two. Herbicide application will always follow the manufacturer's guidelines, and only be carried out by staff wearing suitable PPE and in possession of the relevant qualifications. Records of herbicide use will be kept in accordance with all relevant legislation and must be retained after each treatment. Suitable PPE including boots, durable gloves and full-length overalls should be worn by all staff involved in manual control works due to the potential toxicity of clematis.

3.7.2.2. Recommendations for the management of old man’s beard

Combined herbicide and mechanical removal with disposal on- or off-site.

3.7.3. Options for the management of winter heliotrope

3.7.3.1. Mechanical removal for disposal on- or off-site

Research between INVAS and Atlantic Technological University (ATU) Sligo on the herbicidal management of winter heliotrope was inconclusive but did indicate that this species is not readily susceptible to herbicide management.

On this basis, all infested soil will be excavated with a mechanical digger or excavator and removed to a licenced landfill or a location for deep burial on site. It is noted that the rhizomes of winter heliotrope are far less deeply penetrating and also less vigorous in their growth. They also do not pose a risk to built structures.

The top 500 mm of infested soil will be removed when excavating this species, with a lateral buffer zone of 1 metre from the last visible plant. Winter heliotrope is not included in the 'Third Schedule' of the EC (Birds and Natural Habitats) Regulations (S.I. 477) and, therefore, does not require a licence or specific landfill disposal procedures. No impermeable root barrier membranes will be required for this method. This methodology will have the advantage of removing the entire rhizome system of the plant, thereby reducing the risk of cross-contamination with other soils. All infested soil will be buried on-site or disposed of at a licenced green waste facility. During transport, trailers or other transport vehicles will be sealed or covered with a tarpaulin to prevent the loss of any infested soil or plant material.

3.7.3.2. Recommendations for the management of winter heliotrope

Mechanical removal for disposal on- or off-site.

4. BIOSECURITY

The ecological effects of IAS are often irreversible and, once established, they are extremely difficult and costly to control and eradicate; hence, the urgent need to prevent their introduction and spread. Prevention is clearly more cost-effective and less environmentally damaging than long-term containment, control or eradication. The most effective measure to reduce introductions and halt spread of IAS is to promote and implement good biosecurity practice.

The sections below outline the biosecurity standard operating procedure (SOP) implemented during the herbicidal treatment of October 2023. These biosecurity measures will be implemented for any future herbicidal treatment within the onshore development area.

Plate 4.1 & 4.2: On-site biosecurity during surveys by INVAS staff.

4.1. Biosecurity standard operating procedure for personnel and equipment

This biosecurity SOP applies to all equipment (sampling devices, hand tools, buckets, boots and PPE) that are used during the control of IAS. The purpose of this SOP is to provide standardised practical methods for cleaning and disinfecting all equipment that comes into contact with IAS while carrying out control works. This biosecurity SOP will enhance the client’s existing biosecurity activity to deliver an improved biosecurity system that will help stop the introduction and spread of IAS during operations conducted by the client or contractors.

All staff that were involved in the survey had access to disinfection facilities (Appendix 3) that include but were not limited to:

- Detailed guide to proper cleaning and disinfection procedure and instructions for making the correct disinfection concentration
- A solution of clean water and Virkon Aquatic tablets or powder for the disinfection of equipment and PPE*
- Hard-bristle brushes
- Disposable non-latex gloves for equipment and PPE
- Plastic bags and cable ties (for disposing of IAS material removed from equipment).

[* Disinfectants must be used with care and in strict accordance with the manufacturer's instructions. Disposable gloves should be worn when using the disinfectant solution.]

Before commencing operations, a 1% Virkon Aquatic disinfection solution (10 g Virkon Aquatic powder in 1 litre of clean water) was prepared for staff working in infested areas. The disinfectant solution will remain pink in colour while it is still active. Additional clean water was readily available for further disinfectant solution if required.

Best biosecurity practice will be achieved by ensuring that the following guidelines are adhered to when planning work activities:

- When preparing a works programme, check to see what IAS are present on the site. (View IAS distribution maps on www.biodiversityireland.ie and refer to the Onshore Invasive Species Management Plan). Use this website, local knowledge and prior reports to determine the locations and extent of the infestations.
- Where possible, schedule operations so that uncontaminated sites can be accessed before sites that are known or suspected to support IAS.
- Where multiple sites must be accessed and there is no opportunity to clean and disinfect the equipment, make sure to have alternative, clean equipment available.
- Clean and disinfect all equipment prior to arrival on site. If this is not possible, clean and disinfect the equipment before entering the site.
- Clean and disinfect all equipment when moving between sites.

- Report suspected IAS to project stakeholders, including the future construction management team and Ecological Clerk of Works, accompanied by the location (grid reference) and good quality photographs.

It is important that all PPE and equipment used are cleaned and disinfected according to the procedures below. These biosecurity measures should be conducted before leaving each site.

- Put on disposable gloves before cleaning and disinfecting the equipment.
- Visually inspect all equipment that has come into contact with water for evidence of attached IAS material, or adherent mud or debris. Remove any such material before cleaning and disinfecting the equipment and leaving the site.
- Dispose of any IAS material taken from the equipment using the plastic bags provided.
- Spray equipment with the disinfection solution to the point of run-off. Do not rinse in clean water for at least 15 minutes.
- Use the hard-bristle brush to remove all mud and debris from boots and equipment. Then spray the prepared disinfectant solution onto the cleaned surfaces to the point of run-off. During inspection and cleaning, pay particular attention to places where IAS could be accidentally trapped, such as the treads of boots and attachment points on equipment.
- Visually inspect all PPE that has been in contact with vector material and remove any attached IAS material, or adherent mud or debris. Wipe down this PPE with an absorbent cloth soaked in the prepared disinfectant solution.
- Where time permits and it is practical, it is good biosecurity practice to air dry equipment following cleaning and disinfection.
- Remove disposable gloves and dispose of safely.

Appendices

Appendix 1: Survey details for the site at Poolbeg in July/October 2023.

Contactor name	INVAS Biosecurity
Surveyor name	William Earle
Survey date/time	21/07/2023 & 10/10/2023
County	Dublin
Area	Poolbeg
Site ID	JKO_Poolbeg_CodlingWindPark
Risk assessment (potential hazards)	Slips/trips/falls, isolation, disused land, steep slopes, animals, public
Health and safety (PPE required)	Safety boots, hi-viz
Species recorded	JKO, BKO, SBU, WHO, BUD, CLE
GPS details	53.336396, -6.202955 (897-1024)
Area located	Active compound, public path, overgrown site
Site details	Heavily overgrown in parts
Pervious treatment/interference	N/A
Infestation beyond fence line	Yes
Notes	No
Photos	1030-1215
Is the site within or proximate to an ecologically sensitive area (SAC/SPA)	Yes, South Dublin Bay SAC (IE000210), South Dublin Bay pNHA (000210) and South Dublin Bay and River Tolka Estuary SPA (IE004024).

Appendix 2: Detailed species description

Japanese knotweed

Distinguishing features	Japanese knotweed (*Reynoutria japonica*) (and the closely related Bohemian knotweed, *Reynoutria x bohemica*) is a robust, vigorous herbaceous perennial that grows in dense and often continuous stands. It has branched, hollow, red or purple mottled bamboo-like shoots that grow to 3 m tall (Bohemian knotweed grows to 4 m and giant knotweed grows to 5 m tall). In winter, stems remain on site as the tall, dry, red or straw-coloured hollow canes. All the leaves of Japanese knotweed plants are flattened (truncate) at the base. (The leaves of Bohemian knotweed are larger and more variable than those of Japanese knotweed, supporting both heart-shaped (indented/cordate at the base) and flattened (truncate at the base) forms, the former being more prominent lower down the stem.) Leaves are arranged in a zig-zag pattern on an arching stem. Flowers are small, creamy-white and hang in clusters from leaf axils; the clusters are longer than leaves in Japanese knotweed, while they are roughly the same length as the subtending leaf for Bohemian knotweed. Japanese knotweed has deeply penetrating, woody rhizomes - to 2 m deep and 7 m laterally from the last visible plant.
Habitat	Knotweeds are species of waste ground, roadsides, rail corridors and riparian habitats - alongside lakes, rivers, canals, ponds and ditches in rich to poor soil types.
Ecology	Knotweeds are non-native and invasive species (native to East Asia in Japan, China and Korea) and widespread in Ireland. Bohemian knotweed is a hybrid between the smaller Japanese and the larger giant knotweed species.
Impact	Knotweeds can impact on biodiversity by outcompeting native plants. Riparian habitats invaded by knotweeds have lower invertebrate abundance, species richness and biomass, and lower plant species richness compared to uninvaded sites, which is likely to impact on local fauna that use riparian habitats. Following dieback in winter, the ground surrounding infestations is left vulnerable to soil erosion and bankside subsidence due to the absence of a root weft that is normally produced by native grasses and herbs to bind the soils against winter floods. The presence of knotweed leaf litter in streams has also been shown to have adverse effects on the species composition of affected streams. The robust and extensive woody rhizomes of knotweed species are capable of penetrating asphalt, cracked foundations, walls, land drainage works and other built structures, causing significant structural damage.
Dispersal	The rhizomes are highly regenerative and even small rhizome fragments can produce new plants. Rhizome material can remain dormant in the soil for up to 20 years. Cut or discarded stems with nodes can also root and produce new plant stands. As only female plants have been recorded in Ireland, no viable seeds are produced.
Legislation	Japanese and Bohemian knotweed are subject to restrictions under Regulations 49 and 50 (the latter not currently commenced) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477), being listed in the Third Schedule (Part 1) of this legislative

	Act. Soil taken from a place that is infested with knotweed (vector material) is also restricted under Part 3 of this Third Schedule. The law relating to knotweed is primarily contained in Regulation 49 (2), which states that it is an offence to 'allow or cause to disperse' plants listed in the Third Schedule, of which Japanese and Bohemian knotweed are included. As such, any knotweed plant material or contaminated soil that is to be removed from an infested site can only be done so under a licence issued by the NPWS.

Figure 1: Identification of Japanese knotweed throughout the year.

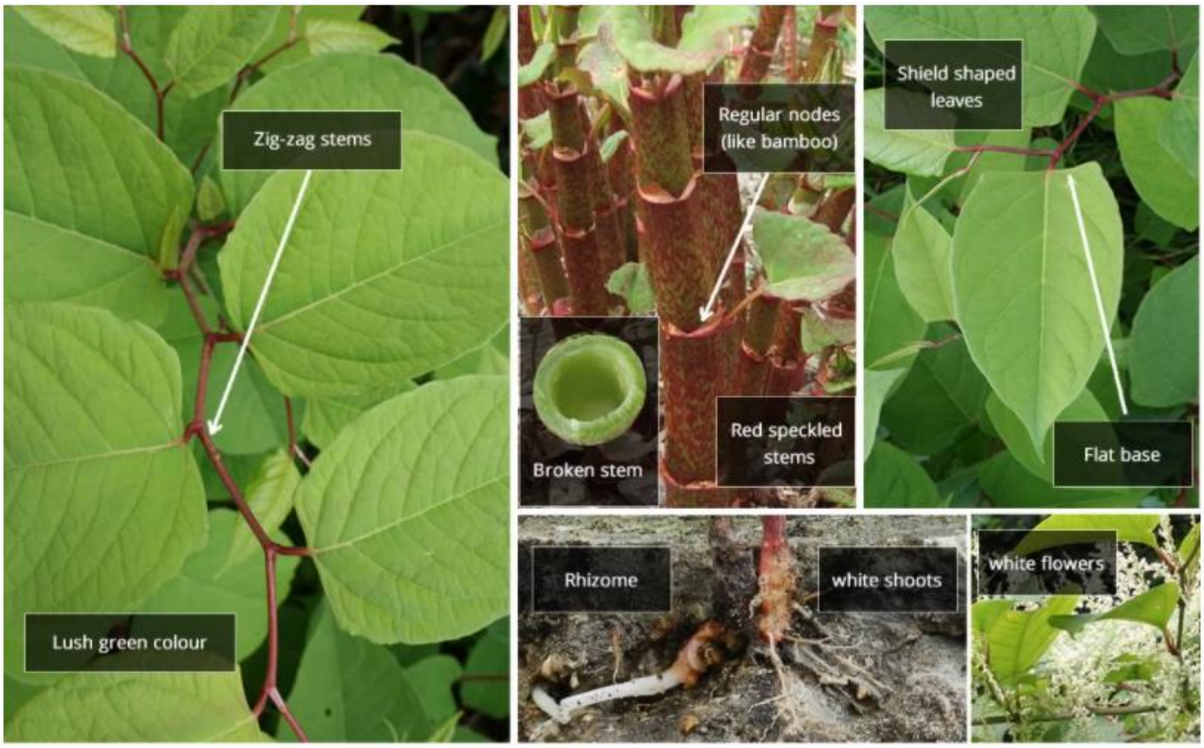

Figure 2: Japanese knotweed key identification features.

Bohemian knotweed

Distinguishing features	Bohemian knotweed *(Reynoutria x bohemica*) is a robust, vigorous herbaceous perennial that grows in dense and often continuous stands. Bohemian knotweed has branched, hollow, red or purple mottled bamboo-like shoots that grow to 4 m tall. (Japanese knotweed grows to 3 m and giant knotweed grows to 5 m tall.) In winter, stems remain on site as the tall, dry, red or straw-coloured hollow canes. The leaves of Bohemian knotweed are larger and more variable than those of Japanese knotweed, supporting both heart-shaped (indented/cordate at the base) and flattened (truncate at the base) forms (Plate 3.6), the former being more prominent lower down the stem. Short hairs are present on the underside of the leaf, especially along the midvein. Leaves are arranged in a zig-zag pattern on an arching stem. The leaf texture can be somewhat rougher than in Japanese knotweed. Flowers are small, creamy-white and hang in clusters from leaf axils; the clusters are roughly the same length as the subtending leaf. This species has deeply penetrating, woody rhizomes - to 2 m deep and 7 m laterally from the last visible plant.
Habitat	This is a species of waste ground, roadsides, rail corridors and riparian habitats - alongside lakes, rivers, canals, ponds and ditches in rich to poor soil types.

Ecology	Non-native and invasive species (native to East Asia in Japan, China and Korea) and widespread in Ireland. Bohemian knotweed is a hybrid between the smaller Japanese and the larger giant knotweed species.
Impact	This species can impact on biodiversity by outcompeting native plants. Riparian habitats invaded by knotweeds have lower invertebrate abundance, species richness and biomass, and lower plant species richness compared to uninvaded sites, which is likely to impact on local fauna that use riparian habitats. Following dieback in winter, the ground surrounding infestations is left vulnerable to soil erosion and bankside subsidence due to the absence of a root weft that is normally produced by native grasses and herbs to bind the soils against winter floods. The presence of knotweed leaf litter in streams has also been shown to have adverse effects on the species composition of affected streams. The robust and extensive woody rhizomes of knotweed species are capable of penetrating asphalt, cracked foundations, walls, land drainage works and other built structures, causing significant structural damage.
Dispersal	The rhizomes of this species are highly regenerative and even small rhizome fragments can produce new plants. Rhizome material can remain dormant in the soil for many years. Cut or discarded stems with nodes can also root and produce new plant stands. As only female plants have been recorded in Ireland, no viable seeds are produced.
Legislation	Bohemian knotweed is subject to restrictions under Regulations 49 and 50 (the latter not currently commenced) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477), being listed in the Third Schedule (Part 1) of this legislative Act. Soil taken from a place that is infested with Bohemian knotweed (vector material) is also restricted under Part 3 of this Third Schedule. The law relating to Bohemian knotweed is primarily contained in Regulation 49 (2), which states that it is an offence to 'allow or cause to disperse' plants listed in the Third Schedule, of which Bohemian knotweed is one. As such, any Bohemian knotweed plant material or contaminated soil that is to be removed from an infested site can only be done so under a licence issued by the NPWS.

Sea buckthorn.

Distinguishing features	Sea buckthorn (*Hippophae rhamnoides*) is a dense and thorny deciduous woody shrub. It can grow up from 2 to 4 metres tall. It has small, petalless flowers each having 4 stamens and a 2-lobed calyx. Flowers bloom from March to April, with male and female flowers appearing on separate plants. Leaves are narrow, lanceolate and alternate and are covered with tiny silvery scales giving them a greyish appearance. The bush has stout spines and in autumn bright orange-yellow berries (7 mm across) are borne on the female plants.
Habitat	Seashores and cliffs, but also thrives in dry disturbed ground.
Ecology	Dioecious, wind pollinated, flowers in winter and fruits in autumn (Preston, 2002), it also spreads by suckering (shoots which grow from a bud at the base of the shrub) (Reynolds, 2002).
Impact	Because of the dense vegetation that the species produces, it can easily outcompete native species and become dominant. Sea buckthorn has a significant adverse impact on native floral (and associated faunal) biodiversity, as well as soil nutrient status.
Dispersal	Although wildlife may carry and distribute viable seed, the primary source of this species in coastal habitats was deliberate plantings. This species has been planted in the past in an effort to stabilise coastal land. Further dispersal now occurs through rhizome growth and layering.
Legislation	Sea buckthorn is subject to restrictions under Regulations 49 and 50 (the latter not currently commenced) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477), being listed in the Third Schedule (Part 1) of this legislative Act. The law relating to sea buckthorn is primarily contained in Regulation 49 (2), which states that it is an offence to 'allow or cause to disperse' plants listed in the Third Schedule, of which sea buckthorn is one. As such, any sea buckthorn plant material or contaminated soil that is to be removed from an infested site can only be done so under a licence issued by the NPWS.
Control options	Significant control can be achieved through the implementation of an annual combined mechanical/chemical management plan.

Three-cornered leek.

Distinguishing features	Three-cornered leek (*Allium triquetrum*) is an erect, perennial and that can form dense stands. Usually 3 to 5 leaves will grow per bulb and they are light green in colour. They can grow up to 30cm long, are sharply keeled and curled at the tip. Stems will grow up to 45cm long and triangular in cross-section. The leaves have a strong garlic smell when crushed and all parts of the plant are edible, when fresh. Flowers will have six white and lobed tepals (like petals) in a drooping one-sided umbel (like the Bluebell) of 3 to 15 flowers. There is also a distinctive green stripe down the centre of each tepal. The underground bulbs are white and round, usually up to 20mm in diameter.
Habitat	It is a species of damp and shaded roadsides, waste grounds, forests and riparian lowland rivers and canals habitats.
Ecology	It is a non-native species (native to Mediterranean basin) whose range is expanding in Ireland, mostly in southern coastal counties.
Impact	Because of the dense vegetation that the species produces, it can easily outcompete native species and become locally dominant.
Dispersal	Dispersed by long-lived bulbs and seeds. Its seeds are commonly spread by ants.
What to do if you find this species	Do not dig or carry out ground works in or near infestations until a suitable biosecurity plan has been put in place.
Control options	**Mechanical:** Effective control can be achieved by excavating bulbs, rhizomes and all above-ground vegetation. Excavated material must be carefully disposed of off-site or retained on-site on top of root barrier membrane. Bulbs that remain in the soil will re-sprout in spring. **Herbicide:** Chemical treatment can provide relatively effective control of Three-cornered leek when carried out in the growing season. However, because of probable reinfestation by bulbs, rhizomes and/or seeds, it cannot be assumed that all plants in the treatment area will be eradicated. **Monitoring:** It is important to monitor the treated areas annually and to schedule further treatment, as necessary.
Legislation	Three-cornered leek is subject to restrictions under Regulations 49 and 50 (the latter not currently commenced) of the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477), being listed in the Third Schedule (Part 1) of this legislative Act. The law relating to Three-cornered leek is primarily contained in Regulation 49 (2), which states that it is an offence to 'allow or cause to disperse' plants listed in the Third Schedule, of which Three-cornered leek is included. As such, any plant material or contaminated soil that is to be removed from an infested site can only be done so under a licence issued by the National Parks and Wildlife Service (NPWS).

Buddleja

Distinguishing features	Buddleja (*Buddleja davidii*) is a perennial shrub that can grow to up 4 metres tall. Leaves are grey-green, lanceolate and oppositely arranged. Stems are light brown and with a cracked appearance. This species has an extensive network of large and fine roots. Strongly scented lilac flowers are borne on a long conical spike. Each plant produces large numbers of small seeds that can persist for up to four years in the soil.
Habitat	On waste ground, roadsides, rail corridors and along lakes, rivers, canals, ponds and ditches in rich to poor soil types.
Ecology	Introduced from China as an ornamental and butterfly attractant, buddleja has now become widespread in urban environments throughout Ireland. This species is highly adaptable and tolerant of disturbed conditions.
Impact	The penetrating roots can cause damage to buildings and hard structures while the profusion of above-ground growth produced each growing season can have an adverse impact on biodiversity.
Dispersal	Buddleja reproduces by seeds that are spread primarily by wind. It can also reproduce asexually via stem and root cuttings.
Management	Manual (pulling saplings), mechanical (cutting) and herbicide (stump treatment of cut plants) management options can achieve effective control of buddleja. All management works will require post-treatment monitoring and follow-up treatment.
Legislation	N/A

Winter heliotrope

Distinguishing features	Winter heliotrope (*Petasites fragrans*) is a perennial, rhizomatous species that can form dense stands. The rounded-kidney shaped leaves of this species can be present throughout the year and grow to 20 cm in diameter, with large lobes where the leaf stalks attach. They have a conspicuous toothed margin with dull downy hair beneath that rubs off easily. Stems are up to 30 cm long. The rhizome network is extensive, but it is usually quite shallow (to 30 cm deep). Winter heliotrope flowers produce an inflorescence up to 15 mm long in short, loose, cone-like racemes. Individual florets are pink/lilac and tubular with sweet vanilla-scented flowers. Flowering stems are erect, D-shaped (don't roll freely between fingers), pinkish and covered with scale-like bracts.
Habitat	Riparian species on fertile soil adjacent to rivers and canals, but also in disturbed terrestrial habitats such as ditches, roadsides, railway embankments and waste places.
Ecology	This is a non-native species (native to Mediterranean region) and is widespread in Ireland. It is one of the few plants that actively grow throughout winter, flowering from November to February. This species readily forms monocultures in suitable habitats.

	Winter heliotrope may be confused with native Butterbur (*Petasites hybridus*) and Coltsfoot (*Tussilago farfara*). To date, only male plants have been recorded in Ireland. This plant is favoured by beekeepers as it provides a rare source of nectar during the winter months. Is becoming particularly prevalent along river and canal banks in Ireland.
Impact	Because of the dense vegetation that the species produces it can easily outcompete native species and become locally dominant.
Dispersal	It is dispersed via rhizome expansion and fragments. Rhizomes are often transported accidentally during ground works via machinery, equipment and soil movement.
Legislation	N/A
Control options	Control may be achieved through mechanical excavation and deep burial of this species on- or off-site.

Old man's beard

Distinguishing features	Old man's beard/Traveller's joy (*Clematis vitalba*) is a fast-growing vine with climbing woody stems that can extend its vertical or horizontal range by up to 10 m in one season. The plant can live for up to 40 years and has woody stems that can grow to 20 m long. This species is a deciduous, perennial plant and the leaves are pinnately compound (leaflets in opposite pairs with one terminal leaflet), consisting of usually 5 leaflets. Flowers are white and about 2 cm in diameter. Seeds are produced in autumn and often remain on the vines late into winter. Individual plants can produce up to 100,000 seeds per season. Where the plant produces dense canopy vegetation, it can produce up to 17,000 viable seeds per 0.5 m^2. It rapidly forms dense vegetative canopies over host plants or structures, often totally obscuring them from view.
Habitat	Grows in hedgerows, roadsides, rail corridors, riverbanks and forest edges. Seedling growth is restricted in closed canopy woodlands.
Ecology	The growth form of the species is such that it uses its vines to climb over trees, shrubs, along fence lines and any other support structure that it can avail of. Old man's beard can self-pollinate or be pollinated by wind or insects. Plants in their third year of growth can produce viable seeds. Seeds can remain viable in the soil for up to 5 years and soil disturbance creates opportunities for germination from the soil seed reserve.
Impact	The blanketing growth of this species can smother and even collapse large trees, while the dense canopy it produces restricts light to plants beneath, thus effectively suppressing them. Old man's beard can impede wind passage through this dense blanketing vegetation and

	cause the collapse of man-made structures or already weakened trees. Old man's beard has a significant adverse impact on native floral (and associated faunal) biodiversity. Because of the large biomass of vegetation that the weed produces, it can readily impede access in infested locations to humans and animals. This reduced access can also make it difficult to implement control measures. Reputedly, sap from old man's beard plants can cause blistering to human skin.
Dispersal	This species is primarily dispersed by seed through the action of wind (roads/rail corridors), water (rivers), human and animal interaction. Hanging vines will set root at any node that touches the ground and produce new plants. Old man's beard can spread by fragmentation, where cut or detached stems (with nodes) come into contact with the ground.
Legislation	Not yet contained in any legislative lists.

Appendix 3: Non-native invasive plant species regulated by the European Union (Birds and Natural Habitats) Regulations 2011 to 2015. *(Since the inclusion of the knotweed species in this regulation the Genus name has been reclassified from Fallopia to Reynoutria. The Genus name (Fallopia) is used in this case when referring directly to the text of the Regulation).*

Common name	Scientific name	Geographical application
American skunk-cabbage	*Lysichiton americanus*	Throughout the State
A red alga	*Grateloupia doryphora*	Throughout the State
Bohemian knotweed	*Fallopia x bohemica*	Throughout the State
Brazilian giant-rhubarb	*Gunnera manicata*	Throughout the State
Broad-leaved rush	*Juncus planifolius*	Throughout the State
Cape pondweed	*Aponogeton distachyos*	Throughout the State
Cord-grasses	*Spartina* (all species and hybrids)	Throughout the State
Curly waterweed	*Lagarosiphon major*	Throughout the State
Dwarf eelgrass	*Zostera japonica*	Throughout the State
Fanwort	*Cabomba caroliniana*	Throughout the State
Floating pennywort	*Hydrocotyle ranunculoides*	Throughout the State
Fringed water-lily	*Nymphoides peltata*	Throughout the State
Giant hogweed	*Heracleum mantegazzianum*	Throughout the State
Giant knotweed	*Fallopia sachalinensis*	Throughout the State
Giant-rhubarb (Chilean rhubarb)	*Gunnera tinctoria*	Throughout the State
Giant salvinia	*Salvinia molesta*	Throughout the State
Himalayan balsam	*Impatiens glandulifera*	Throughout the State
Himalayan knotweed	*Persicaria wallichii*	Throughout the State
Hottentot-fig	*Carpobrotus edulis*	Throughout the State
Japanese knotweed	*Fallopia japonica*	Throughout the State
Large-flowered waterweed	*Egeria densa*	Throughout the State
Mile-a-minute weed (Asiatic tearthumb)	*Persicaria perfoliata*	Throughout the State
New Zealand pigmy weed	*Crassula helmsii*	Throughout the State
Parrot's feather	*Myriophyllum aquaticum*	Throughout the State

Common name	Scientific name	Geographical application
Rhododendron	*Rhododendron ponticum*	Throughout the State
Salmonberry	*Rubus spectabilis*	Throughout the State
Sea-buckthorn	*Hippophae rhamnoides*	Throughout the State
Spanish bluebell	*Hyacinthoides hispanica*	Throughout the State
Three-cornered leek	*Allium triquetrum*	Throughout the State
Wakame	*Undaria pinnatifida*	Throughout the State
Water chestnut	*Trapa natans*	Throughout the State
Water fern	*Azolla filiculoides*	Throughout the State
Water lettuce	*Pistia stratiotes*	Throughout the State
Water-primrose	*Ludwigia* (all species)	Throughout the State
Waterweeds	*Elodea* (all species)	Throughout the State
Wireweed	*Sargassum muticum*	Throughout the State

Part 3: Vector Materials

Vector material	Species referred to	Geographical application
Blue mussel (*Mytilus edulis*) seed for aquaculture taken from places (including places outside the State) where there are established populations of the slipper limpet (*Crepidula fornicata*) or from places within 50 km of such places	Mussel (*Mytilus edulis*) Slipper limpet (*Crepidula fornicata*)	Throughout the State
Soil or spoil taken from places infested with Japanese knotweed (*Fallopia japonica*), giant knotweed (*Fallopia sachalinensis*) or their hybrid Bohemian knotweed (*Fallopia* x *bohemica*)	Japanese knotweed (*Fallopia japonica*) Giant knotweed (*Fallopia sachalinensis*) Bohemian knotweed (*Fallopia x bohemica*)	Throughout the State

Appendix 4. Non-native invasive alien species of European concern (Regulation (EU) 1143/2014).

PLANTS

LATIN NAME	ENGLISH
Alternanthera philoxeroides	Alligator weed
Cabomba caroliniana	Fanwort
Pontederia crassipes	Water hyacinth
Elodea nuttallii	Nuttall's waterweed
Gymnocoronis spilanthoides	Senegal tea plant
Hydrocotyle ranunculoides	Floating pennywort
Lagarosiphon major	Curly waterweed
Ludwigia grandiflora	Water-primrose
Ludwigia peploides	Floating primrose-willow
Lysichiton americanus	American skunk cabbage
Myriophyllum aquaticum	Parrot's feather
Myriophyllum heterophyllum	Broadleaf watermilfoil
Pistia stratiotes (will be added to the Union List after a two years' transition period on 2 August 2024)	Water lettuce
Rugulopteryx okamurae	Marine algae
Salvinia molesta	Kariba weed
Acacia saligna	Coojong
Ailanthus altissima	Tree of heaven
Baccharis halimifolia	Eastern baccharis
Hakea sericea	Needlebush
Prosopis juliflora	Mesquite
Triadica sebifera	Chinese tallow tree
Andropogon virginicus	Broomsedge bluestem
Cortaderia jubata	Purple pampas grass
Ehrharta calycina	Perennial veldtgrass
Microstegium vimineum	Nepalese browntop
Pennisetum setaceum	Crimson fountaingrass
Cardiospermum grandiflorum	Balloon vine

Celastrus orbiculatus (will be added to the Union List after a five years' transition period on 2 August 2027)	Staff vine
Humulus scandens	Japanese hop
Lygodium japonicum	Japanese climbing fern
Persicaria perfoliata	Asiatic tearthumb
Pueraria montana (var lobata)	Kudzu vine
Asclepias syriaca	Common milkweed
Gunnera tinctoria	Chilean rhubarb
Heracleum mantegazzianum	Giant hogweed
Heracleum persicum	Persian hogweed
Heracleum sosnowskyi	Sosnowsky's hogweed
Impatiens glandulifera	Himalayan balsam
Koenigia polystachya	Himalayan knotweed
Lespedeza cuneata	Chinese bushclover
Parthenium hysterophorus	Whitetop weed

ANIMALS

LATIN NAME	**ENGLISH**
Axis axis	Chital
Callosciurus erythraeus	Pallas' squirrel
Callosciurus finlaysonii	Finlayson's squirrel
Herpestes javanicus	Small Asian mongoose
Muntiacus reevesi	Muntjac deer
Myocastor coypus	Coypu
Nasua nasua	Coati
Nyctereutes procyonoides	Racoon dog
Ondatra zibethicus	Muskrat
Procyon lotor	Raccoon
Sciurus carolinensis	Grey squirrel
Sciurus niger	Fox squirrel
Tamias sibiricus	Siberian chipmunk

Acridotheres tristis	Common myna
Alopochen aegyptiacus	Egyptian goose
Corvus splendens	Indian house crow
Oxyura jamaicensis	Ruddy duck
Pycnonotus cafer	Red-vented bulbul
Threskiornis aethiopicus	Sacred ibis
Lampropeltis getula	Common kingsnake
Lithobates catesbeianus	American bullfrog
Trachemys scripta	Red-eared, yellow-bellied and Cumberland sliders
Xenopus laevis (will be added to the Union List after a two years' transition period on 2 August 2024)	African clawed frog
Ameiurus melas	Black bullhead
Channa argus	Northern snakehead
Fundulus heteroclitus (will be added to the Union List after a two years' transition period on 2 August 2024)	Mummichog
Gambusia affinis	Western mosquitofish
Gambusia holbrookii	Eastern mosquitofish
Lepomis gibbosus	Pumpkinseed
Morone americana	White perch
Perccottus glenii	Amur sleeper
Plotosus lineatus	Striped eel catfish
Pseudorasbora parva	Topmouth gudgeon
Arthurdendyus triangulatus	New Zealand flatworm
Eriocheir sinensis	Chinese mittencrab
Faxonius rusticus	Rusty crayfish
Faxonius limosus	Spiny-cheek crayfish
Faxonius virilis	Virile crayfish
Limnoperna fortunei	Golden mussel
Pacifastacus leniusculus	Signal crayfish
Procambarus clarkii	Red swamp crayfish

Procambarus virginalis	Marbled crayfish
Solenopsis geminata	Tropical fire ant
Solenopsis invicta	Red imported fire ant
Solenopsis richteri	Black imported fire ant
Vespa velutina nigrithorax	Asian hornet
Wasmannia auropunctata	Electric ant/Little fire ant

Appendix 5: Decontamination record sheet for the survey at the Poolbeg in July/October 2023.

Daily Biosecurity Record Sheet	
Site ID	JKO_Poolbeg_CodlingWindPark
Project details	IAS survey
Biosecurity supervisor	WE
Date	10/10/2023

Infestation/works boundary in place (Yes/No)	No	Vehicle access demarcated (Yes/No)	No
Staff access/egress decontamination in place (Yes/No)	No	Vehicle/equipment decontamination in place (Yes/No)	No

Vehicle (description/reg)	Activity	Time decontaminated	Picture	Driver signature
Hilux	General decon	1600	1600	WE

Notes/Comments:

Signed: **WE** **Date:** **10/10/2023**

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Natura Impact Statement

Volume 7

Appendix 2 - Harbour porpoise Dynamic Energy Budget model

Harbour porpoise bioenergetic modelling

The potential effect of disturbance from pile driving noise on harbour porpoise as a feature of the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC

Authors: Booth, C; Chudzinska, M; Sinclair, RR; Wilder, F; Klementisova, K

Introduction

Given the close proximity of the proposed Codling Offshore Wind Farm (hereafter referred to as the 'proposed development') to the Rockabill to Dalkey Island Special Area of Conservation (SAC), the Lambay Island SAC and the Codling Fault Zone SAC, it is necessary for the Natura Impact Statement (NIS) to consider potential impacts to harbour porpoise within these protected sites. The objective of this document is to support the Appropriate Assessment, and focusses on the potential for disturbance resulting from underwater noise from pile driving activities to impact on the harbour porpoise feature of the SACs.

Conservation Objectives

The conservation objectives for the Rockabill to Dalkey Island SAC for harbour porpoise (site code: 3000) are to maintain the favourable conservation condition of harbour porpoise in the SAC. Under this, Target 2 relates to disturbance from underwater noise:

- *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 community of harbour porpoise within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.*

At the time of writing, there are no Conservation Objectives for harbour porpoise at the Lambay Island SAC or the Codling Fault Zone SAC.

The marine mammal impact assessment (**EIAR Volume 3 Chapter 11 Marine Mammals, Document No. CWP-CWP-CON-08-03-03-REP-0006**) does identify the potential for disturbance to harbour porpoise from pile driving activities. Given the close proximity of the proposed development to the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC, it is predicted that some individuals that use the SACs may be disturbed. This disturbance effect may result in a temporary change in the distribution of individuals using the SACs, and a temporary change in behaviour whereby individual porpoise may cease foraging for a limited period of time.

Porpoise bioenergetic modelling

Use of bioenergetic modelling for conservation

Disturbance from pile driving activities has the potential to cause behavioural, physiological and health changes which can have subsequent effects on an individual's vital rates (i.e. their chances of reproducing or surviving). The effects of disturbance from pile driving on animals are widely considered to be mediated by two factors:

1) the state of the individual (e.g., life history stage (e.g. juvenile, adult), exposure history, body condition (a proxy for overall health)), and
2) the environment that the animals live in (e.g. prey resource availability).

Dynamic bioenergetic models can be used to predict the changes in individual body condition and explore how such changes could affect that individual's vital rates. These kinds of models have been widely used to investigate how natural and anthropogenic disturbance might affect individuals and populations of marine mammals (see Pirotta et al. (2018) and Pirotta et al. (2023) for reviews).

A benefit of these bioenergetics models is that they can be used to take into account how an individual's energetic requirements vary during different life history stages (e.g. calves, juveniles and adults) and take into account the state of the environment the individual is in (e.g., different quality of environment, presence of predators). Therefore, these models provide a useful method to consider how disturbance can affect different life stages under different assumptions about the quality of the environment. It's important to note that animals in a good quality environment (or condition) are likely to be more resilient to lost foraging opportunities than those in a poor environment (or condition).

Estimating the effect of disturbance from pile driving on harbour porpoises

The impact of disturbance on porpoises will depend on:

1) the "**probability of disturbance**": this is informed by the probability that an individual is exposed to noise associated with that activity ("**probability of exposure**") and the probability that it will respond to that exposure ("**probability of response**") and
2) The "**disturbance effect**": how long that individual ceases to feed as a result of its response.

Within the bioenergetic model, the product of the **probability of exposure** and the **probability of response** acts as a single parameter (an index), referred to as "**probability of disturbance**". For highly mobile species it is expected that the probability of disturbance would be close to 0 whereas values closer to 1 are expected for species with a high degree of residency in the impacted area where all animals are disturbed on every disturbance day[1]. The unit for the disturbance effect is the number of hours that animals cease foraging for, following disturbance.

Understanding the extent to which porpoises might be disturbed requires consideration of the current state of knowledge regarding their movement and foraging behaviour and the effects of

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[1] The residency patterns of harbour porpoise in the Rockabill and Dalkey Island SAC is unknown. While studies have shown that porpoise are present year round, it is not known if the porpoise present are resident or transient in the area. Berrow et al. (2021) 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*".

disturbance (as these factors, in combination, dictate the likelihood of exposure, disturbance and effect). Therefore, to ensure bioenergetic model simulations are robust, detail on the current state of knowledge regarding harbour porpoises (regarding probability of exposure, probability of response and disturbance effect) is provided, in the context of the assessment herein.

Probability of exposure

The main source of data from which harbour porpoise movement ecology is understood is animal-borne telemetry (i.e. tags which track the locations of animals over time). Tags have been deployed on harbour porpoises for decades, with deployments ranging from hours (Wisniewska et al. 2016, Wisniewska et al. 2018) to over a year (Nielsen et al. 2018). To date, porpoises have been tagged in a few locations globally (the waters off Greenland, the Inner Danish waters (Kattegat & Skagerrak) and off the east coast of the USA and Canada). These studies have generated key data improving our understanding of the species movement ecology. Harbour porpoises are generally considered to be highly mobile, ranging over large distances – but sometimes utilising smaller core regions, for short periods (e.g. weeks). Estimated mean daily movements in the Bay of Fundy were between ~14 and 59 km per day.

Nielsen et al. (2018) demonstrated the long-term (i.e. months-years) large-scale movements of harbour porpoises using satellite telemetry data from West Greenland and Danish waters. Porpoises tagged, generally with shorter deployment durations, in inner Danish waters were observed to stay mostly within shallower waters of the Kattegat and Skagerrak, but with some individuals ranging over the continental shelf and into the North Sea (Nabe-Nielsen et al. 2018) (Nielsen et al. 2018). One animal in this temporally restricted dataset did travel 1,000 km from the tagging location to the waters off Shetland in the span of a few days (Teilmann et al. 2008). Animals tagged in the waters between Greenland and Canada demonstrated large-scale ranging with movements of 1,000 km offshore (and into waters >2,500 m deep). Of the 30 animals tagged, ~75% moved offshore (i.e. 1,000s km away). All the tagged porpoises exhibited strong side fidelity returning to the same general area after moving offshore into the Atlantic Ocean basin. The authors note: *"Six tags from Greenland transmitted long enough (up to 3 yr) to demonstrate extensive movements and strong site fidelity to the tagging site in West Greenland the following summer. This study documents that harbour porpoises use oceanic habitats and can dive to depths that enable mesopelagic foraging, while repeatedly demonstrating summer site fidelity to coastal areas".* This work raises a question of whether the movement behaviour of North Sea porpoises has been adequately captured by shorter tag deployments in Inner Danish waters studies (a region which is considered to maintain a relatively closed population – i.e. one with limited movements).

In terms of the spatial and temporal area usage observed in porpoises, animals tagged in the Bay of Fundy, Canada (for 2-5 month deployments) occupied focal regions for periods of days to months (112 – 415 km^2), while also occasionally using greater, expanded ranges (4,728 – 22,103 km^2) (Johnston et al. 2005). Animals tagged in an earlier study in the same region estimated porpoises were using a range of ~50,000 km^2 (Read and Westgate 1997). Teilmann et al. (2008) indicated some similarities to the work in Canada with short-term focal regions of between 400 km^2 and 1,600 km^2.

The Rockabill to Dalkey Island SAC is 273 km^2 in surface area. Based on the current state of knowledge it is highly likely that porpoises are using this area periodically and that it represents a small part of a larger range.

Chudzińska et al. (2024) used a detailed harbour porpoise movement model (DEPONS) to estimate how the probability of exposure changed for different high- and low-use areas for a semi-resident population in Inner Danish waters. This is a region that is 40 km wide at its northern end and 110 km wide at the southern end (its widest point) – which topographically might be considered comparable to the Irish Sea (34 km wide and 74 km respectively; though 200 km wide in the middle). Chudzińska et al. (2024) explored how the probability of exposure varied under different scenarios where the impacted area had a radius of 30 km (corresponding to an area of 2,826 km^2). The high-use area estimates are considered as a proxy for a region close to an SAC, following Chudzińska et al. (2024) where 75% of simulated harbour porpoise in a **high-use area had a probability of exposure in the range 0.15-0.35 (mean 0.24).** For the **low-use area the mean probability of exposure estimates were <0.1**. All estimates are for a semi-resident population in the Inner Danish waters and, whilst there is no information on how harbour porpoise use the Irish and Celtic Seas, using the "high use" estimate from that region represents a realistic, but conservative estimate given the timescales associated with construction (i.e. many months). If values from the North Sea DEPONS model were used – **all probability of exposure values would be close to 0** (due to the expansive modelled movement of animals in that region).

Probability of response

The probability of response is likely to vary with distance from the source of disturbance (Graham et al. 2019) and potentially due to the state of the animal (e.g. life stage, body condition, past experience etc.) (Graham et al. 2019). A mean **probability of response** can be calculated from dose-response relationships (such as Figure 6 of Graham et al. (2019) for harbour porpoise in the vicinity of the Beatrice Offshore Windfarm during its construction). A mean probability of response was calculated based on the dose-response relationship in combination with the approach described by Tyack and Thomas (2019). This resulted in a **mean probability of response of 0.23 for harbour porpoise within 30 km of the piling activity**.

Probability of disturbance

To determine the potential effects on vital rates, it is possible to multiply the **mean probability of exposure** (0.24) by the **mean probability of response** (0.23) to obtain a **probability of disturbance** value of 0.05. Therefore, if porpoise movements in the Irish and Celtic Sea are analogous to those in the Inner Danish waters DEPONS movement model (a potentially conservative assumption), then **the probability of disturbance is likely to be <0.05**.

If the upper bound of the **probability of exposure** is used (0.35) then this can be multiplied by the **mean probability of response** (0.23) to obtain a **probability of disturbance value of 0.08**. Critically, based on the available data and modelling tools, there is **very little scientific support for probability of disturbance values of above 0.1**.

Disturbance effect

Above discusses the current state of knowledge which informs the likelihood that an animal will be present to be disturbed by a single noise source. Now it is important to consider what is known about how exposure to low frequency broadband noise, like that generated during pile driving, affects foraging of harbour porpoises (and, therefore, energy intake and expenditure). Currently, there is relatively little data to describe porpoise foraging behaviour and the effects of disturbance (in terms of the duration of disrupted foraging). However, consideration is given as to how to apply the current state of knowledge to provide estimates of this parameter.

To evaluate the likely duration of foraging disruptions, a range of observed harbour porpoise swim speeds (1.2, 2.0 and 3.0 ms^{-1} (Verfuß et al. 2009, Kastelein et al. 2018)) and maximum disturbance distances were used (based on the spatial extent of responses from 2.2 -33 km summarised in Brandt et al. (2018); Southall et al. (2019); Brown et al. (2023)), assuming that while the animal is swimming from a starting location to a "safe distance" it is not foraging (

Table 1). This suggests **very few animals would cease foraging for more than 6 hours and the vast majority would be disrupted for much less time** (Table 1). Following Benhemma-Le Gall et al.

(2021), where at 11-12 km from the source there was no reduction in foraging probability this would suggest **impacted foraging durations of only 0.46 - 2.55 hours**.

Table 1 1Number of foraging hours lost (effect of disturbance) calculated from distance/observed swim speeds, where distance is the maximum disturbance distance - the animal's location in relation to the piling vessel at the start of piling.

Maximum disturbance distance											
6 km				12 km				36 km			
Distance from source (km)	Swim speed (ms^{-1})			Distance from source (km)	Swim speed (ms^{-1})			Distance from source (km)	Swim speed (ms^{-1})		
	1.2	2.0	3.0		1.2	2.0	3.0		1.2	2.0	3.0
	Lost foraging hours				Lost foraging hours				Lost foraging hours		
0.5	1.27	0.76	0.51	1	2.55	1.53	1.02	3	7.64	4.58	3.06
1	1.16	0.69	0.46	2	2.31	1.39	0.93	6	6.94	4.17	2.78
2	0.93	0.56	0.37	4	1.85	1.11	0.74	12	5.56	3.33	2.22
3	0.69	0.42	0.28	6	1.39	0.83	0.56	18	4.17	2.50	1.67
4	0.46	0.28	0.19	8	0.93	0.56	0.37	24	2.78	1.67	1.11
5	0.23	0.14	0.09	10	0.46	0.28	0.19	30	1.39	0.83	0.56

The current iPCoD model relies on transfer functions derived via expert elicitation in 2018. Following a review and discussion of the available scientific data and literature, experts agreed that when assessing the effects of a day of disturbance (i.e. a day upon which pile driving occurs), that the disrupted foraging was unlikely to exceed an average of 6 hours of lost foraging. Whilst this assessment was made in 2018, before Benhemma-Le Gall et al. (2021) published their work, this assumption appears reasonable, though is likely conservative.

Report intent

The purpose of this report is to investigate whether disturbance resulting from pile driving at the proposed development is likely to result in significant impacts to individual harbour porpoise vital rates (survival and reproduction).

Methods

The individual-based, dynamic bioenergetics model developed by Hin et al. (2019) for long-finned pilot whales was adapted so that it could be applied to harbour porpoise (HP). A full description of the bioenergetic models can be found in Harwood et al. (2020), Harwood et al. (2022) and Chudzińska et al. (2024). A range of simulations were then run, which differed by probability of disturbance and disturbance effect (in terms of lost foraging time). Below is a short, general description of the bioenergetic models, and the way in which uncertainty around model parameter values was addressed (see Appendix 1 and Chudzińska et al. (2024) for further details).

Dynamic bioenergetic model for harbour porpoise

Dynamic bioenergetic theory provides a mechanistic framework that predicts the consequences of an organism's acquisition of environmental resources (i.e. finding suitable prey) for growth, reproduction, and to survive. The models are called 'dynamic' as the energy acquisition and allocation varies in time depending on the animal's physiological state, energy demand and prey availability (Nisbet et al. 2000, Kooijman and Kooijman 2010). Thus, the models provide a tool to investigate interactions between populations and their resources, and how this link between animals and resources (availability and/or acquisition) can be affected by disturbance.

The bioenergetic model presented in this report tracks the way in which individual female harbour porpoises assimilate energy over the course of their lives from weaning to death, and how this energy is allocated to daily energy needs (i.e., field metabolism), growth, and the costs of reproduction (e.g., foetal development, and lactation). A simulated individual's energy needs vary depending on their current nutritional state and reproductive state and animals can gain and lose reserves depending on whether or not they obtain sufficient energy. Animals are assumed to starve if their energy levels get too low. Pregnancy is dictated by animal body condition (i.e., energy levels) and calves are considered to be entirely dependent on their mother. Calves are assumed to begin foraging before they wean as they get older.

Age-related and seasonal fluctuations in body condition are therefore the result of variations in the resource density (i.e. prey availability) experienced by individuals and their energy demands. Figure 1 shows the predicted changes in body condition of a typical adult female and her offspring over the course of three reproductive cycles (breeding seasons) in an undisturbed environment. The model proceeds in discrete time steps of 1 day, and each year consists of 365 days.

Birth and death are stochastic processes and growth varies among individuals, depending on the resources (i.e. prey) they encounter. It was therefore necessary to simulate a large number of females in order to obtain reliable estimates of mean lifetime reproductive success for a particular combination of parameter values. A minimum of 1,000 females was required to obtain consistent estimates and thus 2,000 females were chosen for the simulation.

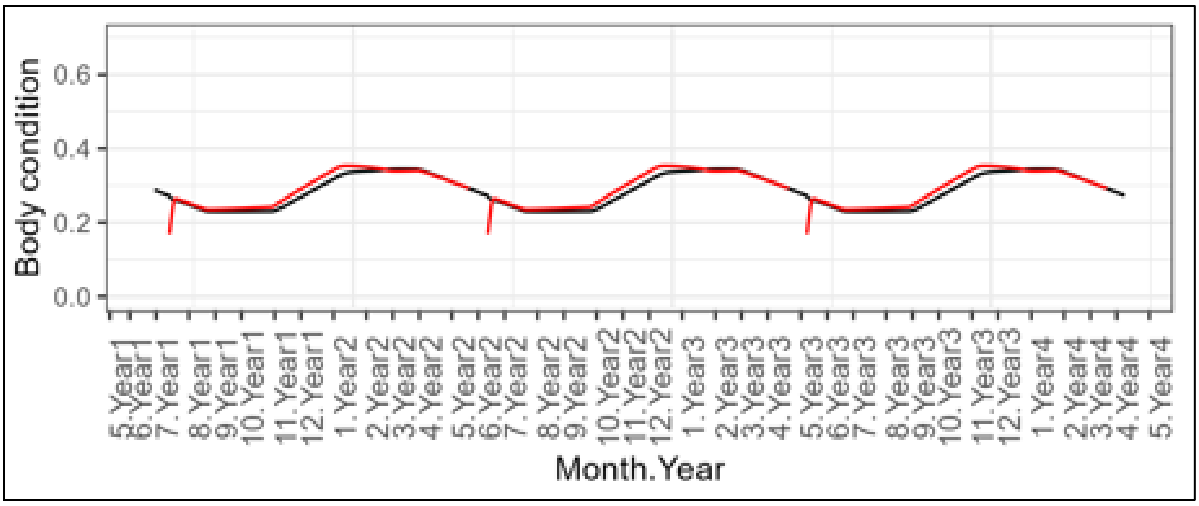

Figure 1 Predicted changes in relative body condition of an average female (black line) and her offspring (red line) over the course of 3 breeding cycles in an undisturbed environment for the period for which all calculations were done when modelling the effect of disturbance.

Modelling the environment and pattern of disturbance events

The quality of the environment is an important variable in simulations assessing the reproduction and survival of porpoises. Animals typically perform better in higher quality environments and worse when the environment is poor quality. This is challenging to define in practice but the environment in model simulations is controlled by a resource density value. For these simulations, the resource density value was calibrated to ensure the resulting outcome would be a stable population (i.e., that the environment gave rise to a proportionate number of calves to offset natural mortality). Since the SAC is a protected habitat because it has supported a relatively high density of porpoise over many years, this assumption is likely conservative (i.e. the quality of modelled environment may be lower than exists in reality).

The following piling schedule was provided by the Developer for the proposed pile driving:

- 78 piling days, starting on 1st April and finishing 9h October (Figure 2)

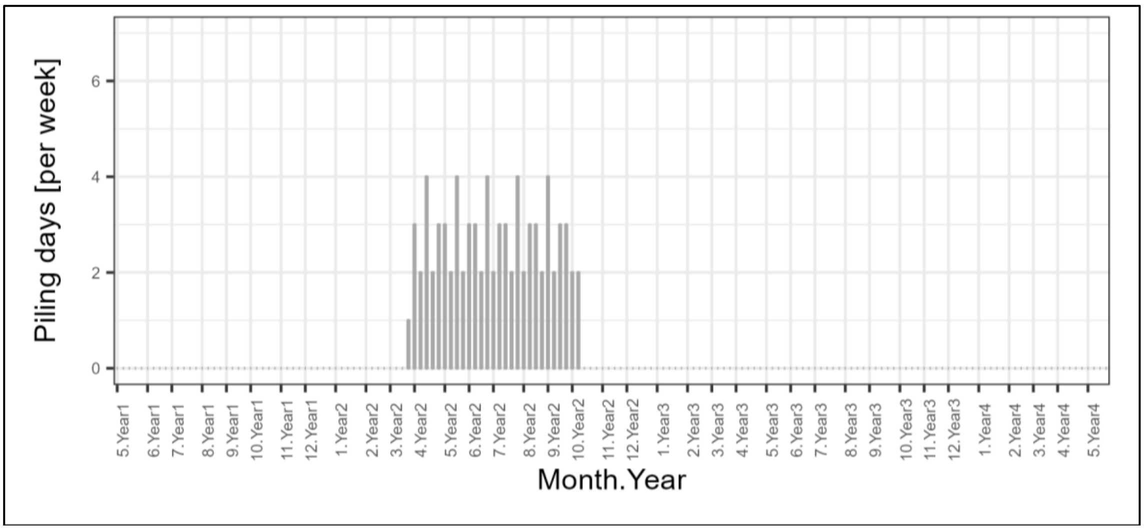

Figure 2 Piling schedule 1: 51 piling days between April and October.

The effects of the piling schedule were evaluated by systematically varying the probability of disturbance and the disturbance effect. On each day of piling, it was determined whether a simulated individual would be disturbed by conducting a binomial trial using the chosen probability of disturbance. If it was disturbed, the model reduced its total assimilated energy on that day by the duration of the chosen disturbance effect expressed as a proportion of the day (e.g. a disturbance effect of 1 h resulted in a 1/24 reduction in assimilated energy). As there are no empirical data on how long individuals stop foraging after being exposed to disturbance from pile-driving noise, values of 1, 2, 4 and 6 hours per day were used for the disturbance effect. The same process was followed for each of the 2,000 simulated females. It was assumed that each disturbance event resulted in the same reduction in assimilated energy for each modelled individual (i.e. an individual would always respond in the same manner within each simulation). Overall, combinations of three **probabilities of disturbance**: 0.05, 0.1, 0.2 and four **disturbance effects**: 1, 2, 4 and 6 hours were run.

To account for parameter uncertainty, the model drew 100 combinations of values from the joint posterior distribution derived from the ABC analysis (see Appendix 1 – Details of the bioenergetic model) and used these to simulate the effect of each permutation of probability of disturbance and disturbance effect values on females that were adults when piling commenced.

For each simulation, three vital rates were documented: adult mortality rate, calf mortality rate, and birth rate (percentage of females alive at the start of the breeding season that gave birth). Birth rate and calf mortality rate were calculated for each year from the breeding season before piling commenced to the breeding season after piling ended. In order to identify significant differences between simulations with and without disturbance, Welsh's unequal variance t-test to pairs of values that used the same combination of parameters was conducted. If a significant difference was detected, this was expressed as a percentage change from the value observed in a scenario with no disturbance. Otherwise, no value is presented – meaning there was no significant difference between the disturbed and undisturbed (no pile driving activity) scenarios.

Results

Figure 3 shows the predicted effects of the different combinations of values for disturbance effect and probability of disturbance resulting from piling on porpoise birth rate, calf mortality rate and adult mortality rate. Results are expressed as a percentage change from no disturbance.

Calf mortality rate

Across all simulations, calf mortality rate was the only affected vital rate due to the simulated pile driving activity and this only occurred in simulations with the most severe assumptions regarding probability of disturbance and disturbance effect. **In most simulations, no effect on calf mortality rate was predicted, especially where the probability of disturbance was 0.05 or where each disturbance resulted in 1-2 hours of lost foraging.**

Using the most realistic upper limits of disturbance effect (6 hour) and probability of disturbance (0.1), the result was a 1.6% increase in calf mortality from the undisturbed simulation. This increase in calf mortality rate is very small, and is limited to the year in which piling activities occurs – i.e.: there is no long term residual impact once piling ceases. This is not considered to be a significant negligible impact to individuals at the site.

Due to the uncertainty in how porpoises use the area, scenarios were explored with more extreme values (for which there is little scientific evidence to support). If these severe assumptions hold, the maximum increase in calf mortality rate was 2.8% under the assumptions that disturbance caused a 6h reduction in foraging and that reduction applied to 20% of the simulated individuals. This is however highly unrealistic given the evidence presented above for the likely limits of disturbance effect and probability of disturbance. This increase in calf mortality rate is very small, and is limited to the year in which piling activities occurs – i.e.: there is no long term residual impact once piling ceases. This is not considered to be a significant negligible impact to individuals at the site. It's important to highlight there is little scientific evidence to support the parameters used in this scenario. As such this is considered extreme.

Birth rate

Pile driving resulted in **no significant change in birth rate** from the undisturbed simulation.

Adult mortality rate

Pile driving resulted in **no significant change in adult mortality rate** from the undisturbed simulation.

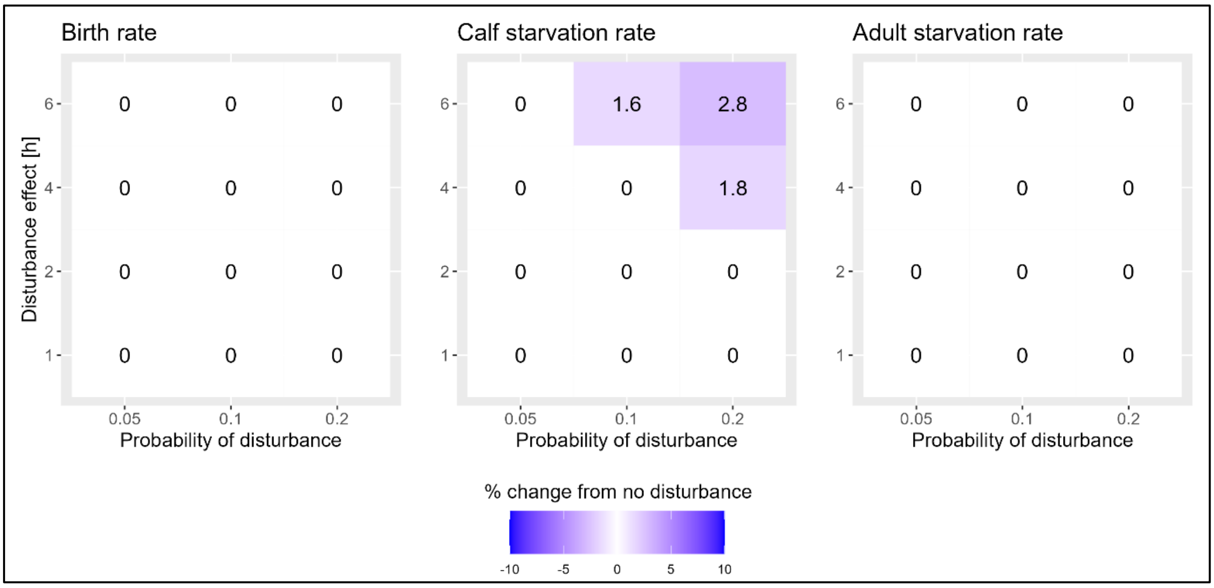

Figure 3 Percentage change from no disturbance for three vital rates: birth rate, calf and adult mortality (from starvation) rates for combinations of probability of disturbance and disturbance effect for harbour porpoises.

Conservatism

It is important to note that whilst not assessed this here, it is likely that there is individual heterogeneity in the response of animals. Responses might be different between animals due to being exposed to a different received level (i.e., the probability of response increases with increasing proximity or received level from the source (e.g. summarised by Harris et al. 2018)), or due to different states of the animal (e.g. body condition, life history stage). As noted above, in the simulations it is assumed that animals respond to the same extent irrespective of their location relative to the piling location and to the same degree each time (i.e. all animals disturbed lose the same amount of energy intake). This is highly unlikely. Chudzińska et al. (2024) demonstrate that if individual heterogeneity is allowed in the probability of response – it dramatically reduces predicted impact. Further, Graham et al. (2019) highlight that the probability of response declines as the piling campaign continues.

Conclusion

It is acknowledged that a number of individuals within the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC may experience disturbance as a result of pile driving at the proposed development. This disturbance effect may result in a temporary change in the distribution of individuals within these SACs, and a temporary change in behaviour whereby individual porpoise may cease foraging for a limited period of time.

Under what should be considered **the most realistic scenarios** (disturbance effect up to a maximum of 4 hrs and a probability of disturbance being 0.05 or 0.01), disturbance from pile driving at the proposed development is not expected to result in any impacts to individual harbour porpoise vital rates.

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Appendix 1 – Details of the bioenergetic model

A full description of the bioenergetic models using the ODD (Overview, Design concepts, and Details protocol), a standardised format for documenting individual-based models (Grimm et al. 2020), together with detailed information on the way in which model parameters were derived can be found in (Harwood et al. 2020, Harwood et al. 2022, Chudzińska et al. 2024).

The equations in a bioenergetics model describe the life history processes of a cohort of organisms, based on energy fluxes. Resources assimilated from the environment are allocated to maintenance, growth and reproduction via a reserve compartment.

The model presented in this report tracks the way in which individual female harbour porpoises assimilate energy over the course of their lives from weaning to death, and how this energy is allocated to daily energy needs (i.e., field metabolism), growth and the costs of reproduction (e.g., foetal development, and lactation). A simulated individual's daily assimilated energy varies with resource density, its structural mass, its state (e.g. pregnant, lactating, moulting) and its relative body condition (defined as the ratio of reserve mass to total mass). Individuals are assumed to have a target body condition (which is based on the maximum body condition observed in free-living animals (McLellan et al. 2002, Lockyer 2007)). They assimilate energy at half of the maximum possible rate when their body condition is at the target level and increase their energy assimilation progressively if their body condition is reduced below this value (see details in Harwood et al. (2020)).

If assimilated energy on a particular day exceeds the combined costs of metabolism, growth and reproduction, the surplus energy is converted to reserve tissue. If the combined costs cannot be covered by assimilated energy, the assimilated energy is assigned to growth (including growth of any foetus). If this is less than the energy required for growth, the growth rate of the female and her foetus is reduced accordingly. The daily costs of maintenance and lactation are always met in full by a combination of the assimilated energy remaining after realized growth costs have been subtracted and catabolism of reserve tissue. In these circumstances, a female's relative body condition will be reduced on the next day.

It was assumed that individuals experience an additional risk of death if their body condition falls below a starvation threshold, which is based on the minimum body condition observed in free-ranging animals. As body condition of porpoises varies seasonally (Lockyer 2007) (Figure 1), this threshold also varies seasonally between 25 and 14% (see Figure 6 in Harwood et al. 2020)

It was assumed that all adult females above a certain age can become pregnant every year. However, the actual age at first successful reproduction and the total number of offspring produced by a female depends on her body condition and life expectancy. The metabolic and growth costs of pregnancy are calculated by including foetal mass in maternal structural mass. Following New et al. (2013) and Hin et al. (2019), it was assumed that a female may choose to terminate a pregnancy at a pre-defined time, which is the day of ovulation.

Offspring are entirely dependent on milk provided by their mother until they start foraging on their own, and their demand for milk depends on their structural mass and body condition. However, following Hin et al. (2019), it was assumed that adult females would reduce the amount of milk they actually provide to their calf as their own body condition declines. Independent foraging is assumed to begin during lactation. Calf foraging efficiency is assumed to increase with age until it attains the adult value.

Quantifying uncertainty around model parameter values in the bioenergetic model

The bioenergetics models require values for more than 50 parameters (see full list in Chudzińska et al. (2024)), some of which are not directly observable, and it is important to try to quantify the uncertainties that are associated with the values used for these parameters. Rejection Approximate Bayesian Computation (ABC) (Lagarrigues et al. 2015) was used to establish plausible statistical distributions for the unobservable parameters, and for other parameters whose reported values showed large variations

The ABC approach involves: (i) defining a set of rejection criteria based on empirical information that can be used to evaluate the plausibility of outputs from a model with a particular set of parameter values; (ii) simulating the model a large number of times with values drawn from prior distributions for the parameters under investigation; (iii) comparing the simulation outputs to the rejection criteria; and (iv) retaining only those combinations of parameter values that produce outputs that fall within the plausible range. This process generates a joint posterior distribution for the parameters under investigation.

The parameters chosen for ABC were: effect of age on foraging efficiency, age of offspring when foraging efficiency was 50% of the adult level, starvation threshold and starvation mortality, field metabolic rate scalar, resource density and calf age at which female begins to reduce milk.

300,000 simulations were run for 2,000 females each, in the absence of disturbance, with parameters drawn from a prior distribution (Chudzińska et al. 2024).

The rejection criteria was developed based on the following population characteristics: population growth rate; proportion of females giving birth each year; female starvation mortality; and offspring survival rate (Chudzińska et al. 2024).

The joint posterior distribution of parameter value combinations that fulfilled the rejection criteria for each species are shown in Chudzińska et al. (2024). This distribution was then sampled at random to provide parameter values for the simulations.

Natura Impact Statement

Volume 7

Appendix 3 - Apportioning ratios technical appendix

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APPENDIX 3 – APPORTIONING RATIOS TECHNICAL APPENDIX

1 Introduction

1. This Technical Appendix summaries the methodology used to apportion impacts quantified in relation to the array site (displacement mortality and / or collision mortality) to colonies within breeding season foraging range of the array site and presents input parameters used to apportion collision and displacement impacts to those breeding colonies. Impacts apportioned to Qualifying Interests (QIs) of each Special Protection Area (SPA) are referenced in the Natura Impact Statement (NIS).

2 Methodology

2. Predicted impacts of given at-sea developments on seabird species can be assigned to local colonies by calculating apportioning factors, which predict the proportion of impact each colony is expected to receive. Apportioning factors are herein presented in relation to kittiwake, herring gull, guillemot, razorbill, puffin, Manx shearwater and gannet. Such apportioning of impacts allows the total estimated collision and displacement impacts on seabirds to be proportionally divided amongst the SPAs and non-SPA colonies the development is predicted to effect. This proportion is estimated based on a function of their population size, distance from the development site and the amount of each colony's foraging range that falls within open sea. Apportioning of impacts to each colony facilitates assessment of the potential effects of the CWP Project on the site integrity of SPA colonies the development is predicted to impact.

3. Apportioning factors were calculated based upon the methodology recommended for proposed offshore wind farm developments in Scotland (NatureScot, 2018), adapted as follows (as outlined in the Method Statement[1] issued to the Irish Government in August 2023):

   a. Non-SPA colonies between mean maximum and mean maximum plus one Standard Deviation (SD) breeding foraging ranges (Woodward *et al*., 2019) were excluded from apportioning. An exception to this was made for herring gull. For this species all colonies, SPAs or otherwise, within the species' mean maximum plus one SD foraging range of the array site were included within apportioning calculations. This differentiation between herring gull and other seabird species was to account for the presence of urban, non-SPA, herring gull breeding colonies along the Irish east coast which are of similar size to (or larger than) SPA colonies within the region, the inclusion of which was considered necessary in the apportioning process. For the other species considered, this precautionary approach to attributing impact to SPA colonies was used as non-SPA colonies are smaller than SPA colonies, and, due to the weighting of colony size and distance from impacted areas within apportioning models, their non-inclusion in impact apportioning when beyond mean-maximum foraging ranges was considered unnecessary.

   b. For Manx shearwater, apportioning to regional colonies was carried out using the mean max. plus 1 SD foraging range for gannet (509.4 km). This is range is considered to be appropriately precautionary, whilst still adequately capturing any potential apportioned impacts. It is considered that impacts apportioned to colonies beyond 509.4 km and within the very large mean maximum plus one SD foraging range of Manx shearwater (2,365.5 km; Woodward *et al.*, 2019) would be effectively indetectable.

[1] Method Statement – Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects. GoBe (APEM Group). Revision 1.0. December 2022. ©GoBe Consultants Limited.

4. Breeding colonies with potential connectivity to the development (i.e. to which a proportion of total impact was apportioned) for each species were defined as those within each species' mean maximum foraging range (plus one SD for SPA colonies) as presented in Woodward *et al*., (2019), with impacts apportioned to colonies where by sea foraging ranges around the nearest edge of the array site overlapped with the colony (or nearest edge of an SPA if it extended beyond a colony location). The foraging ranges used for each species are presented in **Table 1**.

Table 1 Species for which apportioning was carried out and their foraging ranges as recommended by NatureScot (2023) derived from Woodward *et al*., (2019).

Common name	Mean maximum foraging range (km)	Mean maximum foraging range plus 1 SD (km)
Herring gull	58.8	85.6
Guillemot	73.2	153.7
Razorbill	88.7	164.6
Puffin	137.1	265.4
Kittiwake	156.1	300.6
Gannet	315.2	509.4*

* *also used for Manx shearwater.*

Source: Woodward et al. (2019)

5. Colony locations were obtained from The Seabird Monitoring Programme (SMP) database (Seabird Monitoring Programme, 2024). For the apportioning process, rather than 'edge to edge' distances between the array site and breeding colonies (which were used to identify breeding colonies with connectivity to the array site, as described above), 'centroid to centroid' distances were used (as per NatureScot, 2018). It should be noted that centroid to centroid measurements are slightly greater than edge to edge measurements and, as such, colonies slightly beyond mean maximum (or mean maximum plus one SD) foraging ranges may be included in apportioning, where edge to edge measurements are less than these distances. Centroid to centroid distances between identified breeding colonies and the development array site are provided in the tables in presented **Sections 3.1** to **3.7**, below.

2.1 Colony population counts

6. Following the identification of relevant colonies, the most recent count data for these populations were sourced. The majority of these data were obtained from 'Seabirds Count: a census of breeding seabirds in Britain and Ireland (2015–2021)' (Burnell *et al*., 2023). However, where more recent counts were present on the SMP database (Seabird Monitoring Programme, 2024), these were used instead.

7. Once the most recent count data were obtained for each relevant colony, these numbers were corrected to represent individual birds depending on their count unit. Counts recorded in "apparently occupied burrows" (AOB), "apparently occupied nests" (AON), "apparently occupied sites" (AOS) and "apparently occupied territories" (AOT) were multiplied by two, as these are assumed to represent a pair of breeding adults. The final breeding season population counts for each species and SPA combination screened-in are provided in the tables in presented **Sections 3.1** to **3.7**, below.

3 Input parameters and colony weightings for each species

3.1 Kittiwake

8. **Table 2** shows the steps used to determine the weighting of impacts apportioned to each kittiwake breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.1, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 2 Colony parameters used to calculate apportioning of collision impacts to sites designated for kittiwake QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Wicklow Head SPA	Yes	1290	2023	20.14	0.465	27.44%	0.527	0.9	13.02%
Bray Head	No	1746	2015	24.80	0.495	23.00%			10.91%
Lambay Island SPA	Yes	6640	2015	52.80	0.456	20.93%			9.93%
Howth Head Coast SPA	Yes	3546	2018	44.63	0.465	15.37%			7.29%
Ireland's Eye SPA	Yes	802	2016	45.04	0.463	3.42%			1.62%
Rathlin Island SPA	Yes	27412	2021	280.48	0.508	2.75%			1.30%
Carreg Y Llam	No	1228	2021	93.21	0.547	1.04%			0.49%
Great Saltee Island (part of Saltee Islands SPA)	Yes	2076	2015	135.71	0.577	0.78%			0.37%
Skomer	No	3088	2022	159.77	0.683	0.71%			0.34%
Rockabill SPA	No	330	2021	63.97	0.466	0.69%			0.33%
Great Orme	No	1796	2021	148.30	0.514	0.64%			0.30%
Maggys Leap to Newcastle 1	No	1160	2019	124.41	0.485	0.62%			0.29%
Port St Mary - Sound	No	1106	2017	139.07	0.531	0.43%			0.20%
St Tudwals Island East	No	620	2016	103.98	0.542	0.42%			0.20%
New Quay Head	No	664	2018	137.28	0.524	0.27%			0.13%
Bardsey Island	No	242	2019	80.15	0.567	0.27%			0.13%
Dunmore East to Red Head	No	802	2018	160.88	0.565	0.22%			0.10%

[2] Codling Wind Park Environmental Impact Assessment Report - Appendix 10.5: Baseline Characterisation Report.
[3] Berwick Bank Wind Farm Offshore Environmental Impact Assessment. Appendix 11.6: Ornithology population viability analyses technical report (2022). Compiled by DMPS Stats Ltd. and HiDef Aerial Surveying Ltd.

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Little Orme	No	648	2021	154.71	0.495	0.22%			0.10%
Puffin Island	No	406	2021	139.12	0.536	0.16%			0.07%
Ynys Moelfre	No	312	2016	125.81	0.558	0.14%			0.07%
Ailsa Craig SPA	Yes	980	2021	264.20	0.473	0.12%			0.06%
Old Head Of Kinsale SPA	Yes	1442	2015	292.35	0.755	0.09%			0.04%
Maggys Leap 1/Donnard Cove	No	152	2017	124.41	0.485	0.08%			0.04%
Portally to Benlea Head	No	200	2018	165.71	0.561	0.05%			0.02%
Trwyn Cilan	No	56	2016	96.91	0.548	0.04%			0.02%
Ramsey Island	No	92	2022	144.11	0.678	0.03%			0.01%
South Stack Cliffs	No	20	2021	84.28	0.578	0.02%			0.01%
Helvick Head to Ballyquin SPA	Yes	130	2018	205.20	0.657	0.02%			0.01%
Ardnamult	No	52	2018	159.30	0.564	0.01%			0.01%
Calf of Man	No	26	2013	135.99	0.535	0.01%			0.00%
Penymynydd	No	0	2016	96.91	0.548	0.00%			0.00%
Murian	No	0	2016	100.74	0.546	0.00%			0.00%
Porth Ceiriad West	No	0	2016	100.74	0.545	0.00%			0.00%
Porth Ceiriad East	No	0	2016	101.15	0.544	0.00%			0.00%
Trwyn Yr Wylfa 2	No	0	2016	102.57	0.544	0.00%			0.00%
Trwyn Yr Wylfa 1	No	0	2016	103.57	0.543	0.00%			0.00%
St Tudwals Island West	No	0	2016	103.57	0.542	0.00%			0.00%
Middle Mouse	No	0	2016	106.33	0.572	0.00%			0.00%
Lynas to Freshwater Bay	No	0	2016	117.15	0.564	0.00%			0.00%
Freshwater Bay	No	0	2016	119.57	0.563	0.00%			0.00%
Little Saltee (part of Saltee Islands SPA)	Yes	0	2015	133.47	0.573	0.00%			0.00%
Guns Island	No	0	2012	144.11	0.517	0.00%			0.00%

3.2 Herring gull

9. **Table 3** shows the steps used to determine the weighting of impacts apportioned to each herring gull breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.3, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 3 Colony parameters used to calculate apportioning of collision impacts to sites designated for herring gull QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Wicklow Head SPA	No	28	2023	20.14	0.575	2.40%	0.422	0.65	0.66%
Bray Head	No	4	2015	24.80	0.525	0.25%			0.07%
Dalkey Islands SPA	No	38	2016	31.87	0.523	1.44%			0.39%
Howth Head Coast SPA	No	18	2015	41.21	0.560	0.38%			0.10%
Dublin City South (urban population)	No	36	2021	43.77	0.394	0.96%			0.26%
Howth (urban population)	No	920	2021	44.63	0.546	16.95%			4.65%
Ireland's Eye SPA	Yes	636	2015	45.04	0.536	11.73%			3.22%
Lambay Island SPA	Yes	1812	2015	51.97	0.551	24.39%			6.69%
Rockabill SPA	No	430	2015	63.97	0.613	3.44%			0.94%
Skerries Islands SPA	Yes	20	2020	65.04	0.503	0.19%			0.05%
Skerries Town (urban population)	No	498	2021	65.46	0.539	4.33%			1.19%
Balbriggan Town (urban population)	No	2970	2021	72.11	0.482	23.75%			6.51%
Bardsey Island	No	834	2018	80.15	0.877	2.97%			0.81%
South Stack Cliffs RSPB	No	152	2021	84.28	0.794	0.54%			0.15%
Drogheda (urban population)	No	720	2021	88.18	0.358	5.18%			1.42%
Aberdaron Coast (not in SPA)	No	330	2018	86.33	0.799	1.11%			0.30%

3.3 Guillemot

10. **Table 4** shows the steps used to determine the weighting of impacts apportioned to each guillemot breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.7, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 4 Colony parameters used to calculate apportioning of collision impacts to sites designated for guillemot QI

<table>
<tr><th>Colony</th><th>SPA designated feature</th><th>Count (individuals)</th><th>Year of count</th><th>Distance from array centroid to colony centroid (km)</th><th>Proportion of foraging area at sea</th><th>Proportion of total impact apportioned to colony</th><th>Proportion of population which are adult</th><th>Proportion of adults which breed each year</th><th>Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)</th></tr>
<tr><td>Lambay</td><td>Yes</td><td>59983</td><td>2015</td><td>52.80</td><td>0.469</td><td>73.89%</td><td rowspan="6">0.522</td><td rowspan="6">0.93</td><td>35.87%</td></tr>
<tr><td>Ireland's Eye SPA</td><td>Yes</td><td>4410</td><td>2015</td><td>45.04</td><td>0.469</td><td>7.47%</td><td>3.63%</td></tr>
<tr><td>Bray Head</td><td>No</td><td>1414</td><td>2015</td><td>24.80</td><td>0.534</td><td>6.94%</td><td>3.37%</td></tr>
<tr><td>Wicklow Head</td><td>Yes</td><td>897</td><td>2023</td><td>20.14</td><td>0.525</td><td>6.79%</td><td>3.30%</td></tr>
<tr><td>Great Saltee Island</td><td>Yes</td><td>25851</td><td>2015</td><td>135.71</td><td>0.626</td><td>3.62%</td><td>1.76%</td></tr>
<tr><td>Howth Head Coast</td><td>No</td><td>871</td><td>2015</td><td>44.63</td><td>0.545</td><td>1.29%</td><td>0.63%</td></tr>
</table>

3.4 Razorbill

11. **Table 5** shows the steps used to determine the weighting of impacts apportioned to each razorbill breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.8, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 5 Colony parameters used to calculate apportioning of collision impacts to sites designated for razorbill QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Lambay	Yes	7353	2015	52.80	0.469	50.27%	0.533	0.93	24.92%
Ireland's Eye SPA	Yes	1600	2015	45.04	0.469	15.05%			7.46%
Wicklow Head	Yes	276	2023	20.14	0.504	12.07%			5.98%
Bardsey Island	No	3834	2019	80.15	0.719	7.42%			3.68%
Great Saltee Island	Yes	5669	2015	135.71	0.621	4.43%			2.20%
Bray Head	No	150	2010	24.80	0.542	4.02%			1.99%
Howth	No	279	2015	44.63	0.532	2.36%			1.17%
South Stack Cliffs	No	1378	2021	84.28	0.812	2.14%			1.06%
Little Saltee	Yes	850	2015	133.47	0.619	0.69%			0.34%
Carreg Y Llam	No	438	2021	93.21	0.681	0.66%			0.33%
Lleyn Peninsula (Inc. St Tudwalls Island And Trwyn Cilan, Excluding Carreg Y Llam)	No	292	2016	83.36	0.697	0.54%			0.27%
Abrahams Bosom	No	83	2016	83.11	0.822	0.13%			0.06%
Maen Du	No	65	2016	80.67	0.725	0.12%			0.06%
Braich Anelog (Aberdaron Coast not in)	No	25	2016	80.84	0.725	0.05%			0.02%
Gogarth	No	18	2016	82.53	0.825	0.03%			0.01%
Ynysoedd Gwylan (Fawr and Bach total)	No	13	2019	86.33	0.695	0.02%			0.01%

3.5 Puffin

12. **Table 6** shows the steps used to determine the weighting of impacts apportioned to each puffin breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.9, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 6 Colony parameters used to calculate apportioning of collision impacts to sites designated for puffin QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Copeland Islands	No	212	2019	183.08	0.423	0.29%	0.543	0.93	0.15%
Skokholm	Yes	12192	2023	155.53	0.581	16.94%			8.55%
Bardsey Island	No	282	2019	73.25	0.406	2.52%			1.27%
Gobbins	No	54	2019	208.05	0.447	0.05%			0.03%
Midland Island	Yes	262	2022	152.36	0.575	0.38%			0.19%
Ramsey Island	No	55	2021	134.87	0.556	0.11%			0.06%
Lambay	Yes	288	2015	43.14	0.434	6.96%			3.51%
Skomer	Yes	36074	2022	150.53	0.575	54.06%			27.30%
Ireland's Eye	Yes	12	2016	33.97	0.442	0.46%			0.23%
St Bees Head	No	2	2023	206.48	0.408	0.00%			0.00%
Great Saltee Island	Yes	1098	2021	126.05	0.561	2.40%			1.21%
South Stack Cliffs RSPB	No	10	2022	78.21	0.362	0.09%			0.05%
Little Saltee Island	Yes	540	2016	123.81	0.557	1.24%			0.63%
The Skerries RSPB	No	584	2023	88.84	0.351	4.12%			2.08%
Ynysoedd Gwylan	No	1238	2019	79.43	0.398	9.63%			4.86%
Lundy Island	No	1335	2023	233.10	0.645	0.74%			0.37%

3.6 Manx shearwater

13. **Table 7** shows the steps used to determine the weighting of impacts apportioned to each Manx shearwater breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.10, of Appendix B - Baseline Characterisation Report[2]) are applied to give the proportion of breeding adults apportioned to each colony. In the absence of information relating to the proportion of adults which breed each year, or precedence from other developments relating to non-breeding sabbatical rates for this species, it is assumed that all adults breed each year (i.e. all adults impacted are breeding at one of the colonies listed in **Table 7**).

Table 7 Colony parameters used to calculate apportioning of collision impacts to sites designated for Manx shearwater QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Deenish Island	Yes	702	2000	425.85	0.853	0.01%	0.469	1.0	0.00%
Copeland Islands	Yes	9700	2007	183.08	0.634	0.63%			0.19%
Skokholm	Yes	177890	2018	155.53	0.616	16.43%			4.75%
Bardsey Island	Yes	16183	2001	73.25	0.625	6.65%			1.95%
Midland Island	No	33096	2018	152.36	0.616	3.18%			0.92%
Puffin Island (Kerry)	Yes	12658	2000	442.16	0.857	0.10%			0.04%
Scariff Island	Yes	3920	2000	425.85	0.854	0.03%			0.01%
Great Ganilly	No	2	2015	353.88	0.712	0.00%			0.00%
Great Skellig	Yes	1476	2001	442.06	0.861	0.01%			0.00%
Ramsey Island	No	12450	2022	134.87	0.621	1.52%			0.44%
Sanda Islands	No	600	2006	252.5	0.665	0.02%			0.01%
Bryher	No	78	2015	353.88	0.717	0.00%			0.00%
Round Island	No	156	2015	353.88	0.714	0.00%			0.00%
Shipman Head	No	78	2015	353.88	0.717	0.00%			0.00%
Skomer	Yes	699326	2018	150.53	0.618	68.80%			19.94%
Tresco	No	92	2015	353.88	0.716	0.00%			0.00%
Calf of Man	No	848	2014	127.58	0.616	0.12%			0.03%
St Martin's	No	52	2015	353.88	0.712	0.00%			0.00%
Annet	No	458	2015	353.88	0.722	0.01%			0.00%
Treshnish Isles Spa	No	3984	2018	404.79	0.740	0.05%			0.02%
Gugh	No	160	2022	353.88	0.720	0.00%			0.00%

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to colony centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
St Agnes	No	130	2022	353.88	0.721	0.00%			0.00%
Great Saltee Island	No	300	2002	126.05	0.663	0.04%			0.01%
St Helens	No	248	2022	353.88	0.715	0.00%			0.00%
Blasket Islands SPA	Yes	39068	2001	474.65	0.859	0.28%			0.11%
High Island	No	1636	2015	327.01	0.816	0.03%			0.01%
Ailsa Craig SPA	No	40	2018	251.54	0.655	0.00%			0.00%
Eigg	No	500	1999	463.18	0.762	0.00%			0.00%
Rum SPA	Yes	240000	2001	454.38	0.770	2.08%			0.75%

3.7 Gannet

14. **Table 8** shows the steps used to determine the weighting of impacts apportioned to each gannet breeding colony. As colony counts relate to breeding adults only, correction factors in the form of the proportion of the population which are adult (taken from Table B.11, of Appendix B - Baseline Characterisation Report[2]) and proportion of adults which breed each year (taken from NatureScot guidance to Berwick Bank OWF[3]) are applied to give the proportion of breeding adults apportioned to each colony.

Table 8 Colony parameters used to calculate apportioning of collision impacts to sites designated for gannet QI

Colony	SPA designated feature	Count (individuals)	Year of count	Distance from array centroid to centroid (km)	Proportion of foraging area at sea	Proportion of total impact apportioned to colony	Proportion of population which are adult	Proportion of adults which breed each year	Percentage of impacts apportioned to colony (corrected for proportion of breeding adults)
Grassholm	Yes	72022	2015	154.97	0.624	48.39%	0.568	0.9	24.74%
Ailsa Craig	Yes	66452	2014	264.20	0.655	14.63%			7.48%
Lambay	No	1852	2015	52.80	0.465	14.38%			7.35%
Great Saltee Island	Yes	9444	2014	135.71	0.663	7.78%			3.98%
Ireland's Eye Spa	No	700	2015	45.04	0.471	7.37%			3.77%
Little Skellig	Yes	70588	2014	449.13	0.860	4.09%			2.09%
Scar Rocks	No	4750	2014	215.79	0.429	2.39%			1.22%
Bull Rock	Yes	12776	2014	427.43	0.857	0.82%			0.42%
Middle Mouse	No	42	2022	106.33	0.351	0.11%			0.06%
Garvan Isles	No	60	2016	219.63	0.420	0.03%			0.02%

4 References

15. Berwick Bank Wind Farm Offshore Environmental Impact Assessment. Appendix 11.6: Ornithology population viability analyses technical report (2022). Compiled by DMPS Stats Ltd. and HiDef Aerial Surveying Ltd.

16. Burnell, D., Perkins, A. J., Newton, S. F., Bolton, M., Tierney, D. & Dunn, T. E. (2023). Seabirds Count. A census of breeding seabirds in Britain and Ireland (2015 – 2021). Lynx Nature Books.

17. Codling Wind Park Environmental Impact Assessment Report - Appendix 10.5: Baseline Characterisation Report.

18. NatureScot (2018). Interim Guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs. Available at https://www.nature.scot/doc/interim-guidance-apportioning-impacts-marine-renewable-developments-breeding-seabird-populations [Accessed April 2024]

19. NatureScot (2023). Guidance to support Offshore Wind Applications: Marine Ornithology. Available at https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/renewable-energy/marine-renewables/advice-marine-renewables-development [Accessed April 2024].

20. Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects. GoBe (APEM Group). Revision 1.0. December 2022. ©GoBe Consultants Limited.

21. Woodward, I., Thaxter, C. B., Owen, E., & Cook, A. S. C. P. (2019). Desk-based revision of seabird foraging ranges used for HRA screening. BTO research report, (724).

Natura Impact Statement

Volume 7

Appendix 4 - Population Viability Analysis

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APPENDIX 4 – POPULATION VIABILITY ANALYSIS

1 Introduction

1. This Appendix provides input parameters used in order to undertake density independent and density dependent Population Viability Analysis (PVA) to inform assessments of Adverse Effect on Site Integrity (AESI) for selected ornithological SCIs of Special Protection Areas (SPAs) as part of the Natural Impact Statement In-combination Assessment (**NIS, Volume 6 Part 2**).

2 PVA Inputs

2. PVAs were undertaken using the online version of the Natural England and JNCC Seabird PVA tool (http: / / ec2-34-243-66-127.eu-west-1.compute.amazonaws.com / shiny / seabirds / PVATool_Nov2022 / R /).

3. For each PVA, parameter logs were generated in order to provide a full account of information relating to all model parameters. Parameter logs are provided per designated site in **Sections 2.1** to **2.5**, below.

2.1 PVAs for SCIs of Wicklow Head SPA

2.1.1 Kittiwake – In-combination collision impact mortality scenarios: Density Independent

Set up

4. The log file was created on: 2024-03-13 09:33:47 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package         Version
## popbio         "popbio"        "2.4.4"
## shiny          "shiny"         "1.1.0"
## shinyjs        "shinyjs"       "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"  "0.4.5"
## DT             "DT"            "0.5"
## plotly         "plotly"        "4.8.0"
## rmarkdown      "rmarkdown"     "1.10"
## dplyr          "dplyr"         "0.7.6"
## tidyr          "tidyr"         "0.8.1"
```

Basic information

5. This run had reference name “”.

6. PVA model run type: simplescenarios.

7. Model to use for environmental stochasticity: betagamma.

8. Model for density dependence: nodd.
9. Include demographic stochasticity in model?: Yes.
10. Number of simulations: 5000.
11. Random seed: 2744.
12. Years for burn-in: 0.
13. Case study selected: None.

Baseline demographic rates

14. Species chosen to set initial values: Black-Legged Kittiwake.
15. Region type to use for breeding success data: Global.
16. Available colony-specific survival rate: National.
17. Sector to use within breeding success region: Global.
18. Age at first breeding: 4.
19. Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.
20. Number of subpopulations: 1. Are demographic rates applied separately to each subpopulation?: No.
21. Units for initial population size: breeding.adults
22. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

23. **Initial population values**: Initial population 1290 in 2023
24. **Productivity rate per pair**: mean: 0.6036278 , sd: 0.325783
25. **Adult survival rate: mean**: 0.854 , sd: 0.077
26. **Immatures survival rates**:
27. Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA
28. Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA
29. Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA
30. Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

Impacts

31. Number of impact scenarios: 8.
32. Are impacts applied separately to each subpopulation?: No
33. Are impacts of scenarios specified separately for immatures?: No
34. Are standard errors of impacts available?: No
35. Should random seeds be matched for impact scenarios?: No

36. Are impacts specified as a relative value or absolute harvest?: relative
37. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

38. **Impact on productivity rate mean**: 0 , se: NA
39. **Impact on adult survival rate mean**: 0.00044 , se: NA

Scenario B - Name: A T1

All subpopulations

40. **Impact on productivity rate mean**: 0 , se: NA
41. **Impact on adult survival rate mean**: 0.00079 , se: NA

Scenario C - Name: A T2a

All subpopulations

42. **Impact on productivity rate mean**: 0 , se: NA
43. **Impact on adult survival rate mean**: 0.00112 , se: NA

Scenario D - Name: A T2b

All subpopulations

44. **Impact on productivity rate mean**: 0 , se: NA
45. **Impact on adult survival rate mean**: 0.0047 , se: NA

Scenario E - Name: B PO

All subpopulations

46. **Impact on productivity rate mean**: 0 , se: NA
47. **Impact on adult survival rate mean**: 0.00039 , se: NA

Scenario F - Name: B T1

All subpopulations

48. **Impact on productivity rate mean**: 0 , se: NA
49. **Impact on adult survival rate mean**: 0.00074 , se: NA

Scenario G - Name: B T2a

All subpopulations

50. **Impact on productivity rate mean**: 0 , se: NA
51. **Impact on adult survival rate mean**: 0.00107 , se: NA

Scenario H - Name: B T2b

All subpopulations

52. **Impact on productivity rate mean**: 0 , se: NA
53. **Impact on adult survival rate mean**: 0.00464 , se: NA

Output:

54. First year to include in outputs: 2023
55. Final year to include in outputs: 2053
56. How should outputs be produced, in terms of ages?: breeding.pairs
57. Target population size to use in calculating impact metrics: NA
58. Quasi-extinction threshold to use in calculating impact metrics: NA

2.1.2 Kittiwake – In-combination collision impact mortality scenarios: Density Dependent

Basic run parameters

59. With the exception of the specification of density-dependence, the PVA model was parameterised to match the parameters used for the density-independent modelling carried out for in-combination effects on kittiwake at Wicklow Head. The basic run parameters that were used are summarised in **Table 1**.

Table 1 Basic run parameters used for density-dependent PVA modelling

Environmental stochasticity	Demographic stochasticity	Density dependence	Number of simulations	Starting seed	Years for burn-in
Beta/gamma	Yes	Weibull - manually edited in the underlying code	5000	2744	0

Demographic parameters

60. Survival rates used for the kittiwake PVA modelling are presented in **Table 2**. These parameters were set to the default values available within the tool based on national survival data, with a standard error of 0.077 applied to the first age class to allow variation around this parameter within the modelling. Density dependence was assumed to act only upon reproductive rate so survival rates were modelled based on a fixed mean and standard deviation.

Table 2 Adult and immature survival rates used in the density-dependent PVA modelling

Adult survival rate	Immature survival rate (age in years)			
	0-1	1-2	2-3	3-4
0.854 (0.077)	0.790 (0.077)	0.854 (0.077)	0.854 (0.077)	0.854 (0.077)

Source: Default values from the NEPVA tool with based on UK National survival rate data

61. Parameters relating to reproduction that were used for the kittiwake PVA modelling are presented in **Table 3**. These parameters were also set to the default values available within the tool based on global breeding success data. Density dependence was assumed to act upon reproductive rate so the mean value was only used to derive the input parameters for the density dependence function.

Table 3 Reproductive parameters used

Reproductive rate		Maximum brood size	Age at first breeding
Mean*	Standard Deviation		
0.604	0.325783	2	4

**Used only to calculate the value of the scale parameter in the Weibull distribution determining density dependence (See Population size data, below); Source: Default values from the NEPVA tool with based on Global breeding success data*

Population size data

62. The population count used in the modelling is presented in **Table 4.** This represents the latest count of kittiwake at Wicklow Head taken from data provided by Arklow Phase 2 OWF project

Table 4 The population size assumed

Colony name	Initial population size (breeding adults)	Year of population count
Wicklow Head	1290	2023

Source: Arklow Phase 2

Density Dependence

63. Density-dependence was incorporated as a modifier of reproductive rate with reproductive rate in a given year of a simulation being inversely related to population size. The formulation used to model density-dependence was based on a Weibull distribution as follows:

$$D \ = maxD * \exp\left(-a * \ N^{b}\right)$$

64. Where *D* is the parameter upon which density-dependence is acting (in this case reproductive rate), *MaxD* is the maximum population average value for this parameter in a given year, which determines the variation in population size observed within the simulations, *a* is a scale parameter for the Weibull distribution (dependent on *b*), *N* is the population size and *b* is the shape parameter for the distribution, which determines the strength of the density-dependence (Cook and Robinson, 2016).

65. It was assumed that the population is currently at carrying capacity and therefore representative of the expected average population size across scenarios that do not incorporate an impact. Several plausible values for *MaxD* and *b* were trialled to investigate the way in which density-dependence may modulate the effect of predicted wind farm impacts on predictions of the population consequences for kittiwake at Wicklow Head. These ranged from 0.7 to 1.5 for the maximum value of the reproductive rate in a given year (*MaxD*) and from 0.25 to 2 for the strength of the density dependence (*b*). Specific values trialled are reported in the results tables in Section 2.2. The value of *a* was calculated by setting the reproductive rate to the density-independent value (see **Table 3**) and rearranging the equation to make *a* the subject.

Impact parameters

66. The same apportioned impacts were used as those in the density-independent modelling. Two scenarios, A and B, were modelled to assess the effect of project-only impacts as well as that of Tier 1, Tier 2a and Tier 2b in-combination impacts (see definitions in IFS doc number 1298266). Impacts were incorporated as relative values to the adult survival rate and are summarised in **Table 5**.

67. As with the density independent model runs, the impacts were simulated to begin in 2028 and end in 2053.

Table 5 Relative proportion by which adult survival is decreased as a result of predicted impacts of the windfarm

Scenario	PO	Tier 1	Tier 2a	Tier 2b
Scenario A	0.00044	0.00079	0.00113	0.00470
Scenario B	0.00039	0.00074	0.00107	0.00464

Metrics assessed

68. Density-dependent functions used in the PVA modelling were plotted to allow inspection of the relationship between population size and reproductive rate.

69. Density-independent model outputs were assessed using counterfactual growth rate (the ratio of the impacted population growth rate to the baseline population growth rate) and counterfactual population sizes (the ratio of the impacted population size to the baseline population size). These metrics, particularly the former, are generally used in this context as they are relatively insensitive to misspecification of input parameters (Cook and Robinson, 2016).

70. For each run, the counterfactual population size and the counterfactual growth rate based on comparing the first and last year of modelling (2023 and 2053 respectively) were calculated for the baseline and for the impact scenarios. This is presented alongside the results of the density-independent modelling for comparison.

Results

71. The density dependent curves used to represent different density-dependent scenarios for the Wicklow Head kittiwake PVAs are presented in **Plate** 1.

72. A summary of the counterfactual population sizes and growth rates for the most precautionary (weakest) density dependent scenario trialled is presented in **Table 6**. Outputs of other model runs are presented in **Table 7**– **Table 10**. Example plots of the population trajectories for the worst-case (scenario A, weakest density dependence) and best-case (Scenario B, strongest density-dependence) model runs are presented in **Plate 2** and **Plate 3**.

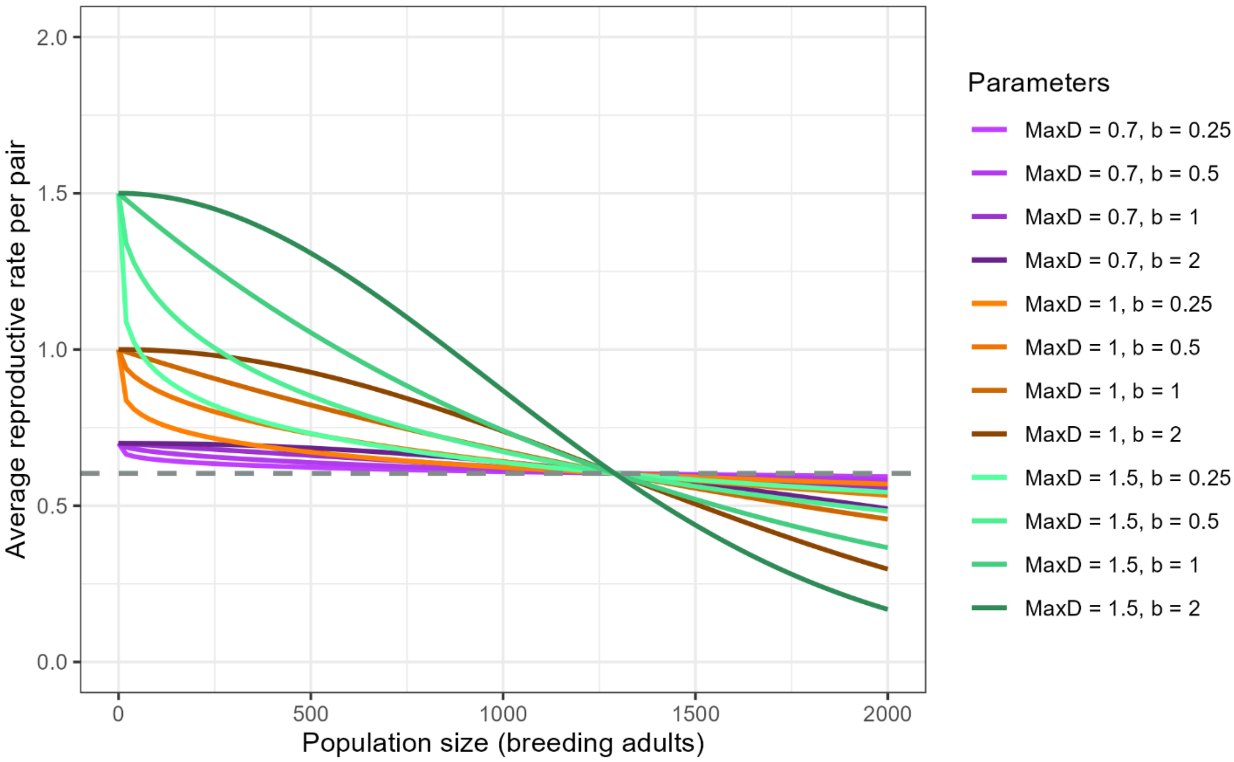

Plate 1 Effect of density dependence on reproductive rate - reproductive rate at different population sizes. The grey dashed line indicates the reproductive rate used in the density independent modelling

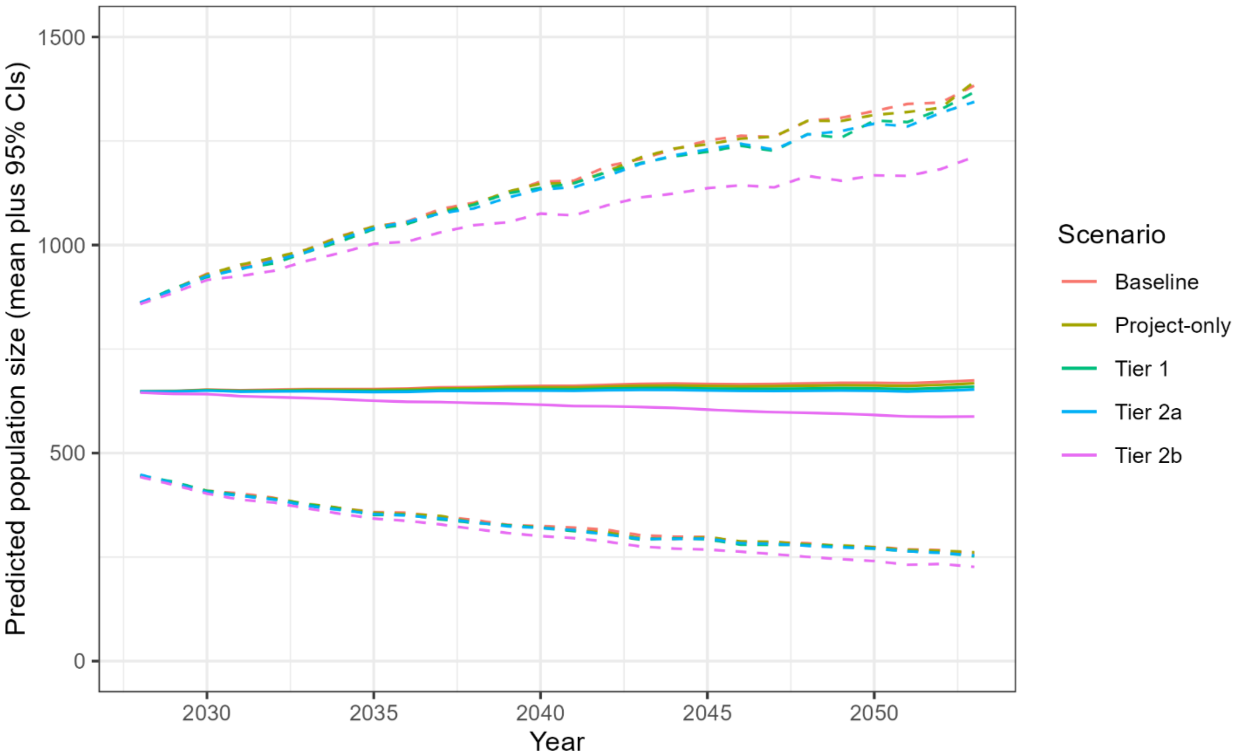

Plate 2 Predicted population trajectories for the worst case density dependent scenario (Scenario A, weakest density dependence). Solid lines represent mean population projections whilst dashed lines indicate 95% confidence intervals.

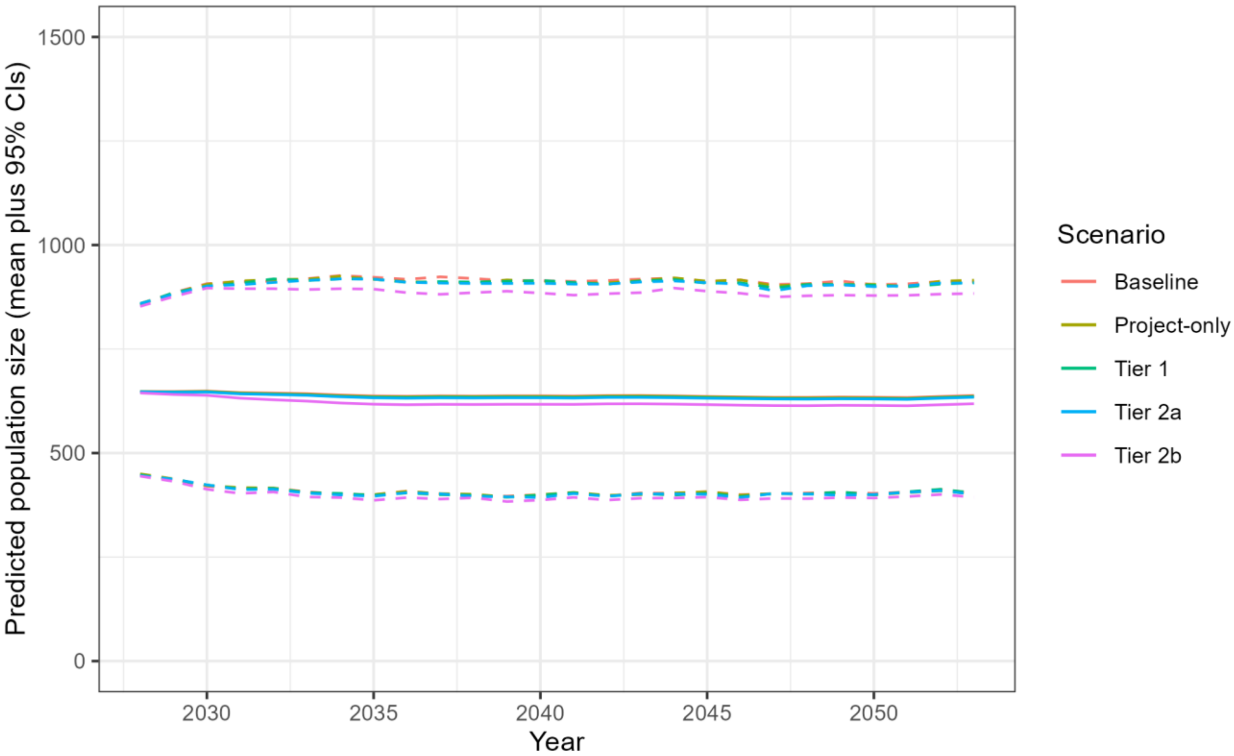

Plate 3 Predicted population trajectories for the best case density dependent scenario (Scenario B, strongest density dependence). Solid lines represent mean population projections whilst dashed lines indicate 95% confidence intervals.

Table 6 Summary of counterfactual population sizes (CPS) counterfactual growth rates (CGR) for models incorporating the weakest level of density dependence trialled

Scenario	Project Only		Tier 1		Tier 2a		Tier 2b	
	CPS	CGR	CPS	CGR	CPS	CGR	CPS	CGR
Scenario A	0.98940	0.99964	0.97767	0.99925	0.96743	0.99890	0.87106	0.99541
Scenario B	0.99076	0.99969	0.98102	0.99936	0.96974	0.99898	0.87416	0.99553

Table 7 Counterfactual population sizes for Scenario A for the project-only and the Tier 1, Tier 2a and Tier 2b in-combination model runs calculated from outputs of PVA for a range of density-dependent scenarios. The higher the maximum population growth rate (MaxD), the more the reproductive rate is able to vary in response to changing population sizes thus the higher MaxD, the quicker density-dependence is able to compensate for additional mortality. Similarly, the higher the shape parameter, b, the stronger the density dependence therefore the lower the impact of the additional mortality will be.

MaxD (Maximum average reproductive rate)	Shape parameter, b (strength of density dependence)	Scale parameter, a*	Final predicted population size					Counterfactual population size			
			Baseline	PO	Tier 1	Tier 2a	Tier 2b	PO	Tier 1	Tier 2a	Tier 2b
0.7	0.25	0.02471575	674.711	667.556	659.642	652.738	587.715	0.989	0.978	0.967	0.871
0.7	0.5	0.00412407	670.299	661.855	655.782	648.192	586.970	0.987	0.978	0.967	0.876
0.7	1	0.00011482	658.722	651.521	644.002	639.083	581.882	0.989	0.978	0.970	0.883
0.7	2	0.00000009	634.715	628.905	623.901	619.050	572.118	0.991	0.983	0.975	0.901
1	0.25	0.08423057	668.301	659.454	653.592	647.680	587.948	0.987	0.978	0.969	0.880
1	0.5	0.01405472	657.266	650.328	644.710	640.006	587.418	0.989	0.981	0.974	0.894
1	1	0.00039132	643.151	638.220	634.003	630.363	589.549	0.992	0.986	0.980	0.917
1	2	0.00000030	630.562	627.251	624.303	622.324	595.694	0.995	0.990	0.987	0.945
1.5	0.25	0.15188653	659.673	652.961	647.699	642.583	588.537	0.990	0.982	0.974	0.892
1.5	0.5	0.02534381	648.952	643.814	639.877	635.645	593.044	0.992	0.986	0.979	0.914
1.5	1	0.00070563	641.306	637.445	634.755	632.072	603.818	0.994	0.990	0.986	0.942
1.5	2	0.00000055	638.340	636.570	634.951	633.208	617.903	0.997	0.995	0.992	0.968

**Calculated by setting the reproductive rate to the density-independent mean value and solving for a*

Table 8 Counterfactual population growth rates for Scenario A for the project-only and the Tier 1, Tier 2a and Tier 2b in-combination model runs calculated from outputs of PVA for a range of density-dependent scenarios. The higher the maximum population growth rate (MaxD), the more the reproductive rate is able to vary in response to changing population sizes thus the higher MaxD, the quicker density-dependence is able to compensate for additional mortality. Similarly, the higher the shape parameter, b, the stronger the density dependence therefore the lower the impact of the additional mortality will be.

MaxD (Maximum average reproductive rate)	Shape parameter, b (strength of density dependence)	Scale parameter, a*	Population growth rate (2023 – 2053)					Counterfactual population growth rate			
			Baseline	PO	Tier 1	Tier 2a	Tier 2b	PO	Tier 1	Tier 2a	Tier 2b
0.7	0.25	0.02471575	1.0015	1.0011	1.0007	1.0004	0.9969	1.000	0.999	0.999	0.995
0.7	0.5	0.00412407	1.0013	1.0009	1.0006	1.0002	0.9969	1.000	0.999	0.999	0.996
0.7	1	0.00011482	1.0007	1.0003	0.9999	0.9997	0.9966	1.000	0.999	0.999	0.996
0.7	2	0.00000009	0.9995	0.9992	0.9989	0.9986	0.9960	1.000	0.999	0.999	0.997
1	0.25	0.08423057	1.0012	1.0007	1.0004	1.0001	0.9969	1.000	0.999	0.999	0.996
1	0.5	0.01405472	1.0006	1.0003	1.0000	0.9997	0.9969	1.000	0.999	0.999	0.996
1	1	0.00039132	0.9999	0.9996	0.9994	0.9992	0.9970	1.000	1.000	0.999	0.997
1	2	0.00000030	0.9992	0.9991	0.9989	0.9988	0.9974	1.000	1.000	1.000	0.998
1.5	0.25	0.15188653	1.0008	1.0004	1.0001	0.9999	0.9970	1.000	0.999	0.999	0.996
1.5	0.5	0.02534381	1.0002	0.9999	0.9997	0.9995	0.9972	1.000	1.000	0.999	0.997
1.5	1	0.00070563	0.9998	0.9996	0.9995	0.9993	0.9978	1.000	1.000	1.000	0.998
1.5	2	0.00000055	0.9997	0.9996	0.9995	0.9994	0.9986	1.000	1.000	1.000	0.999

**Calculated by setting the reproductive rate to the density-independent mean value and solving for a*

Table 9 Counterfactual population sizes for Scenario B for the project-only and the Tier 1, Tier 2a and Tier 2b in-combination model runs calculated from outputs of PVA for a range of density-dependent scenarios. The higher the maximum population growth rate (MaxD), the more the reproductive rate is able to vary in response to changing population sizes thus the higher MaxD, the quicker density-dependence is able to compensate for additional mortality. Similarly, the higher the shape parameter, b, the stronger the density dependence therefore the lower the impact of the additional mortality will be.

MaxD (Maximum average reproductive rate)	Shape parameter, b (strength of density dependence)	Scale parameter, a*	Final predicted population size					Counterfactual population size			
			Baseline	PO	Tier 1	Tier 2a	Tier 2b	PO	Tier 1	Tier 2a	Tier 2b
0.7	0.25	0.02471575	674.71	668.48	661.90	654.29	589.80	0.9908	0.9810	0.9697	0.8742
0.7	0.5	0.00412407	670.30	662.64	656.17	650.42	587.67	0.9886	0.9789	0.9704	0.8767
0.7	1	0.00011482	658.72	651.80	646.47	640.85	583.61	0.9895	0.9814	0.9729	0.8860
0.7	2	0.00000009	634.72	629.24	624.23	619.91	572.83	0.9914	0.9835	0.9767	0.9025
1	0.25	0.08423057	668.30	660.74	654.21	648.24	588.15	0.9887	0.9789	0.9700	0.8801
1	0.5	0.01405472	657.27	650.99	646.34	641.16	588.69	0.9905	0.9834	0.9755	0.8957
1	1	0.00039132	643.15	638.17	634.26	630.38	590.60	0.9923	0.9862	0.9801	0.9183
1	2	0.00000030	630.56	626.59	624.94	622.14	596.33	0.9937	0.9911	0.9866	0.9457
1.5	0.25	0.15188653	659.67	653.47	647.72	643.64	589.71	0.9906	0.9819	0.9757	0.8939
1.5	0.5	0.02534381	648.95	643.87	639.99	636.53	593.64	0.9922	0.9862	0.9809	0.9148
1.5	1	0.00070563	641.31	638.02	635.14	632.89	604.91	0.9949	0.9904	0.9869	0.9432
1.5	2	0.00000055	638.34	636.47	635.55	634.15	618.49	0.9971	0.9956	0.9934	0.9689

**Calculated by setting the reproductive rate to the density-independent mean value and solving for a*

Table 10 Counterfactual population growth rates for Scenario B for the project-only and the Tier 1, Tier 2a and Tier 2b in-combination model runs calculated from outputs of PVA for a range of density-dependent scenarios. The higher the maximum population growth rate (MaxD), the more the reproductive rate is able to vary in response to changing population sizes thus the higher MaxD, the quicker density-dependence is able to compensate for additional mortality. Similarly, the higher the shape parameter, b, the stronger the density dependence therefore the lower the impact of the additional mortality will be.

MaxD (Maximum average reproductive rate)	Shape parameter, b (strength of density dependence)	Scale parameter, a*	Population growth rate (2023 – 2053)					Counterfactual population size			
			Baseline	PO	Tier 1	Tier 2a	Tier 2b	PO	Tier 1	Tier 2a	Tier 2b
0.7	0.25	0.02471575	1.0015	1.0012	1.0009	1.0005	0.9970	0.9997	0.9994	0.9990	0.9955
0.7	0.5	0.00412407	1.0013	1.0009	1.0006	1.0003	0.9969	0.9996	0.9993	0.9990	0.9956
0.7	1	0.00011482	1.0007	1.0003	1.0001	0.9998	0.9967	0.9996	0.9994	0.9991	0.9960
0.7	2	0.00000009	0.9995	0.9992	0.9989	0.9987	0.9961	0.9997	0.9994	0.9992	0.9966
1	0.25	0.08423057	1.0012	1.0008	1.0005	1.0002	0.9969	0.9996	0.9993	0.9990	0.9958
1	0.5	0.01405472	1.0006	1.0003	1.0001	0.9998	0.9970	0.9997	0.9994	0.9992	0.9963
1	1	0.00039132	0.9999	0.9996	0.9994	0.9992	0.9971	0.9997	0.9995	0.9993	0.9972
1	2	0.00000030	0.9992	0.9990	0.9989	0.9988	0.9974	0.9998	0.9997	0.9996	0.9981
1.5	0.25	0.15188653	1.0008	1.0004	1.0001	0.9999	0.9970	0.9997	0.9994	0.9992	0.9963
1.5	0.5	0.02534381	1.0002	0.9999	0.9997	0.9996	0.9972	0.9997	0.9995	0.9994	0.9970
1.5	1	0.00070563	0.9998	0.9996	0.9995	0.9994	0.9979	0.9998	0.9997	0.9996	0.9981
1.5	2	0.00000055	0.9997	0.9996	0.9995	0.9994	0.9986	0.9999	0.9999	0.9998	0.9989

**Calculated by setting the reproductive rate to the density-independent mean value and solving for a*

2.2 PVAs for SCIs of Howth Head Coast SPA

2.2.1 Kittiwake – In-combination collision impact mortality scenarios: Density Independent

Set up

73. The log file was created on: 2024-03-13 10:18:34 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

74. This run had reference name "".

75. PVA model run type: simplescenarios.

76. Model to use for environmental stochasticity: betagamma.

77. Model for density dependence: nodd.

78. Include demographic stochasticity in model?: Yes.

79. Number of simulations: 5000.

80. Random seed: 2744.

81. Years for burn-in: 0.

82. Case study selected: None.

Baseline demographic rates

83. Species chosen to set initial values: Black-Legged Kittiwake.

84. Region type to use for breeding success data: Global.

85. Available colony-specific survival rate: National.

86. Sector to use within breeding success region: Global.

87. Age at first breeding: 4.

88. Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.

89. Number of subpopulations: 1.

90. Are demographic rates applied separately to each subpopulation?: No.

91. Units for initial population size: breeding.adults

92. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

93. **Initial population values**: Initial population 3546 in 2018

94. **Productivity rate per pair**: mean: 0.6036278 , sd: 0.325783

95. **Adult survival rate**: mean: 0.854 , sd: 0.077

96. **Immatures survival rates**:

97. Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA

98. Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA

99. Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA

100. Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

Impacts

101. Number of impact scenarios: 8.

102. Are impacts applied separately to each subpopulation?: No

103. Are impacts of scenarios specified separately for immatures?: No

104. Are standard errors of impacts available?: No

105. Should random seeds be matched for impact scenarios?: No

106. Are impacts specified as a relative value or absolute harvest?: relative

107. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

108. **Impact on productivity rate mean**: 0 , se: NA

109. **Impact on adult survival rate mean**: 1e-04 , se: NA

Scenario B - Name: A T1

All subpopulations

110. **Impact on productivity rate mean**: 0 , se: NA

111. **Impact on adult survival rate mean**: 0.00081 , se: NA

Scenario C - Name: A T2a

All subpopulations

112. **Impact on productivity rate mean**: 0 , se: NA
113. **Impact on adult survival rate mean**: 0.00177 , se: NA

Scenario D - Name: A T2b

All subpopulations

114. **Impact on productivity rate mean**: 0 , se: NA
115. **Impact on adult survival rate mean**: 0.00241 , se: NA

Scenario E - Name: B PO

All subpopulations

116. **Impact on productivity rate mean**: 0 , se: NA
117. **Impact on adult survival rate mean**: 9e-05 , se: NA

Scenario F - Name: B T1

All subpopulations

118. **Impact on productivity rate mean**: 0 , se: NA
119. **Impact on adult survival rate mean**: 8e-04 , se: NA

Scenario G - Name: B T2a

All subpopulations

120. **Impact on productivity rate mean**: 0 , se: NA
121. **Impact on adult survival rate mean**: 0.00175 , se: NA

Scenario H - Name: B T2b

All subpopulations

122. **Impact on productivity rate mean**: 0 , se: NA
123. **Impact on adult survival rate mean**: 0.0024 , se: NA
124. Output:
125. First year to include in outputs: 2018
126. Final year to include in outputs: 2053
127. How should outputs be produced, in terms of ages?: breeding.pairs
128. Target population size to use in calculating impact metrics: NA
129. Quasi-extinction threshold to use in calculating impact metrics: NA

2.3 PVAs for SCIs of Ireland's Eye SPA

2.3.1 Guillemot – In-combination displacement impact mortality scenarios (Construction and Operation & maintenance): Density Independent

Set up

130. The log file was created on: 2024-03-13 16:25:17 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                 Package          Version
## popbio          "popbio"         "2.4.4"
## shiny           "shiny"          "1.1.0"
## shinyjs         "shinyjs"        "1.0"
## shinydashboard  "shinydashboard" "0.7.1"
## shinyWidgets    "shinyWidgets"   "0.4.5"
## DT              "DT"             "0.5"
## plotly          "plotly"         "4.8.0"
## rmarkdown       "rmarkdown"      "1.10"
## dplyr           "dplyr"          "0.7.6"
## tidyr           "tidyr"          "0.8.1"
```

Basic information

131. This run had reference name "".
132. PVA model run type: simplescenarios.
133. Model to use for environmental stochasticity: betagamma.
134. Model for density dependence: nodd.
135. Include demographic stochasticity in model?: Yes.
136. Number of simulations: 5000.
137. Random seed: 2744.
138. Years for burn-in: 0.
139. Case study selected: None.

Baseline demographic rates

140. Species chosen to set initial values: Common Guillemot.
141. Region type to use for breeding success data: Global.
142. Available colony-specific survival rate: National.
143. Sector to use within breeding success region: Global.
144. Age at first breeding: 6.

145. Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

146. Number of subpopulations: 1.

147. Are demographic rates applied separately to each subpopulation?: No.

148. Units for initial population size: breeding.adults

149. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

150. **Initial population values**: Initial population 4410 in 2015

151. **Productivity rate per pair**: mean: 0.5826832 , sd: 0.1894517

152. **Adult survival rate: mean**: 0.94 , sd: 0.025

153. **Immatures survival rates**:

154. Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

155. Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

156. Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

157. Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

158. Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

159. Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

Impacts

160. Number of impact scenarios: 8.

161. Are impacts applied separately to each subpopulation?: No

162. Are impacts of scenarios specified separately for immatures?: No

163. Are standard errors of impacts available?: No

164. Should random seeds be matched for impact scenarios?: No

165. Are impacts specified as a relative value or absolute harvest?: relative

166. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: Con PO

All subpopulations

167. **Impact on productivity rate mean**: 0 , se: NA

168. **Impact on adult survival rate mean**: 1e-04 , se: NA

Scenario B - Name: Con T1

All subpopulations

169. **Impact on productivity rate mean**: 0 , se: NA
170. **Impact on adult survival rate mean**: 0.00024 , se: NA

Scenario C - Name: Con T2a

All subpopulations

171. **Impact on productivity rate mean**: 0 , se: NA
172. **Impact on adult survival rate mean**: 0.00097 , se: NA

Scenario D - Name: Con T2b

All subpopulations

173. **Impact on productivity rate mean**: 0 , se: NA
174. **Impact on adult survival rate mean**: 0.00109 , se: NA

Scenario E - Name: OM PO

All subpopulations

175. **Impact on productivity rate mean**: 0 , se: NA
176. **Impact on adult survival rate mean**: 2e-04 , se: NA

Scenario F - Name: OM T1

All subpopulations

177. **Impact on productivity rate mean**: 0 , se: NA
178. **Impact on adult survival rate mean**: 0.00034 , se: NA

Scenario G - Name: OM T2a

All subpopulations

179. **Impact on productivity rate mean**: 0 , se: NA
180. **Impact on adult survival rate mean**: 0.00181 , se: NA

Scenario H - Name: OM T2b

All subpopulations

181. **Impact on productivity rate mean**: 0 , se: NA
182. **Impact on adult survival rate mean**: 0.00205 , se: NA

Output:

183. First year to include in outputs: 2015

184. Final year to include in outputs: 2053

185. How should outputs be produced, in terms of ages?: breeding.pairs

186. Target population size to use in calculating impact metrics: NA

187. Quasi-extinction threshold to use in calculating impact metrics: NA

2.3.2 Kittiwake – In-combination collision impact mortality scenarios: Density Independent

Set up

188. The log file was created on: 2024-03-13 10:35:40 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

189. This run had reference name “”.

190. PVA model run type: simplescenarios.

191. Model to use for environmental stochasticity: betagamma.

192. Model for density dependence: nodd. Include demographic stochasticity in model?: Yes.

193. Number of simulations: 5000.

194. Random seed: 2744.

195. Years for burn-in: 0.

196. Case study selected: None.

Baseline demographic rates

197. Species chosen to set initial values: Black-Legged Kittiwake.

198. Region type to use for breeding success data: Global.

199. Available colony-specific survival rate: National.

200. Sector to use within breeding success region: Global.

201. Age at first breeding: 4.

202. Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.

203. Number of subpopulations: 1.

204. Are demographic rates applied separately to each subpopulation?: No.

205. Units for initial population size: breeding.adults

206. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

207. **Initial population values**: Initial population 802 in 2016

208. **Productivity rate per pair**: mean: 0.6036278 , sd: 0.325783

209. **Adult survival rate**: mean: 0.854 , sd: 0.077

210. **Immatures survival rates**:

211. Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA

212. Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA

213. Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA

214. Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

Impacts

215. Number of impact scenarios: 8.

216. Are impacts applied separately to each subpopulation?: No

217. Are impacts of scenarios specified separately for immatures?: No

218. Are standard errors of impacts available?: No

219. Should random seeds be matched for impact scenarios?: No

220. Are impacts specified as a relative value or absolute harvest?: relative

221. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

222. **Impact on productivity rate mean**: 0 , se: NA

223. **Impact on adult survival rate mean**: 1e-04 , se: NA

Scenario B - Name: A T1

All subpopulations

224. **Impact on productivity rate mean**: 0 , se: NA
225. **Impact on adult survival rate mean**: 0.0017 , se: NA

Scenario C - Name: A T2a

All subpopulations

226. **Impact on productivity rate mean**: 0 , se: NA
227. **Impact on adult survival rate mean**: 0.00243 , se: NA

Scenario D - Name: A T2b

All subpopulations

228. **Impact on productivity rate mean**: 0 , se: NA
229. **Impact on adult survival rate mean**: 0.00309 , se: NA

Scenario E - Name: B PO

All subpopulations

230. **Impact on productivity rate mean**: 0 , se: NA
231. **Impact on adult survival rate mean**: 9e-05 , se: NA

Scenario F - Name: B T1

All subpopulations

232. **Impact on productivity rate mean**: 0 , se: NA
233. **Impact on adult survival rate mean**: 0.00168 , se: NA

Scenario G - Name: B T2a

All subpopulations

234. **Impact on productivity rate mean**: 0 , se: NA
235. **Impact on adult survival rate mean**: 0.00242 , se: NA

Scenario H - Name: B T2b

All subpopulations

236. **Impact on productivity rate mean**: 0 , se: NA
237. **Impact on adult survival rate mean**: 0.00308 , se: NA

Output:

238. First year to include in outputs: 2016

239. Final year to include in outputs: 2053

240. How should outputs be produced, in terms of ages?: breeding.pairs

241. Target population size to use in calculating impact metrics: NA

242. Quasi-extinction threshold to use in calculating impact metrics: NA

2.3.3 Herring gull – In-combination collision impact mortality scenarios: Density Independent

Set up

243. The log file was created on: 2024-03-13 14:49:00 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

244. This run had reference name “”.

245. PVA model run type: simplescenarios.

246. Model to use for environmental stochasticity: betagamma.

247. Model for density dependence: nodd.

248. Include demographic stochasticity in model?: Yes.

249. Number of simulations: 5000.

250. Random seed: 2744.

251. Years for burn-in: 0.

252. Case study selected: None.

Baseline demographic rates

253. Species chosen to set initial values: Herring Gull.
254. Region type to use for breeding success data: Global.
255. Available colony-specific survival rate: National.
256. Sector to use within breeding success region: Global.
257. Age at first breeding: 5.
258. Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.
259. Number of subpopulations: 1.
260. Are demographic rates applied separately to each subpopulation?: No.
261. Units for initial population size: breeding.adults
262. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

263. **Initial population values**: Initial population 636 in 2015
264. **Productivity rate per pair**: mean: 0.6146853 , sd: 0.4759263
265. **Adult survival rate**: mean: 0.834 , sd: 0.079
266. **Immatures survival rates**:
267. Age class 0 to 1 - mean: 0.794 , sd: 0.079 , DD: NA
268. Age class 1 to 2 - mean: 0.834 , sd: 0.079 , DD: NA
269. Age class 2 to 3 - mean: 0.834 , sd: 0.079 , DD: NA
270. Age class 3 to 4 - mean: 0.834 , sd: 0.079 , DD: NA
271. Age class 4 to 5 - mean: 0.834 , sd: 0.079 , DD: NA

Impacts

272. Number of impact scenarios: 8.
273. Are impacts applied separately to each subpopulation?: No
274. Are impacts of scenarios specified separately for immatures?: No
275. Are standard errors of impacts available?: No
276. Should random seeds be matched for impact scenarios?: No
277. Are impacts specified as a relative value or absolute harvest?: relative
278. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

279. **Impact on productivity rate mean**: 0 , se: NA
280. **Impact on adult survival rate mean**: 0.00128 , se: NA

Scenario B - Name: A T1

All subpopulations

281. **Impact on productivity rate mean**: 0 , se: NA
282. **Impact on adult survival rate mean**: 0.00128 , se: NA

Scenario C - Name: A T2a

All subpopulations

283. **Impact on productivity rate mean**: 0 , se: NA
284. **Impact on adult survival rate mean**: 0.00345 , se: NA

Scenario D - Name: A T2b

All subpopulations

285. **Impact on productivity rate mean**: 0 , se: NA
286. **Impact on adult survival rate mean**: 0.00447 , se: NA

Scenario E - Name: B PO

All subpopulations

287. **Impact on productivity rate mean**: 0 , se: NA
288. **Impact on adult survival rate mean**: 0.00108 , se: NA

Scenario F - Name: B T1

All subpopulations

289. **Impact on productivity rate mean**: 0 , se: NA
290. **Impact on adult survival rate mean**: 0.00108 , se: NA

Scenario G - Name: B T2a

All subpopulations

291. **Impact on productivity rate mean**: 0 , se: NA

292. **Impact on adult survival rate mean**: 0.00325 , se: NA

Scenario H - Name: B T2b

All subpopulations

293. **Impact on productivity rate mean**: 0 , se: NA

294. **Impact on adult survival rate mean**: 0.00428 , se: NA

Output:

295. First year to include in outputs: 2015

296. Final year to include in outputs: 2053

297. How should outputs be produced, in terms of ages?: breeding.pairs

298. Target population size to use in calculating impact metrics: NA

299. Quasi-extinction threshold to use in calculating impact metrics: NA

2.4 PVAs for SCIs of Lambay Island SPA

2.4.1 Guillemot – In-combination displacement impact mortality scenarios (Construction and Operation & maintenance): Density Independent

Set up

300. The log file was created on: 2024-03-13 17:10:14 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

301. This run had reference name “”.

302. PVA model run type: simplescenarios.

303. Model to use for environmental stochasticity: betagamma.

304. Model for density dependence: nodd.

305. Include demographic stochasticity in model?: Yes.

306. Number of simulations: 5000.

307. Random seed: 2744.

308. Years for burn-in: 0.

309. Case study selected: None.

Baseline demographic rates

310. Species chosen to set initial values: Common Guillemot.

311. Region type to use for breeding success data: Global.

312. Available colony-specific survival rate: National.

313. Sector to use within breeding success region: Global.

314. Age at first breeding: 6.

315. Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

316. Number of subpopulations: 1.

317. Are demographic rates applied separately to each subpopulation?: No.

318. Units for initial population size: breeding.adults

319. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

320. **Initial population values**: Initial population 59983 in 2015

321. **Productivity rate per pair**: mean: 0.5826832 , sd: 0.1894517

322. **Adult survival rate**: mean: 0.94 , sd: 0.025

323. **Immatures survival rates**:

324. Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

325. Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

326. Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

327. Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

328. Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

329. Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

Impacts

330. Number of impact scenarios: 8.

331. Are impacts applied separately to each subpopulation?: No

332. Are impacts of scenarios specified separately for immatures?: No

333. Are standard errors of impacts available?: No

334. Should random seeds be matched for impact scenarios?: No

335. Are impacts specified as a relative value or absolute harvest?: relative

336. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: Con PO

All subpopulations

337. **Impact on productivity rate mean**: 0 , se: NA

338. **Impact on adult survival rate mean**: 8e-05 , se: NA

Scenario B - Name: Con T1

All subpopulations

339. **Impact on productivity rate mean**: 0 , se: NA

340. **Impact on adult survival rate mean**: 0.00029 , se: NA

Scenario C - Name: Con T2a

All subpopulations

341. **Impact on productivity rate mean**: 0 , se: NA

342. **Impact on adult survival rate mean**: 0.00075 , se: NA

Scenario D - Name: Con T2b

All subpopulations

343. **Impact on productivity rate mean**: 0 , se: NA

344. **Impact on adult survival rate mean**: 0.00087 , se: NA

Scenario E - Name: OM PO

All subpopulations

345. **Impact on productivity rate mean**: 0 , se: NA

346. **Impact on adult survival rate mean**: 0.00016 , se: NA

Scenario F - Name: OM T1

All subpopulations

347. **Impact on productivity rate mean**: 0 , se: NA

348. **Impact on adult survival rate mean**: 0.00037 , se: NA

Scenario G - Name: OM T2a

All subpopulations

349. **Impact on productivity rate mean**: 0 , se: NA

350. **Impact on adult survival rate mean**: 0.00128 , se: NA

Scenario H - Name: OM T2b

All subpopulations

351. **Impact on productivity rate mean**: 0 , se: NA

352. **Impact on adult survival rate mean**: 0.00154 , se: NA

Output:

353. First year to include in outputs: 2015

354. Final year to include in outputs: 2053

355. How should outputs be produced, in terms of ages?: breeding.pairs

356. Target population size to use in calculating impact metrics: NA

357. Quasi-extinction threshold to use in calculating impact metrics: N

2.4.2 Kittiwake – In-combination collision impact mortality scenarios: Density Independent

Set up

358. The log file was created on: 2024-03-13 10:59:02 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

359. This run had reference name “”.
360. PVA model run type: simplescenarios.
361. Model to use for environmental stochasticity: betagamma.
362. Model for density dependence: nodd.
363. Include demographic stochasticity in model?: Yes.
364. Number of simulations: 5000.
365. Random seed: 2744.
366. Years for burn-in: 0.
367. Case study selected: None.

Baseline demographic rates

368. Species chosen to set initial values: Black-Legged Kittiwake.
369. Region type to use for breeding success data: Global.
370. Available colony-specific survival rate: National.
371. Sector to use within breeding success region: Global.
372. Age at first breeding: 4.
373. Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.
374. Number of subpopulations: 1.
375. Are demographic rates applied separately to each subpopulation?: No.
376. Units for initial population size: breeding.adults
377. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

378. **Initial population values**: Initial population 6640 in 2015
379. **Productivity rate per pair**: mean: 0.6036278 , sd: 0.325783
380. **Adult survival rate**: mean: 0.854 , sd: 0.077
381. **Immatures survival rates**:
382. Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA
383. Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA
384. Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA
385. Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

Impacts

386. Number of impact scenarios: 8.
387. Are impacts applied separately to each subpopulation?: No
388. Are impacts of scenarios specified separately for immatures?: No
389. Are standard errors of impacts available?: No
390. Should random seeds be matched for impact scenarios?: No
391. Are impacts specified as a relative value or absolute harvest?: relative
392. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

393. **Impact on productivity rate mean**: 0 , se: NA
394. **Impact on adult survival rate mean**: 8e-05 , se: NA

Scenario B - Name: A T1

All subpopulations

395. **Impact on productivity rate mean**: 0 , se: NA
396. **Impact on adult survival rate mean**: 0.00054 , se: NA

Scenario C - Name: A T2a

All subpopulations

397. **Impact on productivity rate mean**: 0 , se: NA
398. **Impact on adult survival rate mean**: 0.00112 , se: NA

Scenario D - Name: A T2b

All subpopulations

399. **Impact on productivity rate mean**: 0 , se: NA
400. **Impact on adult survival rate mean**: 0.00176 , se: NA

Scenario E - Name: B PO

All subpopulations

401. **Impact on productivity rate mean**: 0 , se: NA
402. **Impact on adult survival rate mean**: 7e-05 , se: NA

Scenario F - Name: B T1

All subpopulations

403. **Impact on productivity rate mean**: 0 , se: NA
404. **Impact on adult survival rate mean**: 0.00053 , se: NA

Scenario G - Name: B T2a

All subpopulations

405. **Impact on productivity rate mean**: 0 , se: NA
406. **Impact on adult survival rate mean**: 0.00111 , se: NA

Scenario H - Name: B T2b

All subpopulations

407. **Impact on productivity rate mean**: 0 , se: NA
408. **Impact on adult survival rate mean**: 0.00175 , se: NA

Output:

409. First year to include in outputs: 2015
410. Final year to include in outputs: 2053
411. How should outputs be produced, in terms of ages?: breeding.pairs
412. Target population size to use in calculating impact metrics: NA
413. Quasi-extinction threshold to use in calculating impact metrics: NA

2.4.3 Herring gull – In-combination collision impact mortality scenarios: Density Independent

Set up

414. The log file was created on: 2024-03-13 15:46:37 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                  Package          Version
## popbio           "popbio"         "2.4.4"
## shiny            "shiny"          "1.1.0"
## shinyjs          "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets     "shinyWidgets"   "0.4.5"
## DT               "DT"             "0.5"
## plotly           "plotly"         "4.8.0"
## rmarkdown        "rmarkdown"      "1.10"
## dplyr            "dplyr"          "0.7.6"
## tidyr            "tidyr"          "0.8.1"
```

Basic information

415. This run had reference name "".

416. PVA model run type: simplescenarios.

417. Model to use for environmental stochasticity: betagamma.

418. Model for density dependence: nodd.

419. Include demographic stochasticity in model?: Yes.

420. Number of simulations: 5000.

421. Random seed: 2744.

422. Years for burn-in: 0.

423. Case study selected: None.

Baseline demographic rates

424. Species chosen to set initial values: Herring Gull.

425. Region type to use for breeding success data: Global.

426. Available colony-specific survival rate: National.

427. Sector to use within breeding success region: Global.

428. Age at first breeding: 5.

429. Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.

430. Number of subpopulations: 1.

431. Are demographic rates applied separately to each subpopulation?: No.

432. Units for initial population size: breeding.adults

433. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

434. **Initial population values**: Initial population 1812 in 2015

435. **Productivity rate per pair**: mean: 0.6146853 , sd: 0.4759263

436. **Adult survival rate**: mean: 0.834 , sd: 0.079

437. **Immatures survival rates**:

438. Age class 0 to 1 - mean: 0.794 , sd: 0.079 , DD: NA

439. Age class 1 to 2 - mean: 0.834 , sd: 0.079 , DD: NA

440. Age class 2 to 3 - mean: 0.834 , sd: 0.079 , DD: NA

441. Age class 3 to 4 - mean: 0.834 , sd: 0.079 , DD: NA

442. Age class 4 to 5 - mean: 0.834 , sd: 0.079 , DD: NA

Impacts

443. Number of impact scenarios: 8.

444. Are impacts applied separately to each subpopulation?: No

445. Are impacts of scenarios specified separately for immatures?: No

446. Are standard errors of impacts available?: No

447. Should random seeds be matched for impact scenarios?: No

448. Are impacts specified as a relative value or absolute harvest?: relative

449. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name: A PO

All subpopulations

450. **Impact on productivity rate mean**: 0 , se: NA

451. **Impact on adult survival rate mean**: 0.00094 , se: NA

Scenario B - Name: A T1

All subpopulations

452. **Impact on productivity rate mean**: 0 , se: NA

453. **Impact on adult survival rate mean**: 0.00094 , se: NA

Scenario C - Name: A T2a

All subpopulations

454. **Impact on productivity rate mean**: 0 , se: NA

455. **Impact on adult survival rate mean**: 0.00254 , se: NA

Scenario D - Name: A T2b

All subpopulations

456. **Impact on productivity rate mean**: 0 , se: NA
457. **Impact on adult survival rate mean**: 0.00384 , se: NA

Scenario E - Name: B PO

All subpopulations

458. **Impact on productivity rate mean**: 0 , se: NA
459. **Impact on adult survival rate mean**: 0.00079 , se: NA

Scenario F - Name: B T1

All subpopulations

460. **Impact on productivity rate mean**: 0 , se: NA
461. **Impact on adult survival rate mean**: 0.00079 , se: NA

Scenario G - Name: B T2a

All subpopulations

462. **Impact on productivity rate mean**: 0 , se: NA
463. **Impact on adult survival rate mean**: 0.00239 , se: NA

Scenario H - Name: B T2b

All subpopulations

464. **Impact on productivity rate mean**: 0 , se: NA
465. **Impact on adult survival rate mean**: 0.0037 , se: NA

Output:

466. First year to include in outputs: 2015
467. Final year to include in outputs: 2053
468. How should outputs be produced, in terms of ages?: breeding.pairs
469. Target population size to use in calculating impact metrics: NA
470. Quasi-extinction threshold to use in calculating impact metrics: NA

2.5 PVAs for SCIs of North-west Irish Sea SPA

2.5.1 Herring gull – In-combination collision impact mortality scenarios: Density Independent

Set up

471. The log file was created on: 2024-03-20 09:47:10 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                 Package          Version
## popbio          "popbio"         "2.4.4"
## shiny           "shiny"          "1.1.0"
## shinyjs         "shinyjs"        "1.0"
## shinydashboard  "shinydashboard" "0.7.1"
## shinyWidgets    "shinyWidgets"   "0.4.5"
## DT              "DT"             "0.5"
## plotly          "plotly"         "4.8.0"
## rmarkdown       "rmarkdown"      "1.10"
## dplyr           "dplyr"          "0.7.6"
## tidyr           "tidyr"          "0.8.1"
```

Basic information

472. This run had reference name “”.

473. PVA model run type: simplescenarios.

474. Model to use for environmental stochasticity: betagamma.

475. Model for density dependence: nodd.

476. Include demographic stochasticity in model?: Yes.

477. Number of simulations: 5000.

478. Random seed: 2744.

479. Years for burn-in: 0.

480. Case study selected: None.

Baseline demographic rates

481. Species chosen to set initial values: Herring Gull.

482. Region type to use for breeding success data: Global.

483. Available colony-specific survival rate: National.

484. Sector to use within breeding success region:

485. Global. Age at first breeding: 5.

486. Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.

487. Number of subpopulations: 1.

488. Are demographic rates applied separately to each subpopulation?: No.

489. Units for initial population size: breeding.adults

490. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

491. **Initial population values**: Initial population 2468 in 2015

492. **Productivity rate per pair**: mean: 0.6146853 , sd: 0.4759263

493. **Adult survival rate**: mean: 0.834 , sd: 0.079

494. **Immatures survival rates**:

495. Age class 0 to 1 - mean: 0.794 , sd: 0.079 , DD: NA

496. Age class 1 to 2 - mean: 0.834 , sd: 0.079 , DD: NA

497. Age class 2 to 3 - mean: 0.834 , sd: 0.079 , DD: NA

498. Age class 3 to 4 - mean: 0.834 , sd: 0.079 , DD: NA

499. Age class 4 to 5 - mean: 0.834 , sd: 0.079 , DD: NA

Impacts

500. Number of impact scenarios: 2.

501. Are impacts applied separately to each subpopulation?: No

502. Are impacts of scenarios specified separately for immatures?: No

503. Are standard errors of impacts available?: No

504. Should random seeds be matched for impact scenarios?: No

505. Are impacts specified as a relative value or absolute harvest?: relative

506. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name:

All subpopulations

507. **Impact on productivity rate mean**: 0 , se: NA

508. **Impact on adult survival rate mean**: 0.00402 , se: NA

Scenario B - Name:

All subpopulations

509. **Impact on productivity rate mean**: 0 , se: NA

510. **Impact on adult survival rate mean**: 0.00386 , se: NA

Output:

511. First year to include in outputs: 2015

512. Final year to include in outputs: 2053

513. How should outputs be roduced, in terms of ages?: breeding.pairs

514. Target population size to use in calculating impact metrics: NA

515. Quasi-extinction threshold to use in calculating impact metrics: NA

2.5.2 Great black-backed gull – In-combination collision impact mortality scenarios: Density Independent

Set up

516. The log file was created on: 2024-03-20 11:13:36 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

517. This run had reference name “”.

518. PVA model run type: simplescenarios.

519. Model to use for environmental stochasticity: betagamma.

520. Model for density dependence: nodd.

521. Include demographic stochasticity in model?: Yes.

522. Number of simulations: 5000.

523. Random seed: 2744.

524. Years for burn-in: 0.

525. Case study selected: None.

Baseline demographic rates

526. Species chosen to set initial values: Great Black-Backed Gull.
527. Region type to use for breeding success data: Global.
528. Available colony-specific survival rate: National.
529. Sector to use within breeding success region: Global.
530. Age at first breeding: 5.
531. Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.
532. Number of subpopulations: 1.
533. Are demographic rates applied separately to each subpopulation?: No.
534. Units for initial population size: breeding.adults
535. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

536. **Initial population values**: Initial population 2096 in 2016
537. **Productivity rate per pair**: mean: 0.9707373 , sd: 0.435337
538. **Adult survival rate**: mean: 0.93 , sd: 0.001
539. **Immatures survival rates**:
540. Age class 0 to 1 - mean: 0.93 , sd: 0.001 , DD: NA
541. Age class 1 to 2 - mean: 0.93 , sd: 0.001 , DD: NA
542. Age class 2 to 3 - mean: 0.93 , sd: 0.001 , DD: NA
543. Age class 3 to 4 - mean: 0.93 , sd: 0.001 , DD: NA
544. Age class 4 to 5 - mean: 0.93 , sd: 0.001 , DD: NA

Impacts

545. Number of impact scenarios: 2.
546. Are impacts applied separately to each subpopulation?: No
547. Are impacts of scenarios specified separately for immatures?: No
548. Are standard errors of impacts available?: No
549. Should random seeds be matched for impact scenarios?: No
550. Are impacts specified as a relative value or absolute harvest?: relative
551. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name:

All subpopulations

552. **Impact on productivity rate mean**: 0 , se: NA
553. **Impact on adult survival rate mean**: 0.0018 , se: NA

Scenario B - Name:

All subpopulations

554. **Impact on productivity rate mean**: 0 , se: NA
555. **Impact on adult survival rate mean**: 0.00179 , se: NA

Output:

556. First year to include in outputs: 2016
557. Final year to include in outputs: 2053
558. How should outputs be produced, in terms of ages?: breeding.pairs
559. Target population size to use in calculating impact metrics: NA
560. Quasi-extinction threshold to use in calculating impact metrics: NA

2.5.3 Kittiwake – In-combination collision impact mortality scenarios: Density Independent

Set up

561. The log file was created on: 2024-03-20 10:36:41 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

Basic information

562. This run had reference name “”.

563. PVA model run type: simplescenarios.

564. Model to use for environmental stochasticity: betagamma.

565. Model for density dependence: nodd.

566. Include demographic stochasticity in model?: Yes.

567. Number of simulations: 5000.

568. Random seed: 2744.

569. Years for burn-in: 0.

570. Case study selected: None.

Baseline demographic rates

571. Species chosen to set initial values: Black-Legged Kittiwake.

572. Region type to use for breeding success data: Global.

573. Available colony-specific survival rate: National.

574. Sector to use within breeding success region: Global.

575. Age at first breeding: 4.

576. Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.

577. Number of subpopulations: 1.

578. Are demographic rates applied separately to each subpopulation?: No.

579. Units for initial population size: breeding.adults

580. Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

581. **Initial population values**: Initial population 10988 in 2018

582. **Productivity rate per pair**: mean: 0.6036278 , sd: 0.325783

583. **Adult survival rate: mean**: 0.854 , sd: 0.077

584. **Immatures survival rates**:

585. Age class 0 to 1 - mean: 0.79 , sd: 0.077 , DD: NA

586. Age class 1 to 2 - mean: 0.854 , sd: 0.077 , DD: NA

587. Age class 2 to 3 - mean: 0.854 , sd: 0.077 , DD: NA

588. Age class 3 to 4 - mean: 0.854 , sd: 0.077 , DD: NA

Impacts

589. Number of impact scenarios: 2.
590. Are impacts applied separately to each subpopulation?: No
591. Are impacts of scenarios specified separately for immatures?: No
592. Are standard errors of impacts available?: No
593. Should random seeds be matched for impact scenarios?: No
594. Are impacts specified as a relative value or absolute harvest?: relative
595. Years in which impacts are assumed to begin and end: 2028 to 2053

Impact on Demographic Rates

Scenario A - Name:

All subpopulations

596. **Impact on productivity rate mean**: 0 , se: NA
597. **Impact on adult survival rate mean**: 0.00207 , se: NA

Scenario B - Name:

All subpopulations

598. **Impact on productivity rate mean**: 0 , se: NA
599. **Impact on adult survival rate mean**: 0.00206 , se: NA

Output:

600. First year to include in outputs: 2018
601. Final year to include in outputs: 2053
602. How should outputs be produced, in terms of ages?: breeding.pairs
603. Target population size to use in calculating impact metrics: NA
604. Quasi-extinction threshold to use in calculating impact metrics: NA

Natura Impact Statement

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Appendix 5 - Justification of the use of Counterfactual of Growth Rate Values to determine Adverse Effect on Site Integrity

Date: 06/12/2022

To: NPWS

CC: CWP

Justification of the use of Counterfactual of Growth Rate values to determine Adverse Effect on Site Integrity

Briefing Note No: CWP_OffOrn_1

Purpose of the Note

The purpose of this note is to provide a justification of the use of Counterfactual of Growth Rate (CGR) output values of Population Viability Analyses (PVAs) to determine Adverse Effect on Site Integrity (AESI) upon Special Protection Areas (SPAs). Specifically, that CGR values exceeding 0.995 result in no AESI to Wicklow Head SPA through population level consequences to the breeding kittiwake designated feature.

The production of this note was agreed as an Action from a meeting held with National Park and Wildlife Service (NPWS) on the 4th October 2022, and it is anticipated that this note will allow Codling Wind Park (CWP) to agree the assessment approach with NPWS.

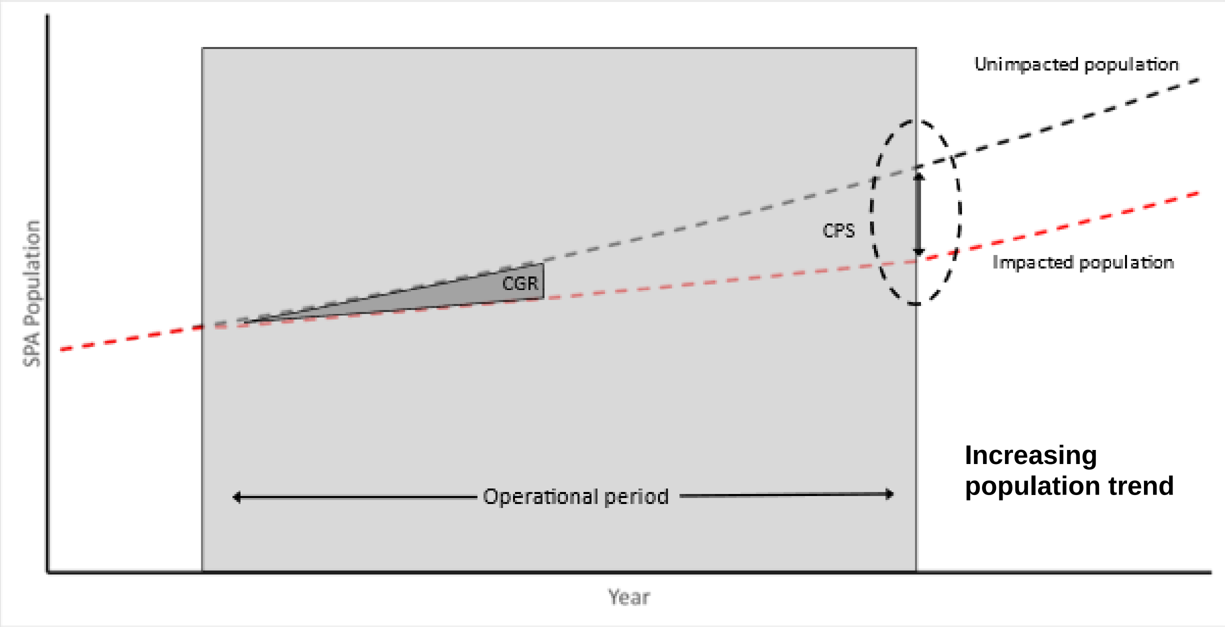
Introduction

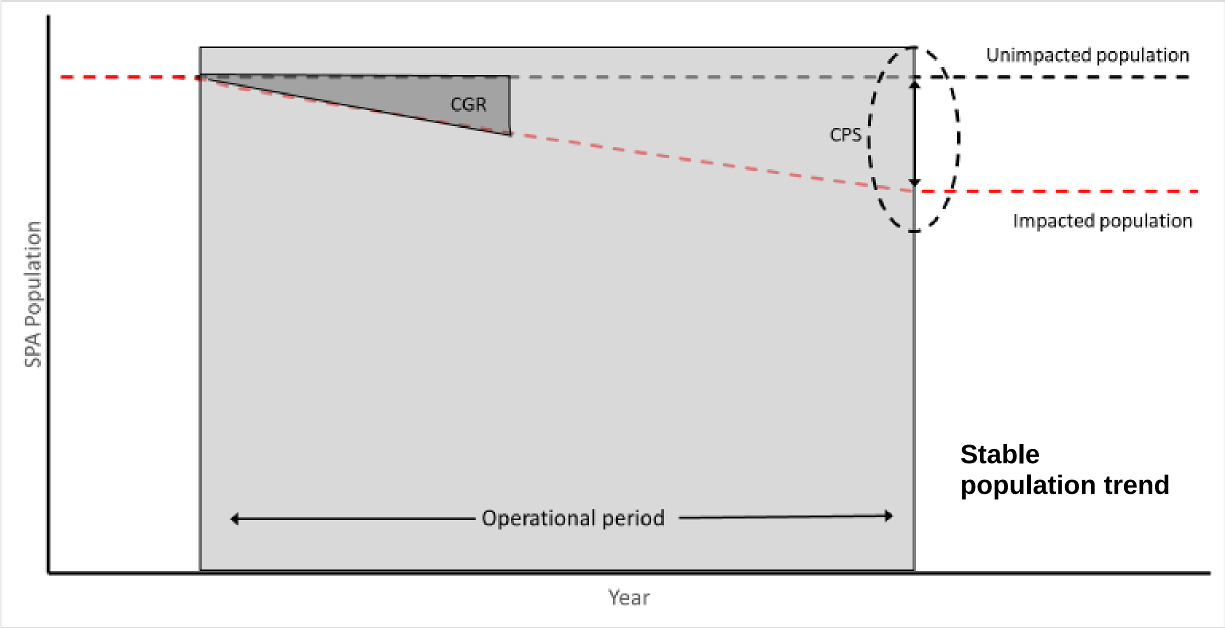
PVAs are used to contextualise quantified impacts of proposed wind farm developments upon designated breeding populations of European Protected Sites (i.e. SPAs) and to inform decisions relating to whether those impacts will have an AESI within the Habitats Regulations Assessment (HRA) process.

PVA outputs focus upon counterfactual scenarios, comparing predicted population trends with and without impacts associated with a proposed development alone (‘project only’ impacts) or combined with other relevant plans and projects (‘in-combination impacts).

For offshore wind farm (OWF) developments the additional impacts considered in counterfactual scenarios typically relate to additional mortality through collision and/or displacement mortality during the operational period of the project. Figure 1 is presented as an interpretive aid and illustrates this concept in relation to three types of theoretical breeding population trend; increasing, stable and decreasing. These illustrations are informative in subsequent discussions about the interpretation of PVA outputs and introduce the concepts of CGR and the related Counterfactual of Population Size (CPS); two counterfactual comparison values regularly referenced in PVA output contextualisation.

- CGR values relate to the difference in the growth rates of impacted and unimpacted predicted populations (i.e. the trendline gradient differences) throughout the operational period of the OWF.
- CPS values relate to the difference in the absolute sizes of the impacted and unimpacted predicted populations at the end of the operational period of the OWF.





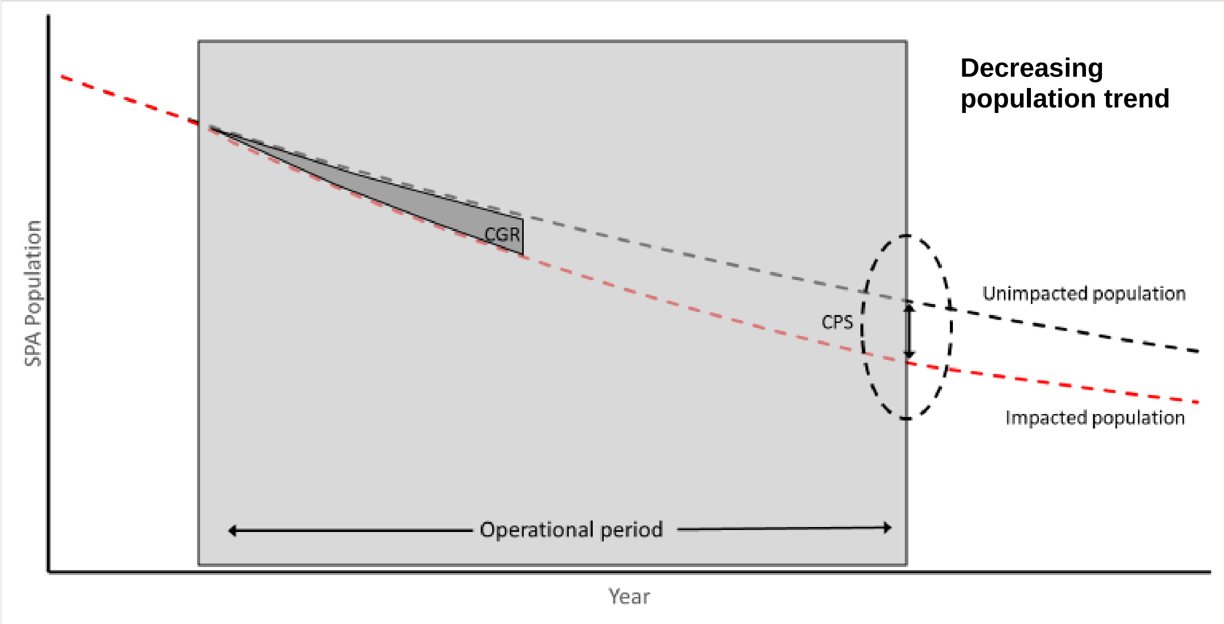


Figure 1: Example unimpacted vs impacted population trendlines for increasing, stable and decreasing populations with illustration of CGR and CPS value determinants.

Figure 2 illustrates annual kittiwake breeding populations within the Wicklow Head SPA between 1999 and 2022. These data suggest a breeding population trend which is stable or perhaps slightly decreasing and is therefore analogous to the stable or decreasing population examples illustrated in Figure 1.

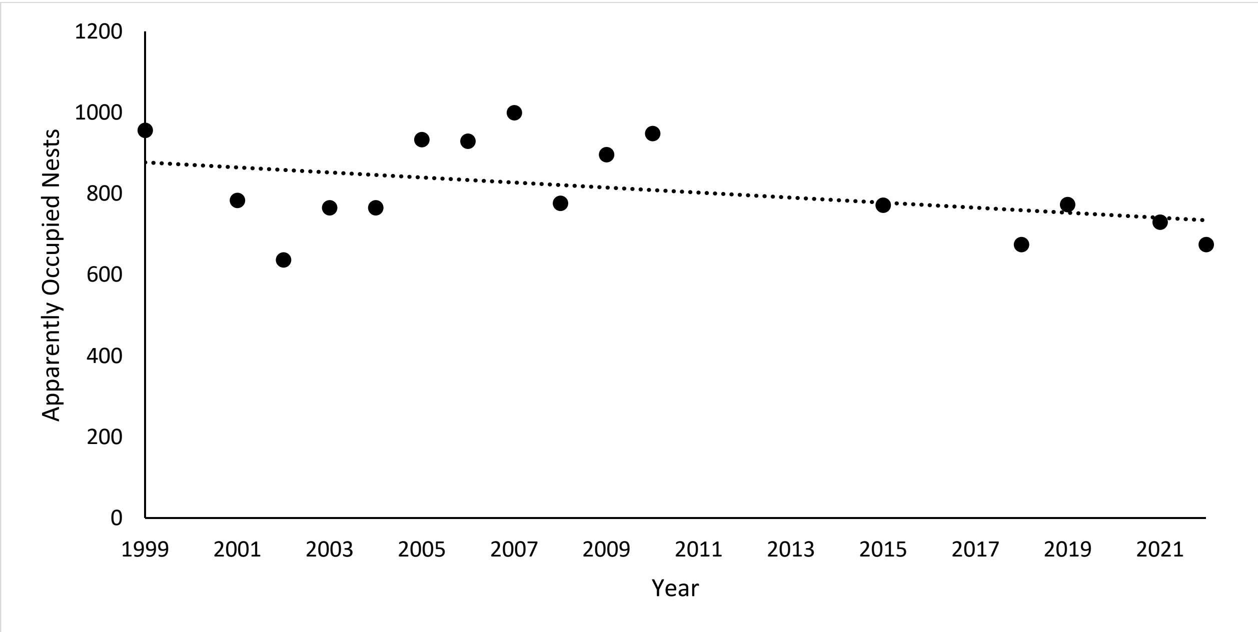


Figure 2: Kittiwake breeding population size within Wicklow Head SPA (1999 – 2022)

Selection of counterfactual comparison values to contextualise PVA outputs

PVA output values may be considered in three broad groupings; ratio values, metrics related to ratio values, and probabilistic values:

- Ratio values relate to the ratios of comparable elements of counterfactuals – these include CGR [the median of the ratio of impacted to unimpacted annual population growth rate] and CPS [the median of the ratio of impacted to unimpacted population size].
- Metrics related to ratio values describe the difference between comparable elements of counterfactuals – for example the difference between impacted and unimpacted population growth rates or population sizes.
- Probabilistic values relate to the probability of particular levels of population change for impacted compared to unimpacted populations (for example, the probability that an unimpacted population might decline by 25% compared to that probability for an impacted population).

In a review of the suitability of PVA output options in impact assessment for offshore renewable energy projects, Jitlal *et al*., 2017[1], found *ratio values*, specifically CGR and CPS, performed better than both the *metrics related to ratio values* and *probabilistic values* tested in respect to sensitivity to mis-specification of input parameters. Due to the low sensitivity of ratio values to mis-specification of input parameters, these metrics (the ratio values, CGR and CPS) are considered to result in the most robust basis for assessment for offshore renewables.

In particular, among the ratio values, CGR was demonstrated to perform consistently better than CPS in this regard. A consequence of this observation, and similar observations by other authors[2,3], is that CGR is now the most routinely utilised PVA output value in HRA for UK OWFs. Consistency with UK OWFs is considered an important factor when considering transboundary impacts from OWFs in multiple jurisdictions, as comparability of results at a strategic level will be critical to manage a coherent network of designated sites.

[1] Jitlal, M., Burthe, S., Freeman, S. and Daunt F. 2017. Testing and Validating Metrics of Change Produced by Population Viability Analysis (PVA). Final Report to Marine Scotland Science. Scottish Marine and Freshwater Science Vol 8 No 23. SMFS 0823.pdf (marine.gov.scot)
[2] Cook, A.S.C.P. & Robinson, R.A. (2016b) Testing sensitivity of metrics of seabird population response to offshore wind farm effects. JNCC Report No. 553. JNCC, Peterborough.
[3] Cook, A.S.C.P. & Robinson, R.A. (2017) Towards a framework for quantifying the population-level consequences of anthropogenic pressures on the environment: The case of seabirds and windfarms. J Environ Manage, 190, 113-121.

Furthermore, where PVAs do not incorporate density dependence effects[4], the argument has been advanced[5] that only CGR values (without accompanying CPS values) should be presented during the contextualisation of PVA outputs. The rationale for this approach (non-inclusion of CPS values) is as follows:

- "…*to avoid misinterpretation of predicted population level effects caused by the low confidence in the CPS output. This is because CPS and CGR are not equally appropriate for model interpretation when modelling in the absence of density dependence. A density independent population has no constraint on increased growth or any form of recovery in decline. This means that a density independent population with a positive growth rate will grow exponentially and a negative growth population with eventually decline into extinction, for which the reality of both instances occurring in a natural population are recognised as being wholly unrealistic. This is due to a natural population not being physically able to exhibit exponential growth due to constraints on natural resources such as prey availability and nesting space. Similarly, a natural population in decline will eventually stabilise and possibly recover due to reduced competition for prey and nesting space. Therefore, in a simulation which excludes these natural constraints on population growth and decline the difference between the baseline and impacted populations will diverge by an increasing amount as the simulation duration increases, meaning that the CPS is time sensitive and becomes less accurate with increasing simulation time. Furthermore, due to the absence of density dependence, neither the baseline nor impacted population projections are likely to be credible since seabird populations are constrained by environmental and demographic variables, resulting in unrealistic population predictions for both the baseline (unimpacted) and impacted scenario modelled.*", and
- "*In contrast, the CGR is time and growth trend (positive or negative) insensitive and therefore, is less prone to the effects of increasing deviation between the impacted and unimpacted population in the absence of density dependence controls, making it a more reliable output in the absence of density dependence within the model.*"

In summary, where PVA is proposed to be undertaken, CWP propose to base the contextualisation of impacts on presentation of CGR values. CWP would welcome confirmation from NPWS that this is acceptable.

Choosing a CGR value to determine no AESI in HRA for Wicklow Head SPA kittiwake

Where it cannot be concluded that an impact will not have a Likely Significant Effect (LSE) upon a designated feature of an SPA, PVA may be used within the Natura Impact Statement (NIS) (Appropriate Assessment -

[4] Non-inclusion of density dependence effects is the case for the large majority of PVA undertaken in relation to OWF assessment in the absence of empirical data to characterise the magnitude of such effects or the demographic mechanisms through which they manifest. This will be the case in all PVA modelling undertaken in relation to Impacts upon Wicklow Head SPA. Although the relatively stable population at this SPA between 1999 and 2022 is indicative of density dependence, it is not possible to incorporate this into population modelling given the data presently available.

[5] Within the Hornsea Project Four Ornithological Assessment Sensitivity Report (May 2022), https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-001415-Hornsea%20Project%20Four%20-%20Other-%20G4.7%20Ornithological%20Assessment%20Sensitivity%20Report.pdf

AA) element of the HRA process to determine if the impact will result in AESI to the SPA through effects upon that feature.

AESI focuses upon contravention of the conservation objectives of the SPA in question. Where PVA is used to address AESI, the focus is specifically upon contravention of conservation objectives relating to maintenance or restoration of the favourable conservation status of the site through the achievement of the population of a designated feature '*maintaining itself on a long-term basis*[6]*…*'.

As impact levels decrease in magnitude, impacted and unimpacted population predictions become more alike, ascertaining whether impacts are likely to have a meaningful long-term consequence on the ability of a designated population to maintain itself becomes increasingly difficult. This is made more so as a consequence of the environmental and demographic stochasticity which is incorporated into the majority of PVA models, and the often considerable levels of uncertainty necessarily associated with seabird demographic parameters used within the modelling.

Considerations focus upon whether impacts are likely to meaningfully change the population trends of designated features, such that they become unable to maintain themselves for hitherto increasing or stable populations (i.e. 'tipping-points' causing population decline), or significantly exacerbate existing downward trends for already decreasing populations.

The probability that such changes will occur alters with the underlying population trends of a designated feature. For example, small magnitude impacts (CGR values close to 1) on a rapidly increasing population are very unlikely to result in such a population no longer being able to maintain itself. Conversely the same level of impact to a stable population may result in such an outcome[7], or exacerbate the decline of an already decreasing population. As such, there are no universally applicable thresholds as to what levels of counterfactual values constitute an AESI in all instances.

At Wicklow Head SPA, where the kittiwake breeding population appears not to be increasing, and consideration is required as to whether additional impacts may initiate or worsen population decline, a conservative CGR threshold is considered to be prudent in the determination of AESI.

As such, CWP propose that, in relation to impacts upon the Wicklow Head SPA breeding kittiwake population, determination of no AESI corresponds with CGR values which exceed 0.995 (i.e. where any reduction in estimated population growth rate is <0.5%). This value has been chosen in the absence of specific national advice, however is analogous with guidance recently provided by Natural England to the Hornsea Four project (Southern North Sea) relating to reductions in population growth rate which, when exceeded, they would not be able to rule out AESI[8].

[6] CO004127.pdf (npws.ie)
[7] Dependant on the strength of compensatory density dependence
[8] Natural England, 2021, Deadline 4 response to Norfolk Boreas OWF

Similarly, for the Norfolk Vanguard project (Southern North Sea), worst-case impacts upon kittiwake from the Flambrough and Filey Coast SPA were predicted to result in a CGR value of 0.9947, which was determined to represent a 'very small risk to the population's conservation status'[9] (i.e. no AESI).

The proposed CGR threshold of 0.995 is more conservative than that considered in determination of AESI upon kittiwake breeding SPAs surrounding the Seagreen OWF Project in Scotland, where CGR > 0.99 appears to have been used for all designated features (including breeding kittiwake) in order to determine no AESI[10].

Likewise, the proposed threshold is more conservative than the 1% change (i.e. CGR >0.99) in kittiwake population trends considered when determining the significance of the Awel Y Mor OWF project off north Wales upon the nearby breeding kittiwake population of the Great Orme SSSI[11].

CWP consider CGR to be established in OWF industry precedent, and the proposed threshold of 0.995 to be a suitably precautionary basis on which to determine if a predicted effect will result in an AESI.

In summary, CWP propose that where CGR values are found to exceed 0.995 no AESI may be concluded in relation to impacts upon the breeding kittiwake designated feature of Wicklow Head SPA. CWP would welcome NPWS confirmation that this approach is acceptable.

---

[9] Norfolk Vanguard OWF: Offshore Ornithology Cumulative and In-combination Collision Risk Assessment – Update for Deadline 7, 2019. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-002882-ExA;%20AS;%2010.D7.21_Offshore%20Ornithology%20Cumulative%20and%20In-combination%20Collision%20Risk%20Assessment.pdf

[10] Seagreen, 2018, Ornithology HRA addendum update, accompanying project EIAR. https://marine.gov.scot/sites/default/files/part_2_section_3_-_ornithology_hra.pdf

[11] 1.16_D1_AyM_Marine_Ornithology_Great_Orme_Assessment_RevA (planninginspectorate.gov.uk)

Natura Impact Statement

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Appendix 6 - Marine Mammal Mitigation Protocol

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Abbreviations

Abbreviation	Term in Full
µPa	Micro ascals
ADD	Acoustic Deterrent Device
BEIS	Department for Business, Energy and Industrial Strategy
CPOD	Click Pod Detector
CWP	Codling Wind Park
dB	Decibels
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMP	Environmental Monitoring Plan
IAC	Inter-array cables
IWDG	Irish Whale & Dolphin Group
JNCC	Joint Nature Conservation Committee
kg	Kilograms
kJ	Kilojoules
km	Kilometres
lb	Pounds
m	Metres
MAP	Maritime Area Planning
MDS	Maximum design scenario
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observers
MW	Megawatts
NEQ	Net Explosive Quantity
NPWS	National Parks & Wildlife Service
OfTI	Offshore Transmission Infrastructure
ORJIP	Offshore Renewables Joint Industry Programme
OSS	Offshore substation structures
OTI	Onshore transmission infrastructure
PAM	Passive Acoustic Monitoring
PDA	Planning and Development Act 2000

Abbreviation	Term in Full
PTS	Permanent Threshold Shift
RMS	Root Mean Squared
SEL	Sound Exposure Level
SPL	Sound Pressure Level
TJBs	Transition joint bays
UXO	Unexploded ordnance
WTGs	Wind turbine generators

Definitions

Glossary	Meaning
Permanent Threshold Shift (PTS)	Permanent threshold shift (or PTS) is a permanent increase in the threshold of hearing (minimum intensity needed to hear a sound) at a specific frequency above a previously established reference level.
Sound Exposure Level (SEL)	The decibel level of the time integral (summation) of the squared pressure over the duration of a sound event; units of dB re 1 $\mu Pa^2/s$.
Sound Pressure Level (SPL)	A means of characterising the amplitude of a sound. There are several ways sound pressure can be measured. The most common of these are the root-mean-square (RMS) pressure, the peak pressure and the peak-to-peak pressure.
Temporary Threshold Shift (TTS)	Temporary threshold shift (or TTS) is a temporary increase in the threshold of hearing (minimum intensity needed to hear a sound) at a specific frequency above a previously established reference level.
Passive Acoustic Monitoring (PAM)	Used to measure, monitor and determine the sources of sound in underwater environments. This is a versatile, non-invasive and cost-effective method to detect, classify and track marine mammals over large areas for long periods.
Acoustic Deterrent Devices (ADDs)	A range of devices that either emit sounds, using electrical or mechanical means, or acoustically reflect those emitted by echolocating cetaceans. Often used to discourage marine mammals from an area where anthropogenic activities are occurring.
Noise abatement	A primary mitigation methodology used to reduce the noise emissions at-source.
Marine Mammal Observer (MMO)	A marine mammal observer (MMO) is a professional in environmental consulting who specialises in whales and dolphins and is responsible for spotting and identifying animals through visual or passive acoustic means.
Monitored zone	The zone which is required to remain clear of marine mammals for a specified time-frame, prior to a noisy activity taking place.
PTS-Onset	The distance from the sound source at which the received level decreases to below the level of PTS-onset for a specific marine mammal hearing group.

1 INTRODUCTION

1.1 The CWP Project

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

2. The Developer is applying for permission for all components of the CWP Project under Section 291 of the Planning and Development Act 2000, as amended (PDA) (as inserted by the Maritime Area Planning (MAP) Act 2021). This includes:

- The generating station, which comprises the wind turbine generators (WTGs), inter array cables (IACs) and interconnector cables;
- The offshore transmission infrastructure (OfTI), which comprises the offshore substation structures (OSSs) and offshore export cables;
- The landfall which describes the point at which the offshore export cables are brought onshore; and
- The onshore transmission infrastructure (OTI) which comprises the onshore export cables, the onshore substation and and network cables to a planned extension to the existing ESB Networks 220 kV substation.

3. A detailed description of the CWP Project is provided in the Environmental Impact Assessment Report (EIAR) **Chapter 4 Project Description**.

1.2 Purpose of the MMMP

4. This Marine Mammal Mitigation Protocol (MMMP) supports the consent application for the CWP Project. The purpose of this MMMP is to provide a framework for the final MMMP, which is anticipated to be required under conditions of the planning consent, to ensure appropriate controls are in place to manage environmental risks associated with the construction and operation of the offshore components of CWP Project as assessed in the EIAR. The MMMP is intended to be a live document which will be updated as project development progresses and will be submitted to the relevant authority (anticipated to be National Parks and Wildlife Service (NPWS)) for approval, prior to the start of construction. A revised document containing the finalised details of the MMMP will also be submitted prior to the commencement of operations. The proposed schedule of submission and scope of the iterations of the MMMP are described in the following 'Scope of the MMMP' section.

1.3 Scope of the MMMP

5. It is anticipated that the development and implementation of a MMMP will form a condition of any planning consent granted. The Developer has also committed to the development of a MMMP within the EIAR and supporting documents for the CWP Project.

6. The MMMP has the following primary objectives:

   1. To outline the potential mitigation measures that could be put in place during **geophysical surveys** to reduce the risk of auditory injury (PTS) to negligible levels;
   2. To outline the potential mitigation measures that could be put in place during **WTG / OSS pile driving activities** to reduce the risk of auditory injury (PTS) to negligible levels;

3. To outline the potential mitigation measures that could be put in place during **onshore substation pile driving activities** in the River Liffey to reduce the risk of auditory injury (PTS) to negligible levels;
4. To outline the potential mitigation measures that could be put in place during **UXO clearance activities** to reduce the risk of auditory injury (PTS) to negligible levels; and
5. To outline the potential mitigation measures that could be put in place during **decommissioning activities** to reduce the risk of auditory injury (PTS) to negligible levels.

7. This MMMP considers the following guidance:

- NPWS (2014): Guidance document for minimising the acoustic impact of man-made sound sources on marine mammals;
- IWDG (2020): IWDG policy on offshore wind farm development;
- JNCC (2017): JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys;
- JNCC (2010b): Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise;
- JNCC (2010a): JNCC guidelines for minimising the risk of injury to marine mammals from using explosives; and
- JNCC (2023): DRAFT guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment.

1.4 Revisions of the MMMP

8. As set out above, the MMMP is considered to be a 'live' document and will be reviewed on a regular basis to allow any changes to the construction programme, operations or unforeseen issues to be incorporated at any stage, and as deemed necessary by the Developer, their agents or relevant authorities. The MMMP will be subject to regular review to address, for example:

- Any conditions stipulated in the planning consent;
- Any conditions following an Annex IV risk assessment and Regulation 54 derogation application;
- Any requirements / issues highlighted through consultation prior to construction;
- Any change / updates to guidance, best practice and available technology at the time of construction; and
- To ensure it incorporates the findings of any pre-construction surveys.

9. Beyond the regular review, the MMMP submitted as part of the application will be updated to account for the final design of the proposed project. This is due to certain final aspects being subject to future survey, such as UXO for which a contemporary survey may be required in advance of construction to ensure the risk of UXO is as low as reasonably practicable. Similarly, the final MMMP will confirm which of the two design options for which consent is being sought will form the final option for construction. The proposed approach to updating the MMMP, and submitting to the NPWS, is as follows:

1. MMMP for purposes of consent;
2. Detailed geophysical survey MMMP; timing of submission subject to geophysical survey(s);
3. Detailed UXO MMMP; timing of submission subject to UXO survey;
4. Detailed WTG piling MMMP, timing of submission subject to final construction programme;
5. Detailed onshore substation piling MMMP, timing of submission subject to final construction programme; and
6. Detailed decommissioning MMMP; timing of submission subject to decommissioning plans.

1.5 Structure of the MMMP

10. In line with the requirements set out above, the structure of this MMMP is outlined in **Table 1-1**.

Table 1-1 Structure of the MMMP

Section 1: Introduction	• Overview of the CWP Project • Purpose and scope of the MMMP
Section 2: Geophysical survey MMMP	• Overview of survey equipment; • Overview of auditory impact (PTS) ranges; • Outline of potential primary mitigation measures; and • Conclusion.
Section 3: WTG / OSS Piling MMMP	• Overview of piling parameters; • Overview of auditory impact (PTS) ranges (instantaneous PTS and cumulative PTS); • Outline of potential primary mitigation measures for instantaneous PTS; • Outline of potential additional mitigation measures for cumulative PTS; and • Conclusion.
Section 4: Onshore Substation Piling MMMP	• Overview of piling parameters; • Overview of auditory impact (PTS) ranges (instantaneous and cumulative PTS); • Outline of potential primary mitigation measures for instantaneous PTS; • Outline of potential additional mitigation measures for cumulative PTS; and • Conclusion
Section 5: UXO MMMP	• Overview of auditory impact ranges; • Outline of potential primary mitigation measures; • Outline of potential additional mitigation measures; and • Conclusion.
Section 6: Decommissioning MMMP	• Short summary.

11. A summary of the key aspects identified above is provided within the following sections. While it is anticipated that these will form the key elements of the MMMP, it should be noted that this list may not be exhaustive and will be reviewed and updated within the final MMMP, in line with the final design of the CWP Project and in consultation with relevant stakeholders post consent and therefore closer to the time of construction.

1.6 Implementation of the MMMP

12. Key to the implementation of this MMMP is the delegation of responsibility for the implementation of the MMMP as relevant to the specific contractor's scope, to the relevant appointed person(s) on behalf of the contractor, who will regularly liaise with and update the Developer on all environmental issues relating to the project during the construction phase. As part of the appointment of a contractor and agreement of contracts, the Developer will determine the lines of communication for environmental compliance with the relevant stakeholders.

13. The appointed contractor will be responsible for developing final construction methods and installation procedures for the CWP Project. Contractors and their subcontractors will ensure that all relevant environmental and maritime legislation is complied with, that all necessary licences and permissions are obtained, that all design embedded mitigation measures are applied and that good working practices are adhered to, to minimise risks to the environment.

14. Contractors will be responsible for implementing the MMMP through contractual agreements with the Developer. Contractors will also be required to complete their own Environmental Management Plans (EMPs) that are specific to their works and that are compliant with the MMMP. Requirements of the MMMP will be communicated to contractors (and their subcontractors) as required, to discharge the relevant consent conditions and to communicate project requirements and standards to facilitate incorporation into contractor EMPs.

15. All project personnel are required to ensure compliance with the requirements of this MMMP (and subsequent revisions thereof) and are responsible for ensuring that their actions constitute good environmental practice. All personnel are also encouraged to provide feedback and suggestions for improvements to ensure effective environmental management of all construction activities.

2 GEOPHYSICAL SURVEY MMMP

16. This section of the MMMP details the proposed marine mammal mitigation and monitoring procedures during pre-construction geophysical surveys at the CWP Project. Exposure to loud sounds can lead to a reduction in hearing sensitivity (a shift in the hearing threshold at particular frequencies), which results from physical injury to the auditory system and can result in permanent changes to the hearing sensitivity (PTS). As such, the objective of the geophysical survey MMMP is to minimise the risk of auditory injury (i.e., PTS) to marine mammals as a result of noise generated by geophysical surveys.

2.1 Survey equipment

17. Pre-construction geophysical equipment could include any or all of the following:

- **Multi-Beam Echo Sounder (MBES):** MBES is used to acquire detailed seabed topography and water depth by emitting a fan shaped swath of acoustic energy (sound waves) along a survey transect. The sound waves are reflected from the seabed to enable high resolution seafloor mapping. The MBES can be either hull- or ROV-mounted.
- **Sub-Bottom Imager (SBI):** provides a real-time 3D view of the sub-seabed via multiple 5 m wide data swaths that penetrate the seabed up to 8 m. The SBI uses a frequency modulated signal to identify buried objects, anomalies, geohazards, and stratigraphy to a 10 cm resolution[1]. SBIs are typically deployed on an ROV or towfish, close to the seabed, and operate at a much lower source level than sub-bottom profilers.
- **Side Scan Sonar (SSS):** SSS utilises conical or fan-shaped pulses of sounds directed at the seafloor to provide information on the surface of the seabed through analysis of reflected sound.
- **Sub Bottom Profiler (SBP) – pinger:** The pinger SBP is a type of geophysical survey tool that uses low frequency or high frequency sounds (pings) to identify acoustic impedance of the sub-surface geology and to identify transitions from one stratigraphic sequence to another[2]. Sound sources that produce lower frequency pulses can penetrate through and be reflected by subsurface sediments (low-resolution data), whilst higher frequency pulses achieve higher resolution images but do not penetrate the subsurface sediments[3].
- **Ultra-High Resolution Seismic (UHRS) – sparker:** A small seismic source containing a cluster of electrodes. These systems discharge high voltage impulses which heat the surrounding water within which the device is located through the use of electrode tips. The generation of heat and subsequently, steam, results in the emission of an acoustic impulse (Hartley Anderson Ltd, 2020). While sparkers are less directional than other SBPs, the acoustic energy they emit is still focussed towards the sea floor.
- **Ultra-Short Base Line (USBL) system:** A USBL system is used to obtain accurate equipment positioning during sampling activities. This system consists of a transceiver mounted under the vessel and a transponder on deployed equipment. The transceiver transmits an acoustic pulse which is detected by the transponder, followed by a reply of an acoustic pulse from the transponder. Range and bearing information allow an accurate estimate of the location of the deployed equipment.
- **Magnetometer:** A magnetometer is used to measure the variation in the earth's total magnetic field to detect and map ferromagnetic objects on or near the sea floor along the survey vessel's tracks. Often, two magnetometers are mounted in a gradiometer format to measure the magnetic

[1] https://krakenrobotics.com/our-services/sub-bottom-imager/

[2] https://www.aspectsurveys.com/survey-services/geophysical/sub-bottom-profiling/

[3] https://www.ixblue.com/maritime/subsea-imagery/sub-bottom-profilers/

gradient between the two sensors. The magnetometer is a passive system and, therefore, does not emit any noise.

2.2 PTS-onset impact ranges

18. The impact of PTS from geophysical surveys is expected to be very highly localised. Potential impact ranges are summarised in **Table 2-1**.

Table 2-1 Predicted auditory injury (PTS) impact ranges for geophysical survey equipment.

Equipment	PTS range
MBES	A recent comprehensive assessment of the characteristics of acoustic survey sources proposed that MBES and SSS should be considered de minimis in terms of being unlikely to result in PTS to marine mammals (Ruppel et al., 2022).
SSS	
USBL	Transmission loss from geometric spreading and frequency-dependent absorption will be such that SPLs within the main beam of the USBL can be expected to drop to below 200 dB re 1 µPa and below the PTS thresholds within a few metres of the source.
SBI	The source levels of SBI equipment are below the PTS-onset thresholds for harbour porpoise, minke whale, dolphins and seals.
SBP	Results for both SBPs and URHS sparkers have indicated that PTS-onset for porpoise is likely to arise between 17–23 m from the use of this equipment at source levels of 267 dB re 1 µPa (SPL_{peak}) (BEIS, 2020). Noise modelling has previously indicated PTS-onset in minke whales within 5 m of the source when SBP pingers operate with a sound source of 220 dB re 1 µPa (SPL_{peak}) (Shell, 2017), and ~10 m for seals (Department for Business Energy & Industrial Strategy, 2019).
URHS	

2.3 Mitigation of PTS

2.3.1 Primary mitigation

19. Both the Department of Housing, Local Government and Heritage (DAHG) guidance (DAHG (2014)) and the Joint Nature Conservation Committee (JNCC) guidance (JNCC (2017)) advise the use of a pre-shooting MMO watch of the Monitored / Mitigation Zone (hereafter referred to as Monitored Zone). The purpose of a pre-shooting MMO watch is to ensure the Monitored / Mitigation Zone is free of marine mammals prior to the commencement of piling operations. The use of MMOs has been a common form of observational monitoring in the USA and UK since the 1980/90s and is now seen as an industry standard practice. Since the 2000s, PAM has also become part of these standards.

20. DAHG (2014) advises a standard Monitored Zone of 500 m radius for multibeam, single beam, side-scan sonar and sub-bottom profiler surveys and that there should be a 30 minute pre-shooting MMO watch of the Monitored Zone. DAHG (2014) do not recommend the use of PAM and state that where visual observations by an MMO are not possible, the sound-producing activities should be postponed until effective visual monitoring is possible.

21. IWDG (2020) states that seabed surveys should apply standard mitigation practices, and should incorporate the use of PAM in poor visibility or darkness.

22. JNCC (2017) also advises a standard mitigation zone of 500 m radius, and states that for high resolution surveys (small airgun or electromagnetic sources: SBP, i.e., pingers, sparkers, boomers

and CHIRP systems, side-scan sonars and multibeam echosounders), there should be a 30 minute pre-shooting MMO watch of the mitigation zone. JNCC (2017) advises that a pre-shooting PAM watch should be used when visual observations by an MMO are not possible.

23. As such, and in light of more recent JNCC and IWDG guidance, which reflects international best practice, the CWP project proposes to utilise PAM during poor visibility or darkness.

2.3.2 Additional mitigation

24. None required.

2.4 Geophysical survey MMMP conclusion

25. There are primary mitigation measures currently available that could be implemented at the CWP Project, to reduce the risk of auditory injury from pre-construction geophysical surveys to negligible levels. These primary mitigation measures include:

- Establishment of a 500 m monitored / mitigation zone;
- Pre-shooting Marine Mammal Observer (MMO) watches (30 minutes); and
- Pre-shooting Passive Acoustic Monitoring (PAM) (if required to supplement the MMO) during poor visibility or darkness.

3 WTG / OSS PILING MMMP

26. This section of the MMMP details the proposed marine mammal mitigation and monitoring procedures during piling activities at the CWP Project. Exposure to loud sounds can lead to a reduction in hearing sensitivity (a shift in the hearing threshold at particular frequencies), which results from physical injury to the auditory system and can result in permanent changes to the hearing sensitivity (PTS). The assessment of PTS includes both instantaneous PTS using the SPL_{peak} metric (this is the PTS-onset impact range from a single strike), and cumulative PTS using the SEL_{cum} metric (this is the PTS-onset impact range from a cumulation of threshold shift across all pile strikes within a 24-hour period). As such, the objective of the Piling MMMP is to minimise the risk of auditory injury (i.e., PTS) to marine mammals as a result of noise generated by piling activities.

27. For the offshore components of the CWP Project, the representative scenario for assessment is the installation of 75 WTG foundations, in addition to the installation of three offshore substations (OSS). Only monopile foundations are proposed for the CWP Project and thus only monopile foundation types have been assessed in the Environmental Impact Assessment (EIA) undertaken for marine mammals (see **Chapter 11 Marine Mammals**).

28. The foundation installation duration under the representative scenario is expected to be up to 78 days in total over the construction period for the WTGs and the OSS combined (assuming 1 pile installed per day). A summary of the piling parameters assessed are presented in **Section 3.1**.

29. In **Chapter 11** of the EIAR, the assessment provides predicted impacts from the representative scenario. The predicted impacts are outlined in **Section 3.2**.

3.1 Piling parameters

30. Underwater noise modelling of pile driven WTG foundations has been undertaken by Subacoustech Environmental Limited using the INSPIRE model. Full details of the underwater noise modelling methods can be found in **Appendix 9.4 Underwater Noise Assessment**. Four WTG model locations were selected within the array site to represent the range of ground conditions across the site as well as the varying water depth (SE, SW, NE and NW). Three piling scenarios have been assessed:

- **Scenario 1 (SE model location):** Most restrictive – 9.5 m monopile, maximum 4,400 kJ hammer energy, 1 pile per 24 hours, 3.17 hours piling, 5,594 hammer strikes;
- **Scenario 2 (NE and SW modelling locations + OSS):** Less restrictive – 9.5 m monopile, maximum 4,400 kJ hammer energy, 1 pile per 24 hours, 3.17 hours piling, 4,734 hammer strikes;
- **Scenario 3 (NW model location):** Least restrictive – 9.5 m monopile, maximum 4,400 kJ hammer energy, 2 piles per 24 hours, 6.33 hours piling, 9,468 hammer strikes.

31. The WTG piling parameters for each scenario, including soft-start and ramp-up details, are provided in **Table 3-1**. Note, the exact same piling parameters are assumed for the installation of the OSS, adopting scenario 2 which is representative of the OSS locations proposed.

Table 3-1 Piling parameters for WTGs under each piling scenario

Energy (kJ)	440	440	1,100	2,200	3,300	4,400	Total
Scenario 1 (SE piling location): Most restrictive (9.5 m pile diameter / 4,400kJ blow energy / 1 pile per 24 hours)							**1 pile per day**
# strikes per pile	200	1,248	1,151	1,143	899	953	**5,594**
Duration (s)	1,200	2,160	1,980	1,980	1,800	2,280	**3 hours 10 minutes**
Strike rate (blows/min)	10	35	35	35	30	25	**–**
Scenario 2 (SW and NE piling locations): Less restrictive (9.5 m pile diameter / 4,400kJ blow energy / 1 pile per 24 hours)							**1 pile per day**
# strikes per pile	200	277	279	277	240	3,461	**4,734**
Duration (s)	1,200	480	480	480	480	8,280	**3 hours 10 minutes**
Strike rate (blows/min)	10	35	35	35	30	25	**–**
Scenario 3 (NW piling location): Least restrictive (9.5 m pile diameter / 4,400kJ blow energy / 2 piles per 24 hours)							**2 piles per day**
# strikes per pile	200	277	279	277	240	3,461	**4,734 per pile** **9,468 for 2 piles**
Duration (s)	1,200	480	480	480	480	8,280	**3 hours 10 minutes per pile** **6 hours 20 minutes for 2 piles**
Strike rate (blows/min)	10	35	35	35	30	25	**–**

3.2 PTS-onset impact ranges

3.2.1 Instantaneous PTS (SPL_{peak})

32. **Table 3-2** outlines the instantaneous PTS-onset impact ranges (using the SPL_{peak} metric). The maximum instantaneous PTS-onset impact range at full hammer energy is 620 m for harbour porpoise at the SE modelling location under piling scenario 1. For minke whales, dolphins and seals, the instantaneous PTS-onset range is <50 m for all modelling locations.

Table 3-2 Predicted instantaneous auditory injury (PTS) impact ranges (m) from WTG piling

Species	Piling scenario	Instantaneous PTS (SPL_{peak})			
		SE	SW	NE	NW
Harbour porpoise	1	620	–	–	–
	2	–	460	420	–
	3	–	–	–	390
Dolphins	1	<50	–	–	–
	2	–	<50	<50	–
	3	–	–	–	<50
Minke whale	1	<50	–	–	–
	2	–	<50	<50	–
	3	–	–	–	<50
Seals	1	<50	–	–	–
	2	–	<50	<50	–
	3	–	–	–	<50

3.2.2 Cumulative PTS (SEL_{cum})

33. **Table 3-3** outlines the cumulative PTS-onset impact ranges (using the SEL_{cum} metric). The maximum cumulative PTS-onset impact range is 9.5 km for minke whales at the SE modelling location under piling scenario 1 (for scenarios 2 and 3 the maximum range is notably smaller than scenario 1, with a maximum range of 5.8 km for scenario 2 and 2.0 km for scenario 3). For harbour porpoise, the maximum cumulative PTS-onset impact range is 4.7 km at the SE modelling location under piling scenario 1 (for scenarios 2 and 3 the maximum range is notably smaller than scenario 1, with a maximum range of 3.2 km for scenario 2 and 2.2 km for scenario 3). For dolphins and seals, the maximum cumulative PTS-onset range is <100 m at all modelling locations and under all scenarios.

Table 3-3 Predicted cumulative auditory injury (PTS) impact ranges (m) from WTG piling

Species	Piling scenario	Cumulative PTS (SEL_{cum})			
		SE	SW	NE	NW
Harbour porpoise	1	4,700	–	–	–
	2	–	2,500	3,200	–
	3	–	–	–	2,200
Dolphins	1	<100	–	–	–
	2	–	<100	<100	–
	3	–	–	–	<100
Minke whale	1	9,500	–	–	–
	2	–	3,000	5,800	–
	3	–	–	–	2,000
Seals	1	<100	–	–	–
	2	–	<100	<100	–
	3	–	–	–	<100

3.3 Mitigation requirements

34. It is not known at this stage if NPWS require mitigation of the instantaneous PTS-onset impact range only, or the cumulative PTS-onset impact range.

35. In Scotland, NatureScot advise that only the instantaneous PTS-onset range (using the SPL_{peak} metric) requires mitigation. NatureScot consider it to be disproportionate to mitigate the cumulative PTS-onset impact range given the acknowledged uncertainties and over-precaution in the cumulative PTS modelling.

36. Underwater noise modelling conducted for the CWP Project has predicted that the maximum PTS-onset range for cumulative PTS is 4.7 km for harbour porpoise and 9.5 km for minke whales. However, there is much uncertainty associated with the prediction of the cumulative PTS impact ranges. These are described in detail in **Chapter 11 Marine Mammals** and summarised here. The prediction of the onset of PTS is determined with the assumptions that:

- The amount of sound energy an animal is exposed to within 24 hours will have the same effect on its auditory system, regardless of whether it is received all at once (i.e., with a single bout of sound) or in several smaller doses spread over a longer period (called the equal-energy hypothesis); and
- The sound keeps its impulsive character, regardless of the distance to the sound source.

37. However, in practice:

- There is a recovery of a threshold shift caused by the sound energy if the dose is applied in several smaller doses (e.g., between pulses during pile driving or in piling breaks) leading to an

onset of PTS at a higher energy level than assumed with the given SEL_{cum} threshold (e.g., Kastak et al., 2005, Mooney et al., 2009, Finneran et al., 2010, Kastelein et al., 2013, Kastelein et al., 2014, Finneran, 2015, Kastelein et al., 2015); and
- Pulsed sound loses its impulsive characteristics while propagating away from the sound source, resulting in a slower shift of an animal's hearing threshold than would be predicted for an impulsive sound (Hastie et al., 2019, Martin et al., 2020, Southall, 2021).

38. Both assumptions, therefore, lead to a conservative determination of the cumulative PTS-onset impact ranges.

39. Given these levels of uncertainty and over-precaution and given that this is an evolving field of research, the Developer does not consider it necessary to commit to mitigating the current predicted cumulative PTS-onset ranges. However, the Developer has provided a suite of appropriate additional mitigation measures that can achieve the required reduction in noise level if ABP and NPWS consider it appropriate.

40. In the event that it is deemed necessary by ABP and NPWS to mitigate the current cumulative PTS onset range, the CWP Project commits to implementing Noise Abatement Systems to ensure an effective reduction of underwater noise of 10 dB SEL_{ss}.

41. The mitigation measures outlined here are divided into those required to mitigate instantaneous PTS (primary mitigation) and those required to mitigate cumulative PTS (additional mitigation).

3.4 Primary mitigation: Instantaneous PTS (SPL_{peak})

42. The instantaneous PTS-onset impact ranges (maximum 620 m) can be mitigated using 'Primary Mitigation Measures'. Primary mitigation measures include those that are considered to be 'industry standard' and are supported by the guidance. These are as follows, and are in addition to the soft-start and energy ramp-up already included in the primary mitigation and modelling:

- Pre-piling MMO watches of the Monitored Zone; and
- Pre-piling PAM.

3.4.1 Pre-piling MMO watches

43. The purpose of a pre-piling MMO watch is to ensure the Monitored Zone is free of marine mammals prior to the commencement of piling operations. The use of MMOs has been a common form of observational monitoring in the USA and UK since the 1980/90s and is now seen as an industry standard practice. Since the 2000s, PAM has also become part of these standards.

44. NPWS (2014) recommends the following approach be adopted, which the proposed project will implement through this MMMP:

- The Monitored Zone will be informed by underwater noise modelling where available;
- The MMO(s) should be qualified and experienced. NPWS (2014) state that a qualified and experienced MMO is defined as *'a visual observer who has undergone formal marine mammal observation and distance estimation training (JNCC MMO training course or equivalent) and also has a minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters'*;
- The MMO should have an unobstructed view of the Monitored Zone;
- The MMO should ideally be located near the centre of the Monitored Zone (i.e., adjacent to the sound source);

- Pre-start up monitoring of the Monitored Zone should be conducted for **at least 30 minutes** before piling commences;
- Piling is not to commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO;
- Once piling has commenced, there is no requirement to cease piling if a marine mammal occurs within the Monitored Zone; however, the MMO should continue monitoring the Monitored Zone during the ramp-up / soft-start procedure; and
- If for any reason there is a break in piling for a period longer than 30 minutes, then pre-start monitoring must be undertaken again, followed by the subsequent ramp-up procedure.

3.4.2 Pre-piling PAM

45. Passive acoustic monitoring (PAM) is the use of acoustic sensors to detect vocalising marine mammals. Since the mid-2000s, PAM has become a part of best practice industry standards in an effort to provide increased marine mammal monitoring capacities during periods of limited visibility, and to prevent delays in the construction and / or operations of offshore industries.

46. In the context of this MMMP, PAM is primarily used as a tool to detect and localise vocalising marine mammals. NPWS (2014) states that PAM '*may be recommended or required as part of the licence / consent conditions in order to optimise marine mammal detection around the site of a plan or project*'. NPWS (2014) highlights that while PAM is encouraged, it was not at the time of publication in 2014 considered by NPWS to be sufficiently developed to be considered the primary or only mitigation measure, as it was not considered to reliably detect all marine mammal species and has a limited detection range for some species.

47. IWDG (2020) recommends that PAM is used in standard mitigation protocols to '*allow detection of cetaceans in poor visibility during the hours of darkness and for detecting animals underwater where source levels are often highest*'.

48. JNCC (2010b) recommends the use of dedicated MMOs and PAM operators. They state that PAM can be a useful supplement to visual observations, though its use is limited by detection range (detecting harbour porpoise in a 500 m mitigation zone), and they also note the limitation that only vocalising animals can be detected. If used, JNCC recommend that the PAM operative should acoustically monitor for marine mammals for a **minimum of 30 minutes** prior to piling commencing, and if a marine mammal is detected, piling should not commence until 20 minutes after the last acoustic detection within the mitigation zone.

49. Given the proposed CWP project will require piling during periods of poor visibility and darkness, it is proposed that pre-piling PAM will be implemented. This will shorten the overall piling programme and the temporal impacts to marine mammals.

3.5 Additional mitigation: Cumulative PTS (SEL_{cum})

50. The inherently conservative maximum predicted cumulative PTS-onset impact ranges (4.7 km for porpoise, 9.5 km for minke whale) are beyond those that can be mitigated by the 'primary' 'industry standard' mitigation measures. As such, additional mitigation measures will be considered ***if NPWS confirm there is a requirement to mitigate cumulative PTS-onset impact ranges***.

51. The piling MMMP provides an outline of the potential additional mitigation measures (in addition to those required to mitigate instantaneous PTS) that could be implemented to reduce the risk of cumulative PTS to negligible levels. The mitigation measures provided reflect current best practice through reference to NPWS guidance and the more recent IWDG policy, and from other relevant

regions for the marine mammal population including, for example, Scottish precedent wherein NatureScot and the Marine Directorate accept ADD and PAM.

3.5.1 Pre-piling ADD activation

52. The purpose of pre-piling ADD activation is to deter marine mammals out of the Monitored Zone prior to the start of piling. The use of pre-piling ADDs is endorsed by Natural England, the MMO and NatureScot, and have been extensively accepted and used as a pre-piling mitigation method in England, Wales, Scotland and other European jurisdictions (e.g., German waters) over the last decade.

53. NPWS (2014) guidance does not include the use of pre-piling ADDs.

54. IWDG (2020) recommends that ADDs should be used to '*reduce the threat of auditory injury, where they are known to be effective for the species present'*. The policy recommends that ADD use should '*not exceed the noise levels of the mitigated activity itself and be only used prior to commencing activities'*.

55. JNCC (2010b) states that ADDs should be considered, but only used in conjunction with visual and / or acoustic monitoring.

56. Currently, the most common ADD used in piling mitigation is the Lofitech AS seal scarer[4]. This ADD has been shown to have the most consistent effective deterrent ranges for harbour porpoise and minke whales, as detailed in the sections below: 'Deterrence of harbour porpoise' and 'Deterrence of minke whales'. It is important to note that there may be additional ADD models identified in the pre-construction phase that are available and suitable for use. As such, if an ADD is identified as part of the suite of mitigation measures set out in the final MMMP, the final ADD choice and specification would be confirmed within the final MMMP.

57. The duration of ADD deployment would be calculated using swimming speed assumptions to ensure that marine mammals are beyond the Monitored Zone when piling commences. For example:

- Assuming a harbour porpoise swims at 1.5 m/s, it would require:
    - 11.1 minutes of ADD activation for an animal to flee from the pile out to 1 km; and
    - 52.2 minutes of ADD activation for an animal to flee from the pile out to 4.7 km (*this is within the range at which ADDs result in significant deterrence of porpoise*).
- Assuming a minke whale swims at 3.25 m/s, it would require:
    - 5.1 minutes of ADD activation for an animal to flee from the pile out to 1 km; and
    - 48.7 minutes of ADD activation for an animal to flee from the pile out to 9.5 km (*though it is noted that there is no evidence currently that ADDs are effective at deterring minke whales out to this distance*).

58. It is important that where ADDs are to be used, the duration of their use is balanced against the increased disturbance impact to marine mammals caused by their use. Therefore, where ADDs are used for mitigation purposes, the duration of their activation would need to be discussed and agreed with NPWS to ensure that the additional impact of disturbance is proportional.

[4] https://www.lofitech.no/

Deterrence of harbour porpoise

59. In the German North Sea, an array of CPODs was used to test the effectiveness of Lofitech devices for deterring harbour porpoise (Brandt et al., 2013b). The extent of deterrence was measured by recording porpoise vocalisations up to 7.5 km from the Lofitech deployment site. Ten trials were conducted, where each trial collected four hours of acoustic detections, in conjunction with an active ADD. During the 40 hours of collected data, there was a significant decline in porpoise detections. Within 750 m, detections of porpoise declined by 86% when the ADD was active. Furthermore, declines in porpoise detections were significant up to 7.5 km from the ADD source (**Plate 3-1**).

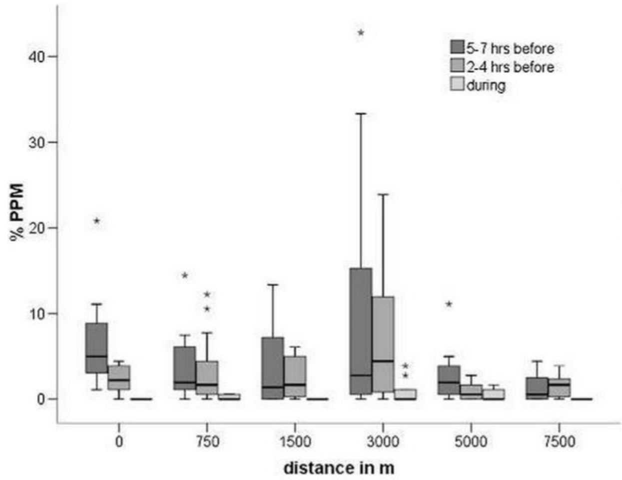


Plate 3-1 Percentage of porpoise positive minutes recorded before and during Lofitech trials at various distances (Brandt et al., 2013b)

60. In addition to acoustic monitoring, visual aerial surveys were conducted to identify changes in harbour porpoise presence during ADD activation. The average density fell to 0.3 porpoise/km^2 when the Lofitech device was activated, where baseline density estimates were 2.4 porpoise/km^2, over the 990 km^2 study area (**Plate 3-2**). To determine the duration of deterrence caused by ADDs, Brandt et al., (2013b) compared harbour porpoise detections before Lofitech activation and after the device was switched off. Porpoise detection rates were significantly lower up to six hours after devices were switched off, and after 7–9 hours, no significant difference was detected.

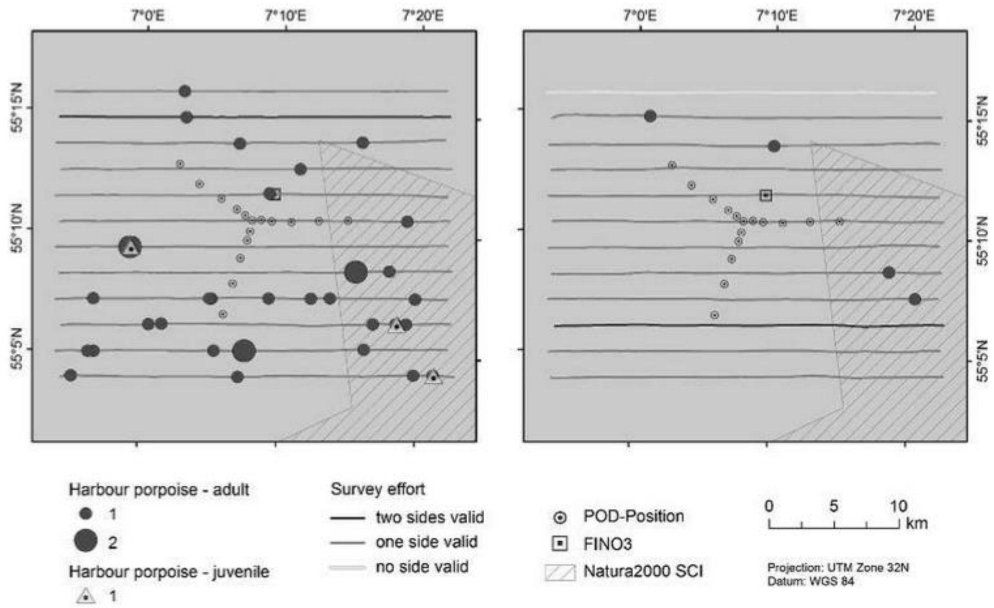


Plate 3-2 Harbour porpoise aerial sightings before (left) and during (right) Lofitech activation (Brandt et al., 2013b)

61. Brandt et al., (2013a) conducted further visual surveys to determine the responses of harbour porpoises to Lofitech ADDs (**Plate 3-3** and **Plate 3-4**). In Danish waters, devices were active for four continuous hours, with seven trials in total, leading to 28 hours of collected data. Sighting rates of harbour porpoise significantly declined up to 1 km from the active Lofitech device, which was associated with a minimum sound level of 129 dB re 1 µPa RMS. Upon activation of the ADD, the mean number of porpoises detected during a scan decreased from 0.86 to 0.01. While Lofitech trials in German waters observed avoidance up to 7.5 km from the device, in Danish waters avoidance was detected at a maximum of 2.4 km from the ADD. However, due to differences in water depth, the sound level at the offshore German site (119 dB re 1 µPa) and the more coastal Danish site were comparable. Porpoise avoidance behaviour occurred immediately upon device activation, with average swim speeds recorded at 1.6 m/s. Visual observations confirmed porpoises within a 1 km radius of the device, on average 51 minutes after the device was deactivated.

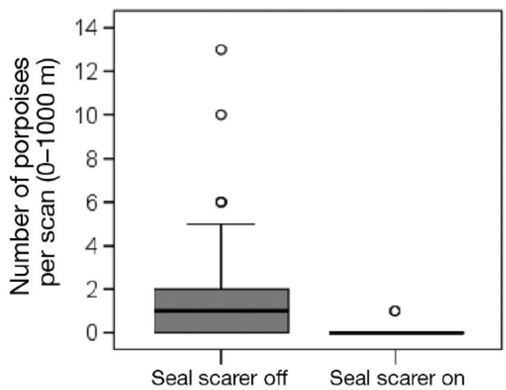


Plate 3-3 Number of harbour porpoises seen during scans when the Lofitech device was active and inactive (Brandt et al., 2013a)

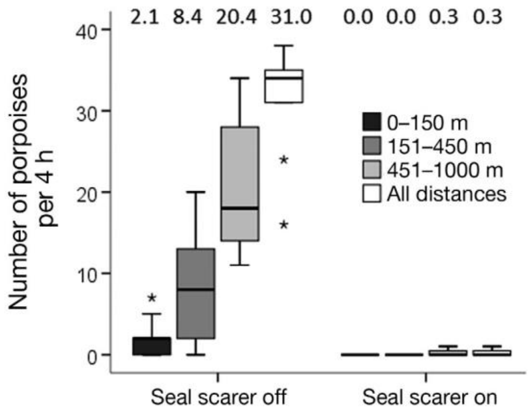
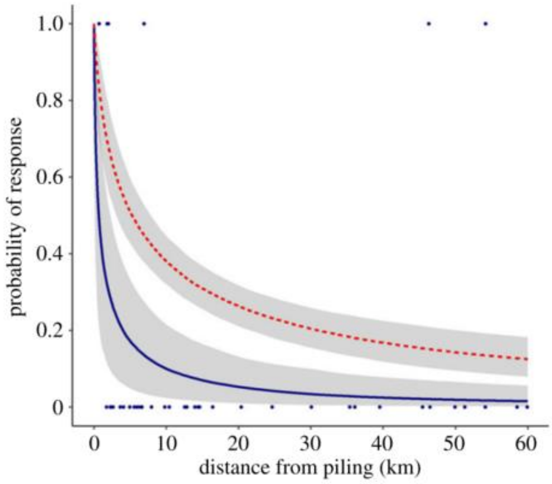


Plate 3-4 Harbour porpoise sighting rates when the Lofitech device was active and inactive over a range of distances (Brandt et al., 2013a)

62. ADDs were deployed (typically for 15 minutes) prior to piling to mitigate potential near-field injury impacts to harbour porpoise at the Beatrice Offshore Wind Farm, and a study of their effectiveness at this site is presented in Graham et al., (2019). They showed that there was a 50% chance of porpoise response out to 5.3 km (95% CI: 3.1–7.8 km) from piling with prior ADD activation. They also note that porpoise responses were higher when ADDs were activated prior to piling compared to when piling occurred without pre-piling ADD activation, though there was only a limited dataset to inform this. They highlight that a balance is needed to mitigate the near-field injury impacts while minimising the wider-field disturbance impacts.



63.

Plate 3-5 The probability of a harbour porpoise response (12 h) in relation to the partial contribution of distance from piling, with (dashed red line) and without (solid navy line) the use of the ADD prior to piling (Graham et al., 2019)

Deterrence of minke whales

64. During a study commissioned by Offshore Renewables Joint Industry Programme (ORJIP) in the UK, the playback of Lofitech ADDs resulted in behavioural modifications of minke whales (McGarry et al., 2017, Boisseau et al., 2021). A significant increase in swim speed and direct movement away from the ADD source implied avoidance of the Lofitech device (**Plate 3-6**). It was therefore suggested that

Lofitech ADDs may be used as a deterrent of minke whales from mitigation zones. One limitation of this study was the ability to follow the focal whale after it had been exposed to the ADD. The ADD was activated 1 km from the focal animal, and remained active for 15 minutes; all animals responded, which demonstrates an effective deterrence zone of at least 1 km. No measurements were made with ADDs activated at initial distances >1 km from the focal animal, and the visual limit of observations limited how far animals could be observed responding, so it is not known what the maximum effective deterrence range is. However, several animals continued to swim further away to a distance of between *c*. 3 km and 4.5 km following exposure.

65. To date, no further studies on the effective deterrence of minke whales from ADDs have been conducted.

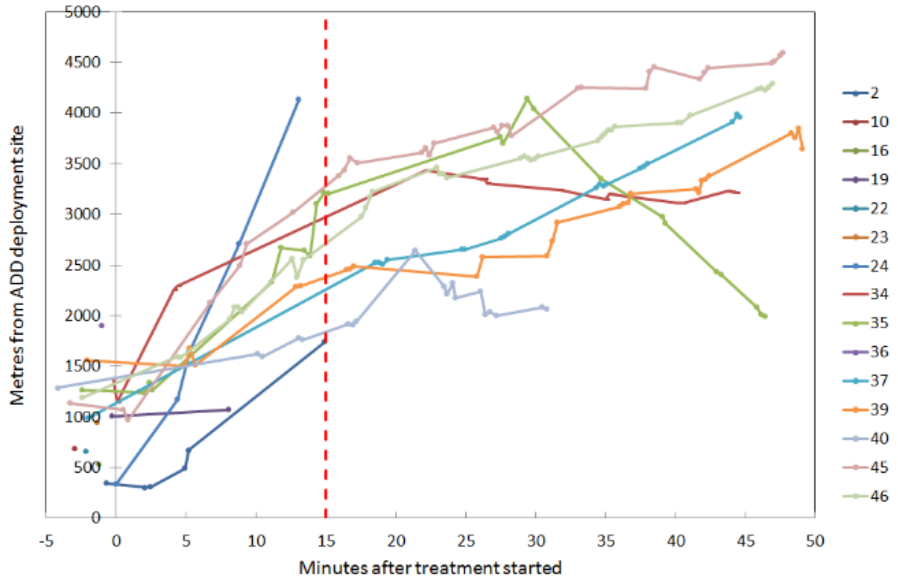


Plate 3-6 Distance of focal whales from the ADD deployment site during treatment and post treatment phases of the experiment (McGarry et al., 2017). The red dashed line indicates the end of the treatment phase.

3.5.2 Potential other additional mitigation measures

66. The predicted cumulative PTS-onset impact range for minke whales (maximum 9.5 km) is beyond those that can be mitigated by the primary 'industry standard' mitigation measures (MMO and PAM). Additionally, whilst there is evidence of affective deterrence out to 3–4 km, there is currently no evidence that ADDs can deter minke whales effectively out to a range of 9.5 km. As such, potential other additional mitigation measures (at-source noise abatement methods and alternative hammer types) will be considered ***if NPWS confirm there is a requirement to mitigate cumulative PTS-onset impact ranges***.

67. There are a number of different at-source noise abatement systems that have been commercially deployed at offshore wind farm projects. The purpose of these noise abatement systems is to reduce the noise propagated through the water column during pile driving, and thus reduce the impact of piling noise on marine life. At this stage it is important to note that the mitigation technology is evolving, and several technologies remain subject to a single supplier. As such, whilst the ability to mitigate to the required level is certain using any one of the technologies, it is prudent to present options in this

MMMP, and to select appropriate options, if required, in consultation with stakeholders closer to the time of construction.

Bubble curtains

68. Bubble curtains are described by Verfuss et al., (2019) as follows: '*Bubble curtains are formed by compressed air that is pumped through one or more nozzle hoses that are laid around the piling position at the seafloor. The air ascends through the nozzles into the water column up to the water surface and thereby builds a curtain of bubbles arising vertically along the tube. Piling sound will be absorbed, reflected and scattered from the ascending air bubbles, and thereby reduced*.'

69. There is increasing information on the effectiveness of bubble curtains to reduce underwater noise, for example:

- Bellmann et al., (2020) report that a single Big Bubble Curtain (BBC) can result in 7 to 11 dB SEL re 1 μPa^{2}s reduction in 40 m water depth, an 8 to 14 dB SEL reduction in 30 m water depth and an 11 to 15 dB reduction in 25 m water depth. Additionally, an optimised double BBC can result in an 8 to 18 dB SEL re 1 μPa^{2}s reduction at 40 m water depth, depending on the air volume used.

Resonators

70. Resonators are described by Verfuss et al., (2019) as follows: '*Resonators consist of an array of (solely or mainly) resonating units that are deployed around the pile to absorb the emitted sound. Unlike with BBCs, which are built of ascending air bubbles from a nozzle hose laid at the seafloor, there are a variety of different ways to build resonators'*. These can include air-filled balloons or foam elements.

71. There is increasing information on the effectiveness of resonators to reduce underwater noise, for example:

- Elzinga et al., (2019) reported on the new noise mitigation system (NMS) developed under the Underwater Noise Abatement System program with a consortium of partners: Van Oord Offshore Wind Projects, AdBm Technologies and TNO (Netherlands Organization for Applied Scientific Research). The NMS consists of a slatted system containing Helmholtz resonators deployed around a monopile. A full-scale test in 2018 showed that a configuration of 0.67 m vertical spacing of slats resulted in a 7 to 8 dB SEL re 1 μPa^{2}s reduction compared to the unmitigated scenario, and when combined with a big bubble curtain resulted in a 14 to 15 dB SEL reduction.
- The Hydro-Sound Damper (HSD) developed by OffNoise Solutions GmbH consists of a net of foam elements of different sizes and materials, and has been shown to result in a 10 to 12 dB SEL re 1 μPa^{2}s reduction alone, or a 15 to 20 dB SEL reduction when used in combination with an optimised BBC (Bellmann et al., 2020).

Casings

72. Casings are described by Verfuss et al., (2019) as follows: '*Casings are hard or soft shells that enclose the pile with reflective material during the piling activity to keep the sound emitted by the pile trapped within the casing. Casings range from flexible pile sleeves made of different fabrics to hollow steel tubes*.'

73. There is increasing information on the effectiveness of casings to reduce underwater noise, for example:

- The IHC-Noise Mitigation Screen developed by IHC IQIP bv consists of a double walled steel tube, with an air-filled interspace. This device has been shown to result in a 13 to 17 dB SEL re 1 μPa²s reduction alone, a 17 to 23 dB SEL reduction when used in combination with an optimised BBC or a 19 to 22 dB SEL reduction when used in conjunction with an optimised double BBC (Bellmann et al., 2020).
- The HydroNAS™ sleeve system developed by W3G Marine Ltd consists of a lightweight inflatable fabric which is used to form a column of air around the pile. The manufacturers website states that this system can result in a 25 dB SEL re 1 μPa²s reduction alone[5].

Environmental limitations

74. The use and effectiveness of each at-source noise abatement method is subject to environmental conditions such as water depth, current speed, wave height and wind speed. These are described further in Verfuss et al., (2019). These system specific environmental limitations need to be taken into consideration when considering which at-source noise abatement method may be suitable for use at the CWP Project.

Alternative hammer types

75. There are a number of different hammer types that have been commercially deployed at offshore wind farm projects for the installation of monopiles. The purpose of these varying hammer types is to reduce the noise propagated through the water column during pile driving, and thus reduce the impact of piling noise on marine life.

76. Whilst CWP have demonstrated that the project can be constructed through traditional percussive piling methods whilst avoiding significant adverse effects (see **Chapter 11 Marine Mammals**), as a responsible developer CWP will continue to review available technology and where new hammer technology is available with a demonstrable reduction in noise at source CWP will review and consider the practical implementation of alternative technology if available. The following sections describe potential or typical technology that may be available, however it is important to note that the technology is nascent, subject to ongoing development, and the specific technology described below cannot be committed to at this stage due to the potential for that technology or manufacturer not being available at the point of construction.

BLUE Piling Technology

77. The BLUE Piling technology is described by Verfuss et al., (2019) as follows: *'The BLUE Hammer from Fistuca BV consists of a steel housing that can be filled with a large water column. The water column is accelerated upwards before dropping onto the pile. High energy levels are achievable which allow a long-lasting blow with high force levels. The cycle of raising and dropping the water column is repeated'.*

78. BLUE Piling technology, produced by Fistuca BV, reduces noise at the source during installation by using the impact of a large water mass to create a pushing force on the pile (Bellmann et al., 2020). This technology reduces vibrations on the pile wall and provides a significant reduction of underwater noise compared to a conventional hammer impact. Underwater noise measurements during a full-

[5] https://www.w3gmarine.com/hydronas.html

scale monopile installation have showed a reduction in underwater noise emissions of more than 20 dB SEL when compared to conventional hammers (Bellmann et al., 2020).

Vibratory Hammers

79. Vibratory hammers are described by Verfuss et al. (2019) as follows: *'The vibratory hammer can be used to vibrate the pile with a certain low vibrating frequency vertically into the seabed. Pairs of counter-rotating eccentric masses generate an upwards and downwards movement, resulting in a vertical amplitude which results in a temporary reduction in soil resistance, which allows the pile to sink into the soil'.*

80. Vibratory piling has been used as an alternative method to impact piling at many wind farms. For example, CAPE Holland's Vibro Lifting Tool (VLT; i.e., vibratory hammer) can support the installation of both monopiles (XXL piles, up to 4 m diameter) and jacket piles and has been commercially deployed in water depths up to 30 m, whilst Dieseko's PVE vibratory hammer has been commercially deployed in water depths up to 40 m (Verfuss et al., 2019).

3.6 WTG / OSS Piling MMMP conclusion

81. A suite of potential mitigation measures are currently available that could be implemented at the CWP Project, to reduce the risk of auditory injury from pile driving to negligible levels. These include:

- For the mitigation of instantaneous PTS (primary mitigation):
    - Pre-piling MMO watches; and
    - Pre-piling PAM (if required to supplement the MMO) during poor visibility or darkness.
- For the mitigation of cumulative PTS (additional mitigation, if required):
    - Pre-piling ADD activation;
    - At-source noise abatement methods; and
    - Alternative hammer types.

82. Both NPWS (2014) and JNCC (2010b) recommend the use of visual observations by an MMO for **at least 30 minutes** prior to piling commencing to ensure the monitored / mitigation zone is free of marine mammals, supplemented with acoustic monitoring by a PAM operator. The use of ADDs prior to piling is not considered in the NPWS (2014) guidance, but the JNCC (2010b) guidance suggests it is considered. The pre-construction MMMP will be agreed with NPWS and the relevant Regulator closer to the time of construction to ensure appropriate technologies are used, and that the most recent guidance and best practice measures are implemented.

4 ONSHORE SUBSTATION PILING MMMP

83. Activities at the onshore substation on the northern shore of the Poolbeg Peninsula may require the installation of a combi-wall and reclamation for the ESB building at landfall on the banks of the River Liffey, Dublin. These activities will occur in the River Liffey, and thus will generate underwater noise that requires consideration in the marine mammal assessment. While it is expected that the combi-wall may be installed using vibro-piling, impact piling using 2.5 m diameter tubular piles was assessed as a proven technology that may also be utilised.

84. The assessment of PTS includes both instantaneous PTS using the SPL_{peak} metric (this is the PTS-onset impact range from a single strike), and cumulative PTS using the SEL_{cum} metric (this is the PTS-onset impact range from a cumulation of threshold shift across all pile strikes within a 24-hour period). As such, the objective of the Piling MMMP is to minimise the risk of auditory injury (i.e., PTS) to marine mammals as a result of noise generated by piling activities.

4.1 Piling parameters

85. Underwater noise modelling for the onshore substation has been undertaken by Subacoustech Environmental Limited using the INSPIRE model. Full details of the underwater noise modelling methods can be found in **Appendix 9.4 Underwater Noise Assessment** and are summarised here in **Table 4-1**. Piling for the onshore substation will be undertaken using a crawler crane with impact hammer attachment, rather than marine vessels.

Table 4-1 Piling parameters for the onshore substation

	1 piling rig	2 piling rigs
Maximum hammer energy (kJ)	400	400
Total number of strikes per piling event	48,000	96,000
Duration of piling event	8 hours	8 hours

4.2 PTS-onset impact ranges

4.2.1 Instantaneous PTS (SPL_{peak})

86. **Table 4-2** outlines the instantaneous PTS-onset impact ranges (using the SPL_{peak} metric). The maximum instantaneous PTS-onset impact range at full hammer energy is <50 m for all marine mammal species.

Table 4-2 Predicted instantaneous auditory injury (PTS) impact ranges (m) from WTG piling at the onshore substation

Species	Instantaneous PTS (SPL_{peak})
Harbour porpoise	<50
Dolphins	<50
Minke whale	<50
Seals	<50

4.2.2 Cumulative PTS (SEL_{cum})

87. **Table 4-3** outlines the cumulative PTS-onset impact ranges (using the SEL_{cum} metric). The maximum cumulative PTS-onset impact range is 3 km for harbour porpoise and 2 km for minke whales when 2 piling onshore rigs are piling simultaneously. For dolphins, the maximum cumulative PTS-onset impact range is <100 m. For seals, this is 300 m.

Table 4-3 Predicted auditory injury (PTS, SEL_{cum}) from piling at the onshore substation

	Minke whale	Dolphins	Harbour porpoise	Seals
Cumulative PTS (SEL_{cum}) 1 rig				
Area (km^2)	0.7	<0.01	1.5	<0.1
Max range (m)	1,100	<50	2,000	130
Cumulative PTS (SEL_{cum}) 2 rig				
Area (km^2)	1.4	<0.1	2.8	<0.1
Max range (m)	2,000	<100	3,000	300

4.3 Primary mitigation: Instantaneous PTS (SPL_{peak})

88. The instantaneous PTS-onset impact ranges (maximum 50 m) can be mitigated using ‘Primary Mitigation Measures’. Primary mitigation measures include those that are considered to be ‘industry standard’ and are supported by the NPWS (2014) guidance. These are as follows:

- Pre-piling MMO watches of the Monitored Zone; and
- Pre-piling PAM (if required).

4.3.1 Pre-piling MMO watches

89. As noted previously, the purpose of a pre-piling MMO watch is to ensure the Monitored Zone is free of marine mammals prior to the commencement of piling operations. The use of MMOs has been a common form of observational monitoring in the USA and UK since the 1980/90s and is now seen as an industry standard practice. Since the 2000s, PAM has also become part of these standards.

90. NPWS (2014) recommends the following approach be adopted, which the proposed project will implement through this MMMP:

- The Monitored Zone should be informed by underwater noise modelling where available (modelling has shown <50 m);
- The MMO(s) should be qualified and experienced. NPWS (2014) state that a qualified and experienced MMO is defined as *'a visual observer who has undergone formal marine mammal observation and distance estimation training (JNCC MMO training course or equivalent) and also has a minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters'*;
- The MMO should have an unobstructed view of the Monitored Zone;
- The MMO should be ideally located near the centre of the Monitored Zone (i.e., adjacent to the sound source);
- Pre-start up monitoring of the Monitored Zone should be conducted for **at least 30 minutes** before piling commences;
- Piling is not to commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO;
- Once piling has commenced, there is no requirement to cease piling if a marine mammal occurs within the Monitored Zone; however, the MMO should continue monitoring the Monitored Zone during the ramp-up / soft-start procedure; and
- If for any reason there is a break in piling for a period longer than 30 minutes, then pre-start monitoring must be undertaken again, followed by the subsequent ramp-up procedure.

4.3.2 Pre-piling PAM

91. As noted previously, PAM is the use of acoustic sensors to detect vocalising marine mammals. Since the mid-2000s, PAM has become a part of best practice industry standards in an effort to provide increased marine mammal monitoring capacities during periods of limited visibility, and to prevent delays in the construction and / or operations of offshore industries.

92. In the context of this MMMP, PAM is primarily used as a tool to detect and localise vocalising marine mammals. NPWS (2014) states that PAM '*may be recommended or required as part of the licence / consent conditions in order to optimise marine mammal detection around the site of a plan or project*'. NPWS (2014) highlights that while PAM is encouraged, it was not at the time of publication in 2014 considered by NPWS to be sufficiently developed to be considered the primary or only mitigation measure, as it was not considered to reliably detect all marine mammal species and has a limited detection range for some species.

93. IWDG (2020) recommends that PAM is used in standard mitigation protocols to '*allow detection of cetaceans in poor visibility during the hours of darkness and for detecting animals underwater where source levels are often highest'*.

94. JNCC (2010b) recommends the use of dedicated MMOs and PAM operators. They state that PAM can be a useful supplement to visual observations, though its use is limited by detection range (detecting harbour porpoise in a 500 m mitigation zone), and they also note the limitation that only vocalising animals can be detected. If used, JNCC recommend that the PAM operative should acoustically monitor for marine mammals for a **minimum of 30 minutes** prior to piling commencing, and if a marine mammal is detected, piling should not commence until 20 minutes after the last acoustic detection within the mitigation zone.

95. Given the proposed CWP project will require piling during periods of poor visibility and darkness, it is proposed that pre-piling PAM will be implemented. This will shorten the overall piling programme and the temporal impacts to marine mammals.

4.4 Additional mitigation: Cumulative PTS (SEL_{cum})

96. The maximum predicted cumulative PTS-onset impact ranges (3 km for porpoise, 2 km for minke whale) are beyond those that can be mitigated by the 'primary' 'industry standard' mitigation measures. As such, additional mitigation measures will be considered ***if NPWS confirm there is a requirement to mitigate cumulative PTS-onset impact ranges***.

97. The piling MMMP provides an outline of the primary and potential additional mitigation measures that could be implemented to reduce the risk of cumulative PTS to negligible levels for piling at the onshore substation. The additional options may be available to reduce the noise impact, but are not required to deliver the project.

4.4.1 Potential additional mitigation measures – ADD Activation

98. The purpose of pre-piling ADD activation is deter marine mammals out of the Monitored Zone prior to the start of piling. The use of pre-piling ADDs is endorsed by Natural England, the MMO and NatureScot, and have been extensively accepted and used as a pre-piling mitigation method in England, Wales, Scotland and other European jurisdictions (e.g., German waters) over the last decade.

99. NPWS (2014) guidance does not include the use of pre-piling ADDs.

100. IWDG (2020) recommends that ADDs should be used to '*reduce the threat of auditory injury, where they are known to be effective for the species present*'. The policy recommends that ADD use should '*not exceed the noise levels of the mitigated activity itself and be only used prior to commencing activities'*.

101. JNCC (2010b) states that ADDs should be considered, but only used in conjunction with visual and / or acoustic monitoring.

102. Currently, the most common ADD used in piling mitigation is the Lofitech AS seal scarer[6]. This ADD has been shown to have the most consistent effective deterrent ranges for harbour porpoise and minke whales, as detailed in the sections above: 'Deterrence of harbour porpoise' and 'Deterrence of minke whales'. It is important to note that there may be additional ADD models identified in the pre-construction phase that are available and suitable for use. As such, if an ADD is identified as part of the suite of mitigation measures set out in the final MMMP, the final ADD choice and specification would be confirmed within the final MMMP.

103. The duration of ADD deployment would be calculated using swimming speed assumptions to ensure that marine mammals are beyond the Monitored Zone when piling commences. For example:

- Assuming a harbour porpoise swims at 1.5 m/s, it would require:
  - 11.1 minutes of ADD activation for an animal to flee from the pile out to 1 km; and
  - 33.3 minutes of ADD activation for an animal to flee from the pile out to 3 km (*this is within the range at which ADDs result in significant deterrence of porpoise*).
- Assuming a minke whale swims at 3.25 m/s, it would require:
  - 5.1 minutes of ADD activation for an animal to flee from the pile out to 1 km; and
  - 10.3 minutes of ADD activation for an animal to flee from the pile out to 2 km (*though it is noted that there is no evidence currently that ADDs are effective at deterring minke whales out to this distance*).

[6] https://www.lofitech.no/

104. It is important that where ADDs are to be used, the duration of their use is balanced against the increased disturbance impact to marine mammals caused by their use. Therefore, where ADDs are used for mitigation purposes, the duration of their activation would need to be discussed and agreed with NPWS to ensure that the additional impact of disturbance is proportional.

4.5 Onshore substation piling MMMP conclusion

105. A suite of potential mitigation measures are currently available that could be implemented at the CWP Project, to reduce the risk of auditory injury from pile driving to negligible levels. These include:

- For the mitigation of instantaneous PTS (primary mitigation):
  - Pre-piling MMO watches; and
  - Pre-piling PAM (if required to supplement the MMO) during poor visibility or darkness.
- For the mitigation of cumulative PTS (additional mitigation, if required):
  - Pre-piling ADD activation.

106. Both NPWS (2014) and JNCC (2010b) recommend the use of visual observations by an MMO for **at least 30 minutes** prior to piling commencing to ensure the monitored / mitigation zone is free of marine mammals, supplemented with acoustic monitoring by a PAM operator. The use of ADDs prior to piling is not considered in the NPWS (2014) guidance, but the JNCC (2010b) guidance suggests it is considered. The pre-construction MMMP will be agreed with NPWS and the relevant Regulator closer to the time of construction to ensure appropriate technologies are used, and that the most recent guidance and best practice measures are implemented.

5 UXO MMMP

107. In line with MARA's Guidance for Consent Holders on the identification of Unexploded Ordnance (UXO) in the Maritime Area, in the event that an UXO is identified, CWPL will notify MARA and the Gardai. It is noted that An Garda Síochána will, in such circumstances, request military assistance be provided to deal with the UXO and that the Naval Service Dive Section are responsible for dealing with any UXO within Irish Territorial waters. In those circumstances, CWPL will engage with An Garda Síochána and the Naval Service Dive Section to ensure that they are aware of the requirements to carry UXO disposal activities in accordance with the mitigation measures in this MMMP and the conditions of the permission.

108. If UXO are identified across the array site or OECC, a risk assessment will be undertaken and items of UXO will be either avoided by equipment micro-siting, moved or detonated in situ. Recent advancements in the commercial availability of methods for UXO clearance mean that high-order detonation may be largely or completely avoided. The methods of UXO clearance considered for CWP Project may include:

- Removal / relocation;
- Low-order detonation (deflagration); and
- High-order detonation.

109. This section of the MMMP details the possible marine mammal mitigation and monitoring procedures during UXO clearance activities at the CWP Project. The objective of the UXO MMMP is to minimise the risk of auditory injury to marine mammals as a result of noise generated by UXO clearance. The metrics presented for PTS for UXO clearance are slightly different to those presented for piling, since UXO clearance is a single blast, rather the multiple pulses from pile driving activities. The assessment of PTS for UXO includes PTS using the SPL_{peak} metric (single strike) and PTS using the SEL_{ss} metric (single strike).

110. The final UXO MMMP will incorporate the most appropriate mitigation measures based upon best available information and proven methodologies at that time to mitigate the impacts of UXO clearance at CWP.

111. Whilst the risk of UXO is considered to be very low, for the purposes of the assessment it is assumed that within the Offshore Development Area of the CWP Project, up to ten UXO may require clearance. For the assessment it is assumed that a maximum charge weight of up to 525 kg Net Explosive Quantity (NEQ) may be required for 2,000 lb (907.2 kg) UXO. Detailed pre-construction surveys have not yet been completed; it is not possible at this time to determine exactly how many items of UXO will require clearance, however these assumptions are based on industry risk assessment and the very low likelihood of encountering UXO in the western Irish Sea. UXO clearance requirements will be the same regardless of the WTG option selected.

112. An overview of the auditory injury impact ranges assessed in the environmental impact assessment undertaken for marine mammals (see **Chapter 11 Marine Mammals**) and the potential mitigation measures for UXO clearance are outlined in the following sections of this MMMP.

5.1 PTS-onset impact ranges

113. The maximum charge weight for the potential UXO devices that could theoretically be present within the offshore development area has been estimated as 525 kg (TNT equivalent). The potential auditory injury (PTS) impact ranges have been modelled for the high-order clearance of a 525 kg UXO alongside a range of smaller devices, at charge weights of 25, 55, 120 and 240 kg. In each case, an

additional donor weight of 0.5 kg has been included to initiate detonation. Additionally, a low-order deflagration scenario has been modelled, assuming a donor charge of 0.25 kg.

114. Estimated auditory injury (PTS-onset) impact ranges are presented in **Table 5-1**. The maximum low order deflagration PTS-onset impact range is 990 m for harbour porpoise. For the high-order clearance of the largest expected UXO, the maximum PTS impact ranges are 12 km for harbour porpoise, 9.5 km for minke whales, 2.5 km for seals and 730 m for dolphins.

Table 5-1 Summary of the auditory injury (PTS-onset) impact ranges for UXO detonation using the impulsive, weighted SEL_{ss} and unweighted SPL_{peak} noise criteria from Southall et al. (2019) for marine mammals

Southall et al. (2019)	PTS (weighted SEL_{ss})				PTS (unweighted SPL_{peak})			
	Minke whale 183 dB	Dolphin 185 dB	Porpoise 155 dB	Seal 185 dB	Minke whale 219 dB	Dolphin 230 dB	Porpoise 202 dB	Seal 218 dB
Low order (0.25 kg)	230 m	<50 m	80 m	40 m	170 m	60 m	990 m	190 m
25 kg + donor	2.2 km	<50 m	570 m	390 m	820 m	260 m	4.6 km	910 m
55 kg + donor	3.2 km	<50 m	740 m	570 m	1.0 km	340 m	6.0 km	1.1 km
120 kg + donor	4.7 km	<50 m	950 m	830 m	1.3 km	450 m	7.8 km	1.5 km
240 kg + donor	6.5 km	<50 m	1.1 km	1.1 km	1.7 km	560 m	9.8 km	1.9 km
525 kg + donor	9.5 km	50 m	1.4 km	1.6 km	2.2 km	730 m	12 km	2.5 km

5.2 Mitigation measures

115. There are a number of potential mitigation measures that could be implemented at the CWP Project in order to reduce the risk of auditory injury from UXO clearance to negligible levels. These measures include pre-clearance soft start, the use of ADDs and monitoring measures, as well as at source noise reduction techniques and consideration of alternative clearance techniques (such as low-order deflagration). As with piling, mitigation measures outlined in this document and relating to UXO have been broken down into primary, additional and potentially required measures to reflect what is known about UXO removal during this stage in the consenting process, and what will be provided post consent once a UXO removal contractor is in place and final requirement for removal methods is known.

116. The different approaches are set out below and described further in the following sections:

- The implementation of an MMO protocol; this includes establishing a protocol in line with NPWS (NPWS, 2014) and JNCC guidelines, including PAM (JNCC, 2010a, 2023);
- The use of pre-clearance deployment of ADDs (JNCC, 2010a, 2023);
- The implementation of a soft-start approach (i.e., use of scare charges) and / or the sequencing of detonations;
- Consideration of any clearance techniques other than high-order detonation (i.e., removal / relocation and deflagration); and
- The use of noise abatement methods (i.e., bubble curtains) (JNCC, 2023).

5.2.1 Primary mitigation measures

Mitigation zone

117. Both the NPWS (2014) and JNCC (2010a) recommend a mitigation zone with a 1 km radius for UXO detonation. However, the estimated maximum ranges within which PTS could occur as a result of the detonation of a maximum 525 kg charge is up to 12 km for porpoise. These ranges are thus greater than the default 1 km mitigation zone recommended by both the NPWS (2014) and JNCC (2010a). A distance modification can be agreed with the Regulatory Authority under both NPWS (2014) and JNCC (2010a) guidelines, as long as information specific to the location and / or plan / project is available to inform a reduction or increase from the default 1 km mitigation zone. Under JNCC (2010a) guidelines, consultation with the appropriate nature conservation body is required throughout this process.

118. By contrast, more recent draft guidelines produced by the JNCC (2023) for minimising the risk of injury to marine mammals from explosive use in the marine environment state that the mitigation zone must cover the full extent of the area within which an animal may be subject to PTS, with a minimum of 1 km covered by MMOs for both low- and high-order clearance of UXO.

119. As impact ranges for auditory injury increase as the charge size weight increases (**Table 5-1**), the actual mitigation zone for the CWP Project will most likely differ from the default / minimum 1 km mitigation zone proposed by the NPWS and JNCC. As such, the mitigation zone used for UXO-detonation at CWP will be determined within the final MMMP once the final charge sizes and detonation methods are confirmed.

120. However, where impact ranges are likely to remain greater than the minimum 1 km mitigation zone (as per JNCC, 2023), it is likely that application of further mitigation measures will be required prior to the commencement of detonations to reduce the likelihood that either:

- Marine mammals are present within the mitigation zone; or
- Auditory injury impacts may occur.

121. This may include the introduction of ADDs and / or noise abatement methods.

Implementation of MMO Protocols (including PAM)

122. Both the NPWS (2014) and JNCC (2010a) recommend the use of an MMO to undertake a pre-detonation search within a defined mitigation zone.

123. Under NPWS (2014) guidelines, which are specific to the Republic of Ireland, it is recommended that *'blasting activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved'.* Further, it is recommended that a minimum pre-detonation search of **30 minutes** is required in waters up to 200 m deep. Under these guidelines, *'sound-producing activity shall not commence until at least 30 […] minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO'* (NPWS, 2014).

124. By comparison, the JNCC (2010a) recommend a **60-minute** pre-watch to be conducted irrespective of water depth. In addition, the JNCC also recommend the use of PAM to be used in conjunction with visual monitoring. This allows for an alternative means of monitoring to be carried out pre-detonation for periods of reduced visibility (e.g., night-time hours, the presence of fog and / or high sea states which make marine mammal detection difficult). During the 60-minute visual / PAM pre-watch, if an animal has been visually or acoustically detected, the MMO / PAM operative should determine whether the marine mammal is within the mitigation zone. UXO detonation should not occur until at least 60

minutes have elapsed with no marine mammal detections in the mitigation zone (JNCC, 2010a). The MMO will record all periods of marine mammal observations, including start and end times. Details of environmental conditions (sea state, weather, visibility, etc.) and any sightings of marine mammals around the vessel will also be recorded as per the JNCC and / or NPWS marine mammal recording forms and guidelines (JNCC, 2010a, NPWS, 2014).

125. Under the draft JNCC (2023) guidelines it is recommended that a minimum **30 minute** pre-detonation search is undertaken for low-order detonations, whilst **60 minute** pre-detonation searches are only required in water depths >200 m. During the pre-watch, a minimum of two MMOs are required for a 1 km mitigation zone, although if PAM is required in conjunction with visual monitoring procedures, then two MMOs and one PAM operator are required. UXO detonation should not occur until at least 60 minutes have elapsed with no marine mammal detections in the mitigation zone (JNCC, 2023).

126. It should be noted that if PAM is unavailable during pre-detonation searches for marine mammals, then UXO detonation would only be able to commence during periods of unrestricted visibility and during daylight hours to prevent the risks of failing to detect marine mammals. During all visual observations, the MMO will undertake visual observations within the 1 km mitigation zone around the UXO location from a suitable elevated platform that allows 360 degree visual observations.

127. The agreed implementation of MMO protocols for UXO detonation will, however, be agreed within the final MMMP once the scope of UXO clearance is known.

5.2.2 Additional mitigation measures

128. The maximum predicted cumulative PTS-onset impact ranges for high-order clearance of a 525 kg UXO (12 km for porpoise and 9.5 km for minke whales) are beyond those that can be mitigated by the ‘primary’ ‘industry standard’ mitigation measures. As such, additional mitigation measures will be considered.

Pre-UXO clearance deployment of ADDs

129. Whilst the NPWS (2014) guidelines do not state the use of ADDs as a method for reducing the risk of causing injury to marine mammals pre-UXO clearance, the JNCC guidelines state that *‘the use of devices that have the potential to exclude animals from the mitigation zone should be considered’* (JNCC, 2010a); this includes the use of ADDs. Under the new draft JNCC (2023) guidelines, it is stated that ADDs ‘*can also be deployed’* in circumstances where the mitigation zone is >1 km.

130. It is worth noting, however, that the JNCC (2010a, 2023) guidelines state that *‘Acoustic Deterrent Devices (ADDs) should only be used in conjunction with visual and / or acoustic monitoring and for as short period as necessary to minimise the introduction of additional noise’*. As such, the decision to use ADDs as part of the suite of mitigation measures for UXO detonation should be made, based on the effectiveness of ADDs as a mitigative device for reducing underwater noise impacts from UXO detonation on marine mammals.

131. IWDG (2020) do not mention the use of ADDs for UXO clearance in their policy for offshore wind farm development and recommendations document.

Deterrence of marine mammals

132. The effectiveness of ADDs to deter porpoise and minke whales is described above in paragraph 48 et seq. For the high-order clearance of the largest expected UXO, the maximum PTS impact ranges are

12 km for harbour porpoise and 9.5 km for minke whales (**Table 5-1**), which exceeds the distances for which evidence is currently available for the effective use of ADDs (7.5 km for harbour porpoise, ~4 km for minke whale).

133. For the high-order clearance of the largest expected UXO, the maximum PTS impact range is 2.5 km for seals (**Table 5-1**), which exceeds the distances for the effective use of ADDs. In 2015, Marine Scotland funded a project to assess the effectiveness of Lofitech devices as harbour seal deterrents (Gordon et al., 2015). In Kyle Rhea in 2013, 10 seals were tagged, and in the Moray Firth in 2014, 13 tags were deployed. In total, 73 controlled exposure experiments (CEE) were conducted, and responses monitored using a novel telemetry tracking system. All animals within ~1 km of the source exhibited a behavioural response during CEEs (n=38) (**Plate 5-1** and **Plate 5-2**). A lack of response to the CEE was first observed 998 m from the device, with a predicted received sound level of 132 dB re 1 1 µPa RMS (**Plate 5-1**). Conversely, responses were detected up to 3.112 km from the ADD, where the predicted received level was 120 dB re 1 µPa RMS. However, distances further than 1 km from the device were characterised by lower response rates, for example, at 4.1 km from the source, only 20% of seals responded to the CEE (**Plate 5-2**). Overall, it was concluded that the use the Lofitech device would deter seals up to ~1 km from the source.

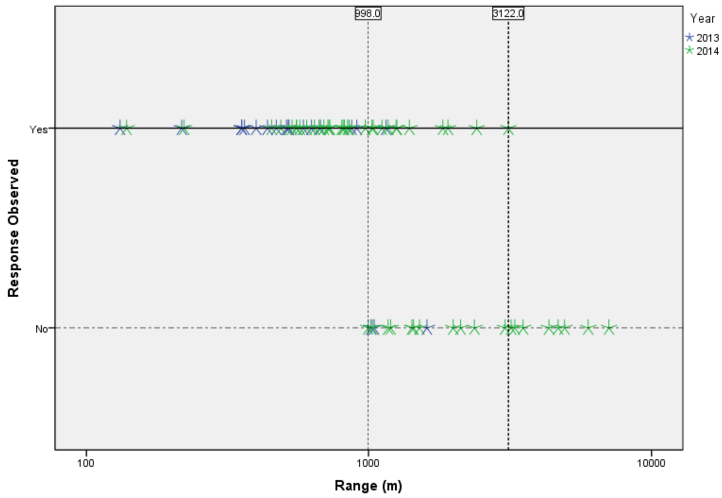


Plate 5-1 Controlled exposure experiments with harbour seals and the Lofitech device which did and did not elicit responses plotted against range (reproduced from Gordon et al., 2015). The range of the first closest non-responsive CEE and the most distant responsive CEEs are indicated by the dotted vertical lines.

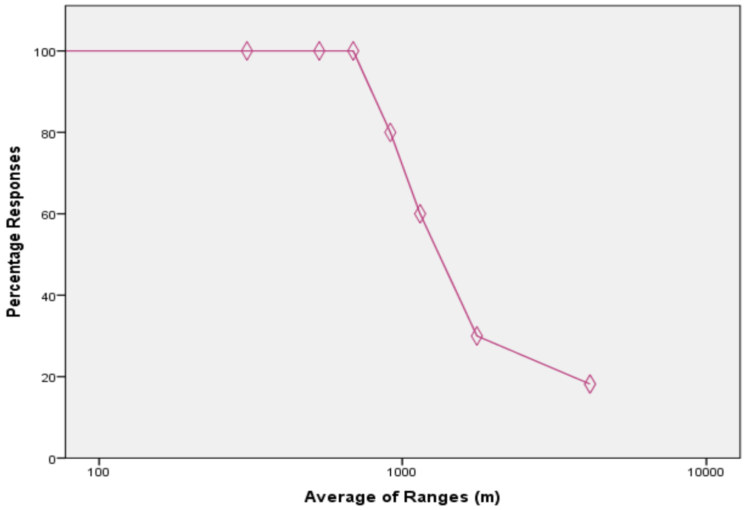


Plate 5-2 Percentage of controlled exposure experiments with harbour seals and the Lofitech device eliciting a response ranked by range (reproduced from Gordon et al., 2015)

Implementation of ADDs for UXO clearance

134. If an ADD is chosen as part of the mitigation measures employed for UXO clearance at the CWP Project, the following measures shall be implemented:

- A suitably trained ADD operator and a dedicated MMO are required to implement the mitigation set out in the final UXO MMMP. The MMO will be required to undertake the pre-detonation watch, which is proposed to be 30 minutes (or 60 minutes depending on water depth), in accordance with recent best practice guidance (JNCC, 2023).
- The duration of ADD deployment would be calculated using swimming speed assumptions to ensure that marine mammals are beyond the mitigation zone when UXO clearance commences.
- The ADD will be switched off immediately prior to UXO detonation.

135. These measures will be reviewed and confirmed within the final MMMP once the scope of UXO clearance is known.

Deflagration

136. The low-order deflagration method which has been through research with Department for Business, Energy & Industrial Strategy (BEIS), Loughborough University and the National Physical Laboratory in the UK, has shown very high efficacy (Robinson et al., 2020). Most recently, low-order deflagration was used at the Moray West wind farm to clear 82 UXOs of various types, with none requiring high-order detonation (Abad Oliva et al., 2024). As such, the JNCC (2023) draft guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance state that:

'Low order deflagration is currently the primary alternative available to high order clearance. […]. These guidelines therefore assume the primary method of clearance is one which will result in reduced noise levels compared to high order clearance, for example, low order deflagration.'

137. The JNCC (2023) guidelines also state that *'when deciding what low noise deflagration tool to use, robust evidence to support claims of reduced noise impacts when using that specified tool is key, as is its effectiveness at working as required. It must be clear in the application which tool is to be used*

and evidence presented demonstrating the noise reduction expected to be achieved by the chosen tool.'

138. As final detailed removal methods are unknown at this stage of the consenting process, deflagration tools cannot be provided at this stage. However, in the unlikely event that UXO clearance is required, once a UXO removal contractor is in place and final detailed removal methods are known, if deflagration tools are chosen as a method of UXO removal, low noise methods will be provided along with suitable evidence to support claims of reduced environmental impacts.

Implementation of a soft-start approach and / or sequencing of detonations

139. Under NPWS (2014) guidelines, which are specific to the Republic of Ireland, it is recommended that (bold underline added) *'the use of a clear Ramp-Up Procedure **must** be considered',* whilst the JNCC (2010a) guidelines state that *'a progressive increase in charge size […] **may be** effective as a means of reducing the risk of injury, by allowing time for marine mammals to move away from the area'.*

140. Both the NPWS (2014) and JNCC (2010a) guidelines recommend that, whenever possible, the order in which the explosive charges are detonated should be controlled and progressive following the completion of the initial MMO / PAM watch, otherwise known as a 'soft-start' or 'ramp-up' procedure.

141. The soft-start approach, for example, will involve the detonation of smaller mass charge sizes first in a progressive series of blasts. This is intended to allow for animal avoidance, surfacing or other potential safeguarding behaviour of marine mammals to occur. Sequential detonations within an overall blast cycle should employ a short inter-charge time delay (of milliseconds in duration) in order to minimise the cumulative effect of separate individual blast pulses (JNCC, 2010a, NPWS, 2014). These are also known as scarer charges.

142. Whilst the draft JNCC (2023) guidelines note that scarer charges are not recommended '*as a mitigation option for marine mammals and should not be used for this purpose'*, it is considered at this stage to rely on extant NPWS (2014) guidelines until such time as they are updated or the draft JNCC guidance finalised. As such, if directed by NPWS, CWP may implement scarer charges if UXO require clearance.

Other potential additional mitigation measures

143. In the event that deflagration fails and the effect cannot be avoided by primary (MMO and PAM) and / or additional mitigation measures (ADDs), and it is safe to do so, CWP commit to implement noise abatement systems.

144. Neither the NPWS (2014) nor the JNCC (2010a) guidelines mention the use of noise abatement systems during UXO clearance; however, the new draft JNCC (2023) guidelines state that noise abatement measures '*should be considered when injury ranges are greater than can be mitigated [against] using MMOs, PAM and / or ADDs (e.g., [impact ranges] >7.5 km [for harbour porpoise])'*. This suggests that noise abatement technologies as a mitigation procedure are not required to be employed unless impact ranges exceed 7.5 km and other methods of mitigation are not successful.

145. Noise abatement technologies are further described in **Section 3.5.2** of this MMMP. Such methods have previously been employed during UXO detonation, such as the use of bubble curtains (Schmidtke, 2010, 2012; Croci et al., 2014; Merchant and Robinson, 2019) and thus, the IWDG (2020) recommend that where UXO removal is not possible, ordnance should be detonated with the use of *'noise abatement to reduce noise impact'.*

146. Croci et al., (2014) presented the results of a study whereby the transmission of a shock wave (one which simulated a shock wave produced by high-order UXO detonation) propagating through a bubble

curtain was investigated. In this study, the attenuation by the use of a bubble curtain was ~48 dB (in terms of peak pressure) (Croci et al., 2014). Another experimental set-up by Cheong et al. (2023) investigated the effectiveness of small bubble curtains around UXO during low-order disposal by conducting controlled experimental trials in a quarry facility. In this study, the results demonstrate that bubble curtains can achieve a reduction in peak sound pressure level of between 13 dB and 17 dB, and in SEL of between 7 dB and 8 dB (Cheong et al., 2023).

147. When comparing the use of ADDs versus noise abatement methods such as bubble curtains during UXO detonation, only high-order detonations of UXO would likely require noise abatement in conjunction with other mitigative measures. In contrast, the use of ADDs only may be sufficient to minimise impacts from low-order (deflagration) clearance.

148. The decision to use noise abatement methods will therefore be made within the final UXO MMMP, when the scope of UXO clearance is known.

5.3 UXO MMMP Conclusion

149. A suite of potential mitigation measures are currently available that could be implemented at the CWP Project, to reduce the risk of auditory injury from UXO detonation to negligible levels. These include:

- Primary mitigation:
  - Pre-detonation MMO watches; and
  - Pre-detonation PAM (if required to supplement the MMO) during poor visibility or darkness.
- Additional mitigation:
  - Pre-detonation ADD activation;
  - The implementation of a soft-start approach (i.e., use of scare charges) and / or the sequencing of detonations; and
  - Consideration of any clearance techniques other than high-order detonation (i.e., removal / relocation and deflagration).
- Potential mitigation (in the event that deflagration fails):
  - At-source noise abatement methods.

150. Both NPWS (2014) and JNCC (2010a, 2023) recommend the use of visual observations by an MMO prior to detonation commencing to ensure the monitored / mitigation zone is free of marine mammals. However, the duration at which pre-detonation watches should last differs between each guidance document. The use of ADDs prior to detonation is not considered in the NPWS (2014) nor IWDG (2020) guidance, but the JNCC (2010a, 2023) guidelines suggest it is considered. There is also disparity in the guidelines on the approach to implementing soft-start procedures or sequencing of detonations. Whilst both the NPWS (2014) and JNCC (2010a) guidelines recommend that, whenever possible, the order in which the explosive charges are detonated should be controlled and progressive following the completion of the initial MMO / PAM watch, the new draft JNCC (2023) guidelines do not recommend the use of scarer charges (i.e., a soft-start or ramp-up procedure).

151. The UXO MMMP will be agreed with NPWS and the relevant Regulator closer to the time of construction to ensure appropriate technologies are used, and that the most recent guidance and best practice measures are implemented.

6 DECOMMISSIONING MMMP

152. Decommissioning activities will include removal of offshore structures above the seabed in reverse order to the construction sequence. The effects of these activities on marine mammals are considered to be similar to, or less than those occurring during construction. The final methods chosen for decommissioning will be dependent on the technologies available at the time, and in accordance with the decommissioning schedule.

153. DAHG (2014) guidance does not cover decommissioning activities.

154. IWDG (2020) acknowledges that at this stage it is not possible to know the decommissioning process, or what impacts it may have on marine mammals. They advise that standard mitigation is used, including 24-hour detection capability and soft-start / ramp-up protocols where applicable.

155. As a minimum, it is expected that an MMO watch and a PAM watch (to supplement the MMO) will likely be required for any underwater noise generating activity that has predicted the potential for auditory injury to marine mammals. Depending on the extent of the predicted auditory injury ranges, other additional mitigation methods can be considered, such as ADDs or noise abatement methods.

156. A full environmental assessment for decommissioning activities will be conducted prior to decommissioning activities taking place. This will outline the potential auditory impact ranges for marine mammals for the decommissioning methods identified for the project. This will also inform a MMMP appropriate for those activities.

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Natura Impact Statement

Volume 7

Appendix 7 - Ornithology Proxy Conservation objectives

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Abbreviations

Abbreviation	Term in Full
AESI	Adverse effect on site integrity
CEMP	Construction Environmental Management Plan
CO	Conservation Objective
CRM	Collision Risk Modelling
CWP	Codling Wind Park
CWPL	Codling Wind Park Limited
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic field
EU	European Union
INNS	Invasive non-native species
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Services
OECC	Offshore Export Cable Corridor
OWF	Offshore wind farm
O&M	Operations and maintenance
OSS	Offshore substation structure
SCI	Special Conservation Interest
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TTS	Temporary Threshold Shift
UXO	Unexploded ordinance
VMP	Vessel Management Plan
WTG	Wind turbine generator

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.
ESB Networks (ESBN)	Owner of the electricity distribution system in the Republic of Ireland, responsible for carrying out maintenance, repairs and construction on the grid.
ESBN network cables *(previously the ESB grid connection)*	Three onshore export cable circuits connecting the onshore substation to the proposed ESBN Poolbeg substation, which will then transfer the electricity onwards to the national grid.
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.
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).
offshore development area	The entire footprint of the offshore infrastructure and associated temporary works that will form the offshore boundary for the development consent application.
offshore export cables	The cables which transport electricity generated by the WTGs from the offshore substations (OSSs) to the landfall.
offshore export cable corridor (OECC)	The area between the array site and the landfall, within which the offshore export cables cable will be installed along with cable protection and other temporary works for construction.
offshore infrastructure	The offshore infrastructure, comprising of the WTGs, IACs, OSSs, Interconnector cables, offshore export cables and other associated infrastructure such as cable and scour protection.

Glossary	Meaning
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.
onshore development area	The entire footprint of the OTI (Onshore transmission infrastructure) 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.
onshore substation	Site containing electrical equipment to enable connection to the national grid.
operations and maintenance (O&M) activities	Activities (e.g., monitoring, inspections, reactive repairs, planned maintenance) undertaken during the O&M phase of the CWP Project.
O&M phase	This is the period of time during which the CWP Project will be operated and maintained.
operations and maintenance base (OMB)	The operational and maintenance facilities to support the CWP Project, including buildings/warehouses, laydown areas, cranes, parking and marine works such as pontoons for maintenance vessels.
parameters	Set of parameters by which the CWP Project is defined and which are used to form the basis of assessments.
phase 1 Project	On 19 of May 2020, the Government announced that seven offshore renewable energy projects had been designated as Relevant Projects, namely Oriel Wind Park, Arklow Bank II, Bray Bank, Kish Bank. North Irish Sea Array, Codling Wind Park and Skerd Rocks. These projects are now known as Phase 1 Projects.
planning application boundary	The area subject to the application for development consent, including all permanent and temporary works for the CWP Project.
Strategic Infrastructure Development	Strategic Infrastructure Development includes development which would: - contribute significantly to meeting any of the objectives of the National Planning Framework, or - contribute significantly to meeting any regional spatial and economic strategy for an area, or - have a significant effect on the area of more than one planning authority.
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 (WTG)	All the components of a wind turbine, including the tower, nacelle, and rotor.

APPENDIX 7 – ORNITHOLOGY PROXY CONSERVATION OBJECTIVES

1 Introduction

1. This appendix forms part of **Volume 7** of the Natura Impact Statement (NIS) for the Codling Wind Park (CWP) Project and should be read in conjunction with **Volume 5 Part 2**. This appendix provides assessment of Adverse Effect on Site Integrity (AESI) against proxy Special Conservation Interest (SCI) specific Conservation Objectives (COs) in relation to Irish breeding seabird Special Protection Areas (SPAs) where presently published COs may be considered as not separately described in relation to each SCI of the SPA. The rationale for the presentation of this additional assessment follows a request from the National Parks and Wildlife Service (NPWS) during consultation in October 2023.
2. Assessment of impacts against appropriate proxy COs are provided on a SCI by SCI basis for each breeding seabird species of relevant Irish SPAs (i.e. SPAs progressed through Screening (**NIS, Volume 3**), which are designated in relation to one or more breeding seabird SCIs and for which published COs may be viewed as being 'generic').
3. For the majority of SCIs considered, the SCI-specific COs of those SCIs (and their associated attributes and targets) presented within the CO document of the Saltee Islands SPA (NPWS, 2011) are regarded to represent the most appropriate proxy COs against which to undertake additional impact assessment. This specifically relates to kittiwake, herring gull, guillemot, razorbill, cormorant, fulmar, lesser black-backed gull, puffin and gannet, which are breeding SCIs of Saltee Islands SPA.
4. For Manx shearwater, where there are no Irish SPAs outlining SCI-specific COs, the CO (and associated attributes and targets) of another seabird species considered similarly pelagic in its habits (i.e. gannet) from Saltee Islands SPA have been used as a basis for a 'non-generic' additional assessment.

1.1 High level assessment of Introduction or spread of Invasive Non-Native Species (INNS) impacts

5. For impacts relating to the introduction or spread of invasive non-native species (INNS), there is considered to be no potential for CWP Project activities to result in the introduction or spread of INNS within in the in-situ habitats used by the SCIs of these SPAs. This is due to the separation distances between all non-overlapping SPAs assessed within the NIS and activities and infrastructure associated with the CWP Project.
6. Impacts from the potential introduction or spread of INNS to non-overlapping SPAs are entirely limited to ex situ habitats which may support the SCIs of those SPAs. As CWP Project areas where the introduction or spread of non-native INNS may coincide with, at most, very limited proportions of the ex-situ supporting habitats of SCIs from the above listed SPAs, it is considered that the potential for such ex-situ impacts to impede the conservation objectives of non-overlapping SPAs is negligible and therefore that there is no meaningful pathway for such impacts to result in AESI.
7. Despite this, the implementation of mitigation measures to align with European Union (EU) policy (specifically EU Regulation 1143 [regarding the prevention and management of the introduction and spread of INNS]; and The EU Biodiversity Strategy for 2030 [which contains a commitment to manage established INNS and decrease the number of Red List species they threaten by 50% by 2030]) in the form of biosecurity protocols outlined within the Construction Environmental Management Plan (CEMP) shall eliminate or reduce CWP Project risk relating to the introduction or spread of invasive non-native species across all areas and phases of the project. This will have the effect of eliminating

or reducing potential ex situ introduction or spread of invasive non-native species impacts within supporting habitats of the SCIs of the above listed non-overlapping SPAs.

8. In relation to the conservation objectives, attributes and targets for SCIs of all non-overlapping SPAs, for introduction and spread of INNS impacts it can be concluded that there is no impediment to their conservation objectives being met for any SCIs and, in turn, that there is no project-only AESI for these SPAs.

2 SCI-specific additional assessments of AESI

2.1 Kittiwake

Table 1: Proxy CO, Attributes and Targets for kittiwake in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Kittiwake	• Wicklow Head SPA • Howth Head Coast SPA • Ireland's Eye SPA • Lambay Island SPA • Helvick Head to Ballyquin SPA • Old Head of Kinsale SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.1.1, below.	None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Collision [1,2]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.1.1 Kittiwake: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

9. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the kittiwake SCI of these SPAs.

10. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all Wind Turbine Generators (WTGs) and Offshore Sub-Stations (OSSs)). This direct effect on habitat has the potential to impact on the following Conservation Objective attribute and target for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline

11. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

12. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 300.6 km, Woodward *et al*., 2019) of kittiwake breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

13. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the kittiwake SCI of these SPAs. The CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

14. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

15. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

16. The Conservation Objective and its attributes and targets for the kittiwake SCI of these SPAs are presented in **Table 1**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that **there is no project-only AESI for the kittiwake SCI of these SPAs.**

Construction phase impact 2 – Changes in prey availability

Array site

Project only assessment

17. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the kittiwake SCI of these SPAs.

18. Kittiwake depredates a range of fish species. Construction phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

19. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact kittiwake prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging kittiwake, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

20. Of kittiwake's key prey species groups, gadoids are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury-inducing underwater noise impacts to this group (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are, however, calculated to occur within only very small areas (up to 34 km^2 and 94 km^2, respectively) of this SCI's breeding season foraging range (mean-maximum + 1 S.D. = 300.6 km, Woodward *et al*., 2019). Although Temporary Threshold Shift (TTS) inducing underwater noise impacts to gadoids are predicted to occur to a larger, although still very small, proportion of theoretical kittiwake breeding season foraging areas (up to 3,500 km^2), TTS impacts to prey species are considered to have very limited potential to result in population or productivity declines to their seabird predators.

21. Areas affected by increased Suspended Sediment Concentration (SSC) levels during construction phase activities within the array site are also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents and occur over considerably shorter durations. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm.

22. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

23. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of kittiwake breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

24. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

25. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly decrease kittiwake prey species biomass or increase the energetic costs of foraging for the kittiwake SCI of these SPAs in such a way as to affect population decline or reductions in breeding population abundance, productivity rate or prey biomass availability. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the kittiwake SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

26. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

27. As per project only assessment, above.

OECC

Project only assessment

28. As the Offshore Export Cable Corridor (OECC) does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the kittiwake SCI of Salee Islands SPA.

29. Kittiwake depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

30. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact kittiwake prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging kittiwake, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

31. Of kittiwake's key prey species groups, gadoids are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of Unexploded Ordinance (UXO) (fewer than ten).

32. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 300.6 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

33. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas, benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

34. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of kittiwake breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

35. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

36. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly decrease kittiwake prey species biomass or increase the energetic costs of foraging for the kittiwake SCI of these SPAs, or lead to reductions in offspring provisioning rates for the kittiwake SCI of these SPAs in such a way as to affect population decline or

reductions in breeding population abundance, productivity rate or prey biomass availability. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the kittiwake SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

37. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

38. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

39. The Conservation Objective and its attributes and targets for the kittiwake SCI of these SPAs are presented in **Table 1,** above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the kittiwake SCI of these SPAs.**

Operation and maintenance impact 1 – Direct effects on habitat

Array site

Project only assessment

40. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the kittiwake SCI of these SPAs.

41. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline.

42. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of the spatial footprint of operational infrastructure within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

43. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 300.6 km, Woodward *et al*., 2019) of kittiwake breeding

within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

44. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the kittiwake SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining the favourable conservation condition of the kittiwake SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

45. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

46. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

47. The Conservation Objective and its attributes and targets for the kittiwake SCI of these SPAs are presented in **Table 1**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the kittiwake SCI of these SPAs.**

Operation and maintenance impact 2 – Changes in prey availability

Array site

Project only assessment

48. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the kittiwake SCI of these SPAs.

49. Kittiwake depredates a range of fish species. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

50. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact kittiwake prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging kittiwake, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

51. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

52. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

53. Key fish species, upon which kittiwake predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

54. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely Electromagnetic Field (EMF) effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

55. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of kittiwake breeding within these SPAs (mean-maximum + 1. S.D. = 300.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

56. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

57. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly decrease kittiwake prey species biomass or increase the energetic costs of foraging for the kittiwake SCI of these SPAs in such a way as to affect reductions in breeding population abundance, productivity rate or prey biomass availability. The

CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the kittiwake SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

58. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase for the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

59. As per project only assessment, above.

OECC

Project only assessment

60. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the kittiwake SCI of these SPAs.

61. Kittiwake depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

62. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact kittiwake prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging kittiwake, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

63. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

64. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

65. Key fish species, upon which kittiwake predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

66. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

67. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of kittiwake breeding within these SPAs (mean-maximum + 1. S.D. = 300.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

68. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

69. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly decrease kittiwake prey species biomass or increase the energetic costs of foraging for the kittiwake SCI of these SPAs in such a way as to affect population decline or reductions in breeding population abundance, productivity rate or prey biomass availability. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the kittiwake SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

70. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase for the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

71. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

72. The Conservation Objective and its attributes and targets for the kittiwake SCI of these SPAs are presented in **Table 1**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the kittiwake SCI of these SPAs.**

Operation and maintenance impact 3 – Collision

Array site

Project only assessment

73. During the operation and maintenance phase of the CWP Project the presence of operational WTGs within the array site may result in the mortality of kittiwake from the above-listed SPAs through the collision of individuals with turbine blades. Collision mortality has the potential to impact on the following Conservation Objective attributes and targets for the kittiwake SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline

74. In relation to these Conservation Objective attributes, mortality resultant from collision with operational WTGs within the array site may directly affect the overall survival rate and associated breeding population abundance of this SCI at these SPAs. Furthermore, collision mortality may also adversely affect the overall productivity rate of these SPAs, through reductions to offspring provisioning rates and other parental care metrics where parent birds experience collision mortality.

75. Total bio-seasonal and total annual estimated kittiwake collision mortalities, as derived in **Appendix 10.3 Collision Risk Modelling (CRM) of the Environmental Impact Assessment Report (EIAR)**, are presented in **Table 2**. Collision mortalities are presented in relation to Representative Scenarios A and B and CRM Band Option 1 and 2 models. As described in **Appendix 10.3 CRM of the EIAR**, Band Option 1 CRMs (which utilise site specific flight height data for this SCI) are considered most appropriate and associated values highlighted in bold. Detailed justification regarding why Band Option 1 models are considered most appropriate for this SCI, and the CRM parameters used, is presented in **Appendix 10.3 CRM of the EIAR**. To summarise, baseline site-specific flight height data for this SCI are consider sufficiently robust to inform collision risk modelling and the use of site-specific data in assessment (alongside a generic Band Option 2 approach) was assessed to be 'an attractive option' in a NPWS review of ornithological assessment methods for east coast Phase 1 projects (ABPmer, 2023). Band Option 2 model outputs are also presented to facilitate comparison with the outputs of other projects (particularly other Irish Offshore Wind Farms (OWFs) with potentially concurrent construction and operational timelines). **Table 2** outlines that, when using Band Option 1 CRM, total annual predicted kittiwake collision mortality is calculated as 18.282 individuals in relation to Representative Scenario A and 15.913 individuals in relation to Representative Scenario B.

76. These collision mortality values have been apportioned to the above-listed SPAs for which kittiwake is an SCI, according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS. These apportioned collision proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 2**, below.

Table 2: Total bio-seasonal and annual collision mortalities to kittiwake and table numbers within NIS Volume 5 Part 2 relevant to mortalities apportioned to these SPAs and resultant increases to SPA mortality rates

	Representative Scenario	CRM Band Option	Bio-season			Annual
			Return Migration (Jan - Apr)	Migration Free Breeding (May-Jul)	Post Breeding Migration (Aug - Dec)	
Total impact	A	**1**	**4.183**	**4.249**	**9.85**	**18.282**
		2	9.536	9.716	22.298	41.550
	B	**1**	**3.639**	**3.699**	**8.575**	**15.913**
		2	8.358	8.546	19.48	36.384

SPA	NIS Volume 5 Part 2 table number	
	Apportioned collision mortalities	Increase to SPA mortality
Wicklow Head SPA	Table 4.2	Table 4.3
Howth Head Coast SPA	Table 4.5	Table 4.6
Ireland's Eye SPA	Table 4.8	Table 4.9
Lambay Island SPA	Table 4.21	Table 4.22
Helvick Head to Ballyquin SPA	Table 4.90	Table 4.91
Old Head of Kinsale SPA	Table 4.106	Table 4.107

77. Increases to SPA kittiwake mortality rates resultant from apportioned annual impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of collision impact from the CWP Project, the most recent colony count from these SPAs (2015 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus kittiwake adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to the above-listed SPAs annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional collision mortality associated with the CWP Project. The relevant tables displaying the SPA-specific increases to kittiwake mortality in **NIS Volume 5 Part 2** are also given in **Table 2**, above.

78. As additional mortality to the kittiwake SCI of these SPAs resulting from collision with operational WTGs is estimated to represent only a very small potential increase (much less than 1%, for preferred Band Option 1 models) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining the favourable conservation condition of the kittiwake SCI of these SPAs. Specifically, collision mortality will not result in significant decline to the breeding population abundance or productivity of this SCI at these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

79. No specific mitigation is proposed or required in respect of collision during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

80. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

The proxy Conservation Objective and its attributes and targets for the kittiwake SCI of these SPAs are presented in **Table 1**, above. With regards to collision impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the kittiwake SCI of these SPAs.**

2.2 Herring gull

Table 3: Proxy CO, Attributes and Targets for herring gull in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Herring gull	• Ireland's Eye SPA • Lambay Island SPA • Skerries Islands SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.2.1, below.	None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Collision [1,2]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.2.1 Herring gull: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

81. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the herring gull SCI of these SPAs.

82. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline

83. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

84. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 85.6 km, Woodward *et al*., 2019) of herring gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

85. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

86. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

87. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

88. Herring gull which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of activities which remove or alter areas of intertidal habitat which are utilised by this SCI. Cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to herring gull connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

89. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline

90. In relation to this Conservation Objective attribute, construction of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

91. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 26.12 km and ‘by-sea’ distance of 31.72 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs herring gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

92. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

93. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

94. The Conservation Objective and its attributes and targets for the herring gull SCI of these SPAs are presented in **Table 3**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the herring gull SCI of these SPAs**.

Construction phase impact 2 – Changes in prey availability

Array site

Project only assessment

95. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the herring gull SCI of these SPAs.

96. Herring gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Construction phase activities within the array site which may affect herring gull prey species have the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

97. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact herring gull prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging herring gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

98. As herring gull is a generalist forager, although fish species (including gadoids, sprats and sandeels) are anticipated to be impacted by underwater noise during the construction phase, these species are not considered to form a key part of the SCI's diet. Underwater noise impacts to gadoids, sprats and sandeels (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a

broader construction window of 262.5 days) are therefore not considered to have potential to result in population level consequences to herring gull on account of the high-level of dietary flexibility demonstrated by this SCI.

99. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

100. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

101. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of herring gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

102. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by herring gull and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

103. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the herring gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of herring gull prey species in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

104. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

105. As per project only assessment, above.

OECC

Project only assessment

106. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the herring gull SCI of these SPAs.

107. Herring gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Construction phase activities within the OECC which may affect herring gull prey species have the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

108. In relation to these Conservation Objective attributes, construction of the CWP Project OECC may impact herring gull prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging herring gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate..

109. As herring gull is a generalist forager, and underwater noise impacts to prey fish species (including gadoids, sprats and sandeels) are anticipated to be very limited, given that no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten), the associated scale of changes in prey availability resultant from construction phase activities within the OECC will be negligible.

110. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 85.6 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

111. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas, benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high levels of recoverability (i.e. within weeks or months).

112. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of herring gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

113. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by herring gull and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

114. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging or lead to reductions in offspring provisioning rates for the herring gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of herring gull prey species in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

115. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

116. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

117. Herring gull which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from construction phase activity for the OECC intertidal landfall may arise as a consequence of activities which remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to herring gull is temporarily reduced within those areas.

118. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

119. In relation to these Conservation Objective attributes, construction of the CWP Project OECC intertidal landfall may reduce the extent and / or quality of intertidal areas in which individuals can undertake foraging behaviours or require individuals to use alternative areas for foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative foraging areas may affect the energetic

costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

120. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 23.12 km and 'by-sea' distance of 31.72 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs herring gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

121. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

122. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

123. The Conservation Objective and its attributes and targets for the herring gull SCI of these SPAs are presented in **Table 3**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the herring gull SCI of these SPAs**.

Operation and maintenance impact 1 – Direct effects on habitat

Array site

Project only assessment

124. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the herring gull SCI of these SPAs.

125. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential

to impact on the following Conservation Objective attributes and targets to the herring gull SCI of these SPAs: the array site

- Breeding population abundance – No significant decline.

126. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

127. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 85.6 km, Woodward *et al*., 2019) of herring gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

128. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

129. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

130. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

131. Herring gull which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of maintenance activities which temporarily remove or alter areas of intertidal habitat which are utilised by this SCI. Cable landfall duct maintenance activities during the operation and maintenance phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to herring gull connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

132. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline.

133. In relation to this Conservation Objective attribute, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

134. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 26.12 km and 'by-sea' distance of 31.72 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs herring gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

135. No specific mitigation is proposed or required in respect of direct effects on habitat during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

136. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

137. The Conservation Objective and its attributes and targets for the herring gull SCI of these SPAs are presented in **Table 3**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the herring gull SCI of these SPAs**.

Operation and maintenance phase impact 2 – Changes in prey availability

Array site

Project only assessment

138. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the herring gull SCI of these SPAs.

139. Herring gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

140. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact herring gull prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for herring gull prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging herring gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

141. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

142. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

143. As herring gull is a generalist forager, although potential prey species are anticipated to experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project, the loss of previously available benthic habitat impacts to herring gull prey species are not considered to have potential to result in population level consequences to herring gull on account of the high-level of dietary flexibility demonstrated by this SCI. The spatial extent of such prey species habitat loss is, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

144. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

145. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of herring gull breeding within these SPAs (mean-maximum + 1. S.D. = 85.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

146. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

147. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the herring gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of herring gull prey species in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

148. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

149. As per project only assessment, above.

OECC

Project only assessment

150. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the herring gull SCI of these SPAs.

151. Herring gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

152. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact herring gull prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging herring gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. This potential reduction in prey biomass availability, if significant, may compromise the ability of the SCI to maintain its population or productivity rate.

153. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

154. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

155. As herring gull is a generalist forager, although potential prey species are anticipated to experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project, the loss of previously available benthic habitat impacts to herring gull prey species are not considered to have potential to result in population level consequences to herring gull on account of the high-level of dietary flexibility demonstrated by this SCI. The spatial extent of such prey species habitat loss is, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

156. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

157. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of herring gull breeding within these SPAs (mean-maximum + 1. S.D. = 85.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

158. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators,

the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

159. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the herring gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of herring gull prey species in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

160. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

161. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

162. Herring gull which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from operation and maintenance phase activity for the OECC intertidal landfall may arise as a consequence of activities which temporarily remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct maintenance and other activities which may require localised excavations during the operation and maintenance phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to herring gull is temporarily reduced within those areas.

163. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline.

164. In relation to these Conservation Objective attributes, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake foraging behaviours or require individuals to use alternative areas for foraging. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative foraging areas may affect the energetic costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

165. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within

these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 26.12 km and 'by-sea' distance of 31.72 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs herring gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance of the herring gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the herring gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

166. No specific mitigation is proposed or required in respect of changes in prey availability during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

167. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

168. The Conservation Objective and its attributes and targets for the herring gull SCI of these SPAs are presented in **Table 3**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the herring gull SCI of these SPAs.**

Operation and maintenance impact 3 – Collision

Array site

Project only assessment

169. During the operation and maintenance phase of the CWP Project the presence of operational WTGs within the array site may result in the mortality of herring gull from the above-listed SPAs through the collision of individuals with turbine blades. Collision mortality has the potential to impact on the following Conservation Objective attribute and target for the herring gull SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline

170. In relation to these Conservation Objective attributes, mortality resultant from collision with operational WTGs within the array site may directly affect the overall survival rate and associated breeding population abundance of this SCI at these SPAs. Furthermore, collision mortality may also adversely affect the overall productivity rate of these SPAs, through reductions to offspring provisioning rates and other parental care metrics where parent birds experience collision mortality.

171. Total bio-seasonal and total annual estimated herring gull collision mortalities, as derived in **Appendix 10.3 CRM of the EIAR**, are presented in **Table 4**. Collision mortalities are presented in relation to Representative Scenarios A and B and CRM Band Option 1 and 2 models. As described in **Appendix 10.3 CRM of the EIAR**, Band Option 1 CRMs (which utilise site-specific flight height data for this SCI) are considered most appropriate and associated values highlighted in bold. Detailed justification regarding why Band Option 1 models are considered most appropriate for this SCI, and the CRM parameters used, is presented in **Appendix 10.3 CRM of the EIAR**. To summarise, baseline site-specific flight height data for this SCI are consider sufficiently robust to inform collision risk modelling and the use of site-specific data in assessment (alongside a generic Band Option 2 approach) was assessed to be 'an attractive option' in an NPWS review of ornithological assessment methods for east coast Phase 1 projects (ABPmer, 2023). Band Option 2 model outputs are also presented to facilitate comparison with the outputs of other projects (particularly other Irish OWFs with potentially concurrent construction and operational timelines). **Table 2** outlines that, when using Band Option 1 CRM, total annual predicted herring gull collision mortality is calculated as 27.411 individuals in relation to Representative Scenario A and 23.283 individuals in relation to Representative Scenario B.

172. These collision mortality values have been apportioned to the above-listed SPAs for which herring gull is an SCI, according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS. These apportioned collision proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 4**, below.

Table 4: Total bio-seasonal and annual collision mortalities to herring gull and table numbers within NIS Volume 5 Part 2 relevant to mortalities apportioned to these SPAs and resultant increases to SPA mortality rates

	Design option	CRM Band option	Bio-season		Annual
			Breeding (Apr – Aug)	Non-Breeding (Sep – Mar)	
Total impact	A	**1**	**25.018**	**2.393**	**27.411**
		2	18.76	1.876	20.636
	B	**1**	**21.178**	**2.105**	**23.283**
		2	15.724	1.596	17.320

SPA	NIS Volume 5 Part 2 table number	
	Apportioned collision mortalities	Increase to SPA mortality
Ireland's Eye SPA	Table 4.10	Table 4.11
Lambay Island SPA	Table 4.23	Table 4.24
Skerries Islands SPA	Table 4.39	Table 4.40

173. Increases to SPA herring gull mortality rates resultant from apportioned annual impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of collision impact from the CWP Project, the most recent colony count from these SPAs (SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus herring gull adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to the above-listed SPAs annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional collision mortality associated with the CWP Project. The relevant tables displaying

the SPA-specific increases to herring gull mortality in **NIS Volume 5 Part 2** are also given in **Table 4** and **Table** 2, above.

174. As additional mortality to the herring gull SCI of these SPAs resulting from collision with operational WTGs is estimated to represent only a very small potential increase (much less than 1%, for preferred Band Option 1 models) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining the favourable conservation condition of the herring gull SCI of these SPAs. Specifically, collision mortality will not result in significant decline to the breeding population abundance or productivity of this SCI at these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

175. No specific mitigation is proposed or required in respect of collision during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

176. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

177. The Conservation Objective and its attributes and targets for the herring gull SCI of these SPAs are presented in **Table 3**, above. With regards to collision impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the herring gull SCI of these SPAs.**

2.3 Guillemot

Table 5: Proxy CO, Attributes and Targets for guillemot in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Guillemot	• Ireland's Eye SPA • Lambay Island SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.3.1, below.	None	No change	No AESI
			Disturbance and displacement (including barrier effects) [1,2,5]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
		7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.3.1 Guillemot: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

178. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

179. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline

180. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

181. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 153.7 km, Woodward *et al*., 2019) of guillemot breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

182. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

183. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

184. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

185. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs**.

Construction phase impact 2 – Disturbance and displacement

Array site

Project only assessment

186. As the array site does not overlap the above-listed SPAs and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for guillemot this is regarded as a 2 km buffer), all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

187. Guillemot are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [6.5/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

188. As such, during the construction phase of the CWP Project, vessel traffic and, as it is installed, the presence of above sea level WTG infrastructure may result in the disturbance and displacement of guillemot which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

189. In relation to these Conservation Objective attributes, disturbance leading to displacement of guillemot from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are erected within the array site during the construction phase, guillemots which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

190. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

191. Total bio-seasonal and total annual estimated construction phase guillemot displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 6**. Note that for seabird receptors such as guillemot, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

192. In the general absence of information relating to construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel y Môr EIAR, 2022), displacement mortalities have been determined on the basis that displacement rates during construction are half of those during the operation and maintenance phase.

193. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 6**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 6**, below.

194. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 6: Total bio-seasonal and annual displacement mortalities to guillemot (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season		Annual
		Breeding (Mar – Jul)	Non-breeding (Aug – Feb)	
Total impact	15% / 1%	5.436	20.010	25.446
	25% / 1%	**9.060**	**33.351**	**42.410**
	35% / 1%	12.684	46.691	59.374
	25% / 2%	18.119	66.701	84.820
	35% / 2%	25.367	93.381	118.748

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Ireland's Eye SPA	Table 4.12	Table 4.13
Lambay Island SPA	Table 4.25	Table 4.26

195. Increases to these SPAs guillemot mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2015 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each

year by multiplying by one minus guillemot adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to guillemot mortality in **NIS Volume 5 Part 2** are also given in **Table 6**Table , above.

196. As additional mortality to the guillemot SCI of these SPAs resulting from construction phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value and also for the more precautionary potential displacement scenarios presented) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase in barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

197. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

198. As per project only assessment, above.

OECC

Project only assessment

199. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

200. Guillemot are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [6.5/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)). As such, during the construction phase of the CWP Project, vessel traffic may result in the disturbance and displacement of guillemot which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

201. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of guillemot from locations around vessel activity within the OECC and surrounding areas may lead to

the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

202. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

203. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for guillemot. Works within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by construction vessels, will cover only an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of guillemot breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 153.7 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 37% of guillemot were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 127 m; an area of approximately 0.051 km^2 around each vessel, which equates to 0.13% of the total OECC area. Construction phase activities within the OECC will include up to a maximum of seven vessels at any one time in offshore areas. These vessels will typically be operating in close proximity to accomplish specific construction activities and therefore have overlapping areas in which they may be causing disturbance.

204. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from construction phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from construction phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance or productivity rate, or increase in barriers to connectivity for the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

205. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

206. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

207. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the

Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs.**

Construction phase impact 3 – Changes in prey availability

Array site

Project only assessment

208. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the guillemot SCI of these SPAs.

209. Guillemot depredates a range of fish species. Construction phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

210. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact guillemot prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging guillemot, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

211. Of guillemot's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase.

212. Mortality or injury-inducing underwater noise impacts to this group (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are, however, calculated to occur within only very small areas (up to 34 km^2 and 94 km^2, respectively) of this SCI's breeding season foraging range (mean-maximum + 1 S.D. = 153.7 km, Woodward *et al*., 2019). Although TTS inducing underwater noise impacts to sandeels are predicted to occur to a larger, although still very small, proportion of theoretical guillemot breeding season foraging areas (up to 3,500 km^2), TTS impacts to prey species are considered to have very limited potential to result in population level consequences to their seabird predators.

213. Areas affected by increased SSC levels during construction phase activities within the array site are also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents and occur over considerably shorter durations. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm.

214. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

215. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of guillemot breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

216. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

217. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the guillemot SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of guillemot prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

218. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

219. As per project only assessment, above.

OECC

Project only assessment

220. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the guillemot SCI of these SPAs.

221. Guillemot depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

222. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact guillemot prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should

these impacts to prey species reduce the availability of those prey species to foraging guillemot, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

223. Of guillemot's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten).

224. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 153.7 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

225. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

226. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of guillemot breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

227. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

228. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the guillemot SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of guillemot prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

229. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

230. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

231. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs.**

Operation and maintenance phase impact 1 – Direct effects on habitat

Array site

Project only assessment

232. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

233. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline

234. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

235. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 153.7 km, Woodward *et al*., 2019) of guillemot breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

236. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within

the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

237. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

238. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

239. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs.**

Operation and maintenance phase impact 2 – Disturbance and displacement

Array site

Project only assessment

240. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for guillemot this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

241. Guillemot are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [6.5/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

242. As such, during the operation and maintenance phase of the CWP Project, vessel traffic and installed WTG infrastructure may result in the disturbance and displacement of guillemot which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;

- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

243. In relation to these Conservation Objective attributes, disturbance leading to displacement of guillemot from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, due to the presence of operational WTGs within the array site, guillemots which would otherwise pass through these areas, may avoid flying through, or close to, the operational array site and alter flightpaths so as to go round this area, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

244. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to areas in which operational WTGs are present, may affect the energetic costs of those behaviours and, in turn, the affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

245. Total bio-seasonal and total annual estimated operation and maintenance phase guillemot displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 7**. Note that for seabird receptors such as guillemot, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

246. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 7**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 7**, below.

247. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 7: Total bio-seasonal and annual displacement mortalities to guillemot (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season		Annual
		Breeding (Mar – Jul)	Non-breeding (Aug – Feb)	
Total impact	30% / 1%	10.871	40.02	50.891
	50% / 1%	**18.119**	**66.701**	**84.820**
	70% / 1%	25.367	93.381	118.748
	50% / 2%	36.238	133.402	169.640
	70% / 2%	50.733	186.762	237.495
SPA		**NIS Volume 5 Part 2 table number**		
		Apportioned displacement mortalities	**Increase to SPA mortality**	
Ireland's Eye SPA		Table 4.14	Table 4.15	
Lambay Island SPA		Table 4.27	Table 4.28	

248. Increases to these SPAs guillemot mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2015 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus guillemot adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to guillemot mortality in **NIS Volume 5 Part 2** are also given in **Table 7**, above.

249. As additional mortality to the guillemot SCI of these SPAs resulting from operation and maintenance phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. Specifically, operation and maintenance phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

250. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

251. As per project only assessment, above.

OECC

Project only assessment

252. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the guillemot SCI of these SPAs.

253. Potential for disturbance and displacement within the OECC during the operational phase of the project is limited to works associated with routine monitoring activity and maintenance or repair events over the operational lifetime of the project. During such activities, displacement and disturbance would potentially occur only within a limited range of any vessels involved.

254. Guillemot are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [6.5/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019). As such, during the operation and maintenance phase of the CWP Project, vessel traffic may result in the disturbance and displacement of guillemot which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

255. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of guillemot from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

256. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, may affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

257. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for guillemot. Maintenance activities within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by vessels during the operation and maintenance phase, will cover only, at most, an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of guillemot breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 153.7 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 37% of guillemot were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 127 m; an area of approximately 0.051 km^2 around each vessel, which equates to 0.13% of the total OECC area. Maintenance and repair activities within the OECC will likely occur infrequently, and involve only a small number of vessels operating in close proximity to

accomplish specific maintenance activities and therefore have overlapping areas in which they may be causing disturbance.

258. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from operation and maintenance phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from operation and maintenance phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance or productivity rate, or increase in barriers to connectivity for the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

259. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

260. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

261. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs.**

Operation and maintenance phase impact 3 – Changes in prey availability

Array site

Project only assessment

262. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the guillemot SCI of these SPAs.

263. Guillemot depredates a range of fish species. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

264. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact guillemot prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging guillemot, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

265. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

266. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

267. Key fish species, upon which guillemot predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

268. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

269. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of guillemot breeding within these SPAs (mean-maximum + 1. S.D. = 153.7 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

270. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

271. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the guillemot SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of

altering the availability of guillemot prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

272. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

273. As per project only assessment, above.

OECC

Project only assessment

274. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the guillemot SCI of these SPAs.

275. Guillemot depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the guillemot SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

276. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact guillemot prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging guillemot, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

277. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

278. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially

infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

279. Key fish species, upon which guillemot predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

280. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

281. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of guillemot breeding within these SPAs (mean-maximum + 1. S.D. = 153.7 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

282. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

283. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the guillemot SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of guillemot prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the guillemot SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the guillemot SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

284. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

285. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

286. The Conservation Objective and its attributes and targets for the guillemot SCI of these SPAs are presented in **Table 5**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the guillemot SCI of these SPAs.**

2.4 Razorbill

Table 8: Proxy CO, Attributes and Targets for razorbill in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Razorbill	• Ireland's Eye SPA • Lambay Island SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase 7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Direct effects on habitat [1]	See Section 2.4.1, below.	None	No change	No AESI
			Disturbance and displacement (including barrier effects) [1,2,5]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.4.1 Razorbill: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

287. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the razorbill SCI of these SPAs.

288. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline

289. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

290. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 164.6 km, Woodward *et al*., 2019) of razorbill breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

291. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the razorbill SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

292. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

293. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

294. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the razorbill SCI of these SPAs.**

Construction phase impact 2 – Disturbance and displacement

Array site

Project only assessment

295. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for razorbill this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the razorbill SCI of these SPAs.

296. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

297. As such, during the construction phase of the CWP Project, vessel traffic and, as it is installed, the presence of above sea level WTG infrastructure may result in the disturbance and displacement of razorbill which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

298. In relation to these Conservation Objective attributes, disturbance leading to displacement of razorbill from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are erected within the array site during the construction phase, razorbills which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

299. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

300. Total bio-seasonal and total annual estimated construction phase razorbill displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 9**. Note that for seabird receptors such as razorbill, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

301. In the general absence of information relating to construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel y Môr EIAR, 2022), displacement mortalities have been determined on the basis that displacement rates during construction are half of those during the operation and maintenance phase.

302. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 9**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table** , below.

303. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 9: Total bio-seasonal and annual displacement mortalities to razorbill (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season				Annual
		Migration Free Breeding (Apr – Jul)	Post Breeding Migration (Aug – Oct)	Migration Free Non-breeding (Nov- Dec)	Return Migration (Jan - Mar)	
Total impact	15% / 1%	1.01	6.54	0.96	0.61	9.126
	25% / 1%	**1.69**	**10.90**	**1.60**	**1.02**	**15.211**
	35% / 1%	2.36	15.26	2.24	1.43	21.295
	25% / 2%	5.63	21.80	3.20	2.05	30.421
	35% / 2%	4.72	30.52	4.48	2.86	42.590

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Ireland's Eye SPA	Table 4.16	Table 4.17
Lambay Island SPA	Table 4.29	Table 4.30

304. Increases to these SPAs razorbill mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2015 count - SMP, 2023) has been used

to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus razorbill adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to razorbill mortality in **NIS Volume 5 Part 2** are also given in **Table 9**, above.

305. As additional mortality to the razorbill SCI of these SPAs resulting from construction phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value and also for the more precautionary potential displacement scenarios presented) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase in barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

306. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

307. As per project only assessment, above.

OECC

Project only assessment

308. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the razorbill SCI of these SPAs.

309. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)). As such, during the construction phase of the CWP Project, vessel traffic may result in the disturbance and displacement of razorbill which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

310. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of razorbill from locations around vessel activity within the OECC and surrounding areas may lead to

the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

311. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

312. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for razorbill. Works within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by construction vessels, will cover only an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of razorbill breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 164.6 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 78% of razorbill were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 395 m; an area of approximately 0.490 km^2 around each vessel, which equates to 1.28% of the total OECC area. Construction phase activities within the OECC will include up to a maximum of seven vessels at any one time in offshore areas. These vessels will typically be operating in close proximity to accomplish specific construction activities and therefore have overlapping areas in which they may be causing disturbance.

313. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from construction phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from construction phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

314. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

315. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

316. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the

Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the razorbill SCI of these SPAs.**

Construction phase impact 3 – Changes in prey availability

Array site

Project only assessment

317. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the razorbill SCI of these SPAs.

318. Razorbill depredates a range of fish species. Construction phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

319. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact razorbill prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging razorbill, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

320. Of razorbill's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury-inducing underwater noise impacts to this group (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are, however, calculated to occur within only very small areas (up to 34 km^2 and 94 km^2, respectively) of this SCI's breeding season foraging range (mean-maximum + 1 S.D. = 164.6 km, Woodward *et al*., 2019). Although TTS inducing underwater noise impacts to sandeels are predicted to occur to a larger, although still very small, proportion of theoretical razorbill breeding season foraging areas (up to 3,500 km^2), TTS impacts to prey species are considered to have very limited potential to result in population level consequences to their seabird predators.

321. Areas affected by increased SSC levels during construction phase activities within the array site are also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents and occur over considerably shorter durations. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm.

322. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

323. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of razorbill breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

324. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

325. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the razorbill SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of razorbill prey species in such a way as to result in a significant decline in the breeding population abundance or productivity of the razorbill SCI of these SPAs, nor will there be any significant increase in barriers to connectivity for this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

326. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

327. As per project only assessment, above.

OECC

Project only assessment

328. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the razorbill SCI of these SPAs.

329. Razorbill depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

330. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact razorbill prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should

these impacts to prey species reduce the availability of those prey species to foraging razorbill, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

331. Of razorbill's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten).

332. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 164.6 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

333. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

334. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of razorbill breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

335. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

336. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the razorbill SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of razorbill prey species in such a way as to result in a significant decline in the breeding population abundance or productivity of the razorbill SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

337. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

338. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

339. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is no project-only AESI for these SPAs razorbill SCI.

Operation and maintenance phase impact 1 – Direct effects on habitat

Array site

Project only assessment

340. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situex situ habitats which may support the razorbill SCI of these SPAs.

341. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline.

342. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

343. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 164.6 km, Woodward *et al*., 2019) of razorbill breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

344. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the razorbill SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

345. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

346. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

347. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the razorbill SCI of these SPAs.**

Operation and maintenance phase impact 2 – Disturbance and displacement

Array site

Project only assessment

348. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for razorbill this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the razorbill SCI of these SPAs.

349. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

350. As such, during the operation and maintenance phase of the CWP Project, vessel traffic and installed WTG infrastructure may result in the disturbance and displacement of razorbill which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

351. In relation to these Conservation Objective attributes, disturbance leading to displacement of razorbill from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, due to the presence of operational WTGs within the array site, razorbills which would otherwise pass through these areas, may avoid flying through, or close to, the operational array site and alter flightpaths so as to go round this area, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

352. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to areas in which operational WTGs are present, may affect the energetic costs of those behaviours and, in turn, the affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

353. Total bio-seasonal and total annual estimated operation and maintenance phase razorbill displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 10**. Note that for seabird receptors such as razorbill, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

354. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 10**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 10**, below.

355. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 10: Total bio-seasonal and annual displacement mortalities to razorbill (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season				Annual
		Migration Free Breeding (Apr – Jul)	Post Breeding Migration (Aug – Oct)	Migration Free Non-breeding (Nov – Dec)	Return Migration (Jan – Mar)	
Total impact	30% / 1%	2.024	13.08	1.921	1.227	18.252
	50% / 1%	**5.633**	**21.801**	**3.202**	**2.046**	**30.422**
	70%/ 1%	4.722	30.521	4.483	2.864	42.590
	50%/2%	6.746	43.601	6.404	4.091	60.842
	70%/2%	9.444	61.042	8.965	5.728	85.179

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Ireland's Eye SPA	Table 4.18	Table 4.19
Lambay Island SPA	Table 4.31	Table 4.32

356. Increases to these SPAs razorbill mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2015 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus razorbill adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to razorbill mortality in **NIS Volume 5 Part 2** are also given in **Table 10**, above.

357. As additional mortality to the razorbill SCI of these SPAs resulting from operation and maintenance phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. Specifically, operation and maintenance phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

358. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

359. As per project only assessment, above.

OECC

Project only assessment

360. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the razorbill SCI of these SPAs.

361. Potential for disturbance and displacement within the OECC during the operational phase of the project is limited to works associated with routine monitoring activity and maintenance or repair events over the operational lifetime of the project. During such activities, displacement and disturbance would potentially occur only within a limited range of any vessels involved.

362. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019). As such, during the operation and maintenance phase of the CWP Project, vessel traffic may result in the disturbance and displacement of razorbill which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline.

363. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of razorbill from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

364. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, may affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

365. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for razorbill. Maintenance activities within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by vessels during the operation and maintenance phase, will cover only, at most, an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of razorbill breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 164.6 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas

(Fliessbach *et al*., 2019), 78% of razorbill were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 395 m; an area of approximately 0.490 km^2 around each vessel, which equates to 1.28% of the total OECC area. Maintenance and repair activities within the OECC will likely occur infrequently and involve only a small number of vessels operating in close proximity to accomplish specific maintenance activities and therefore have overlapping areas in which they may be causing disturbance.

366. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from operation and maintenance phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from operation and maintenance phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering habitat availability to razorbill in such a way as to result in a significant decline in the breeding population abundance or productivity of the razorbill SCI of these SPAs, nor will there be any significant increase in barriers to connectivity for this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

367. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

368. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

369. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the razorbill SCI of these SPAs.**

Operation and maintenance phase impact 3 – Changes in prey availability

Array site

Project only assessment

370. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the razorbill SCI of these SPAs.

371. Razorbill depredates a range of fish species. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

372. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact razorbill prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging razorbill, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

373. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

374. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

375. Key fish species, upon which razorbill predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

376. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

377. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of razorbill breeding within these SPAs (mean-maximum + 1. S.D. = 164.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

378. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential

impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

379. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the razorbill SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of razorbill prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the razorbill SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

380. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

381. As per project only assessment, above.

OECC

Project only assessment

382. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the razorbill SCI of these SPAs.

383. Razorbill depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the razorbill SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

384. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact razorbill prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging razorbill, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

385. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

386. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

387. Key fish species, upon which razorbill predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

388. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

389. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of razorbill breeding within these SPAs (mean-maximum + 1. S.D. = 164.6 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

390. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

391. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the razorbill SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of razorbill prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the razorbill SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the razorbill SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

392. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

393. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

394. The Conservation Objective and its attributes and targets for the razorbill SCI of these SPAs are presented in **Table 8**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the razorbill SCI of these SPAs.**

2.5 Cormorant

Table 11: Proxy CO, Attributes and Targets for cormorant in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Cormorant	• Ireland's Eye SPA • Lambay Island SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.5.1, below.	None	No change	No AESI
			Disturbance and displacement (not including barrier effects) [1,2]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Collision [1,2]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.5.1 Cormorant: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

395. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

396. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline

397. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

398. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 33.9 km, Woodward *et al*., 2019) of cormorant breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

399. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

400. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

401. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

402. Cormorant which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of activities which remove or alter areas of intertidal habitat which are utilised by this SCI. Cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to cormorant connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

403. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline

404. In relation to this Conservation Objective attribute, construction of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

405. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 18.49 km and ‘by-sea’ distance of 21.74 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs cormorant population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

406. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

407. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

408. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs.**

Construction phase impact 2 – Disturbance and displacement

OECC

Project only assessment

409. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

410. Cormorant are considered to be at least somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. high [4/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [9.2/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019). As such, during the construction phase of the CWP Project, vessel traffic may result in the temporary disturbance and displacement of cormorant which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline

411. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of cormorant from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

412. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

413. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively

high observed counts within area) for cormorant. Works within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by construction vessels, will cover only an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of cormorant breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 33.9 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 48% of cormorant were observed to demonstrate escape responses (primarily in the form of taking off) in response to approaching vessels. The mean distance at which these responses occurred was 258 m; an area of approximately 0.209 km^2 around each vessel, which equates to 0.55% of the total OECC area. Construction phase activities within the OECC will include up to a maximum of seven vessels at any one time in offshore areas. These vessels will typically be operating in close proximity to accomplish specific construction activities and therefore have overlapping areas in which they may be causing disturbance.

414. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from construction phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from construction phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

415. No specific mitigation is proposed or required in respect of disturbance and displacement during the construction phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

416. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

417. As the OECC intertidal landfall does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding construction phase works for the OECC intertidal landfall all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

418. Cormorant which breed within these SPAs may also utilise ex situ intertidal areas within South Dublin Bay and, as such, may experience disturbance and displacement impacts in relation to construction phase activities at the OECC intertidal landfall within South Dublin Bay.

419. Such ex situ disturbance and displacement impacts have the the potential to affect the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline

420. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of cormorant from ex situ intertidal habitats around construction activity within at the OECC intertidal landfall may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

421. Temporary localised reductions in the extent of ex situ intertidal habitat areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

422. Despite the above potential pathways to impact, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 18.49 km and 'by-sea' distance of 21.74 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay at any given time. Accordingly, the numbers of such individuals expected to experience disturbance and displacement impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for disturbance and displacement impacts at the OECC intertidal landfall affecting these SPAs cormorant population is *de minimis*. Accordingly, the level of impact is not considered capable of resulting in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

423. No specific mitigation is proposed or required in respect of disturbance and displacement during the construction phase within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

424. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

425. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs**.

Construction phase impact 3 – Changes in prey availability

OECC

Project only assessment

426. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability

impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the cormorant SCI of these SPAs.

427. Cormorant depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

428. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact cormorant prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging cormorant, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

429. Of cormorant's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten).

430. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 33.9 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

431. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

432. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of cormorant breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

433. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

434. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to

reductions in offspring provisioning rates for the cormorant SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of cormorant prey species in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

435. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

436. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

437. Cormorant which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from construction phase activity for the OECC intertidal landfall may arise as a consequence of activities which remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to cormorant is temporarily reduced within those areas.

438. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

439. In relation to these Conservation Objective attributes, construction of the CWP Project OECC intertidal landfall may reduce the extent and / or quality of intertidal areas in which individuals can undertake foraging behaviours or require individuals to use alternative areas for foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative foraging areas may affect the energetic costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

440. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 18.27 km and 'by-sea' distance of 21.74 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs cormorant population is

de minimis. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

441. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

442. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

443. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs.**

Operation and maintenance impact 1 – Direct effects on habitat

Array site

Project only assessment

444. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

445. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline

446. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

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447. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 33.9 km, Woodward *et al*., 2019) of cormorant breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

448. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

449. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

450. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

451. Cormorant which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of maintenance activities which temporarily remove or alter areas of intertidal habitat which are utilised by this SCI. Cable landfall duct maintenance activities during the operation and maintenance phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to cormorant connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

452. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline

453. In relation to this Conservation Objective attribute, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased

occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

454. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 18.49 km and 'by-sea' distance of 21.74 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs cormorant population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

455. No specific mitigation is proposed or required in respect of direct effects on habitat during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

456. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

457. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs.**

Operation and maintenance impact 2 – Disturbance and displacement

OECC

Project only assessment

458. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

459. Potential for disturbance and displacement within the OECC during the operational phase of the project is limited to works associated with routine monitoring activity and maintenance or repair events over the operational lifetime of the project. During such activities, displacement and disturbance would potentially occur only within a limited range of any vessels involved.

460. Cormorant are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. high [4/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low/moderate [9.2/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019). As such, during the operation and maintenance phase of the CWP Project, vessel traffic may result in the disturbance and displacement of cormorant which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline

461. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of cormorant from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

462. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, may affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

463. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for cormorant. Maintenance activities within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by vessels during the operation and maintenance phase, will cover only, at most, an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of cormorant breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 33.9 km, Woodward *et al*., 2019). Maintenance and repair activities within the OECC will likely occur infrequently, and involve only a small number of vessels operating in close proximity to accomplish specific maintenance activities and therefore have overlapping areas in which they may be causing disturbance.

464. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from operation and maintenance phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from operation and maintenance phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance or productivity rate, or increase in barriers to connectivity for the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

465. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

466. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

467. As the OECC intertidal landfall does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding operation and maintenance phase works for the OECC intertidal landfall all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the cormorant SCI of these SPAs.

468. Cormorant which breed within these SPAs may also utilise ex situ intertidal areas within South Dublin Bay and, as such, may experience disturbance and displacement impacts in relation to operation and maintenance phase activities at the OECC intertidal landfall within South Dublin Bay.

469. Such ex situ disturbance and displacement impacts have the potential to affect the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline

470. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of cormorant from ex situ intertidal habitats around operation and maintenance activity within at the OECC intertidal landfall may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

471. Temporary localised reductions in the extent of ex situ intertidal habitat areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

472. Despite the above potential pathways to impact, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 9.69 km and 'by-sea' distance of 12.61 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay at any given time. Accordingly, the numbers of such individuals expected to experience disturbance and displacement impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for disturbance and displacement impacts at the OECC intertidal landfall affecting these SPAs cormorant population is *de minimis*. Accordingly, the level of impact is not considered capable of resulting in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

473. No specific mitigation is proposed or required in respect of disturbance and displacement during the operation and maintenance phase within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

474. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

475. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs**.

Operation and maintenance phase impact 3 – Changes in prey availability

OECC

Project only assessment

476. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the cormorant SCI of these SPAs.

477. Cormorant depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline .

478. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact cormorant prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging cormorant, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

479. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

480. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact

to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

481. Key fish species, upon which cormorant predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

482. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

483. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of cormorant breeding within these SPAs (mean-maximum + 1. S.D. = 33.9 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

484. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

485. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the cormorant SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of cormorant prey species in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

486. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

487. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

488. Cormorant which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from operation and maintenance phase activity for the OECC intertidal landfall may arise as a consequence of activities which temporarily remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct maintenance and other activities which may require localised excavations during the operation and maintenance phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to cormorant is temporarily reduced within those areas.

489. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

490. In relation to these Conservation Objective attributes, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake foraging behaviours or require individuals to use alternative areas for foraging. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative foraging areas may affect the energetic costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

491. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 18.49 km and 'by-sea' distance of 21.74 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs cormorant population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance of the cormorant SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

492. No specific mitigation is proposed or required in respect of changes in prey availability during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

493. As per project only assessment, above.

Operation and maintenance impact 4 – Collision

Array site

Project only assessment

494. During the operation and maintenance phase of the CWP Project the presence of operational WTGs within the array site may result in the mortality of cormorant from these SPAs through the collision of individuals with turbine blades. Collision mortality has the potential to impact on the following Conservation Objective attribute and target for the cormorant SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline

495. In relation to these Conservation Objective attributes, mortality resultant from collision with operational WTGs within the array site may directly affect the overall survival rate and associated breeding population abundance of this SCI at these SPAs. Furthermore, collision mortality may also adversely affect the overall productivity rate of these SPAs, through reductions to offspring provisioning rates and other parental care metrics where parent birds experience collision mortality.

496. Flight activity by cormorant recorded within the array site during baseline surveys was extremely low throughout the baseline survey period (only one cormorant was recorded in flight within the array site during baseline digital aerial surveys; see **Appendix 10.5 Ornithology Baseline characterisation report of the EIAR**). Consequently, CRM has not been undertaken for this species on the basis that flight densities within the array site are extremely low and that resultant mortality rates to this SCI would be negligible.

497. As additional mortality to the cormorant SCI of these SPAs resulting from collision with operational WTGs is estimated to represent only a negligible potential increase to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the cormorant SCI of these SPAs. Specifically, collision mortality will not affect the population dynamics of the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

498. No specific mitigation is proposed or required in respect of collision during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

499. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

500. The Conservation Objective and its attributes and targets for the cormorant SCI of these SPAs are presented in **Table 11**, above. With regards to collision impacts during the operation and maintenance

phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the cormorant SCI of these SPAs**.

2.6 Fulmar

Table 12: Proxy CO, Attributes and Targets for fulmar in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Fulmar	• Lambay Island SPA • Horn Head to Fanad Head SPA • Beara Peninsula SPA • Tory Island SPA • West Donegal Coast SPA • Deenish Islands and Scariff Island SPA • Iveragh Peninsula SPA • Puffin Island SPA • Skelligs SPA • Mingulay and Berneray SPA • Blasket Islands SPA • Dingle Peninsula SPA • Kerry Head SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase 7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Direct effects on habitat [1]	See Section 2.6.1, below.	None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.6.1 Fulmar: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

501. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the fulmar SCI of these SPAs.

502. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline

503. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

504. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 1,200.2 km, Woodward *et al*., 2019) of fulmar breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

505. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

506. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

507. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

508. The Conservation Objective and its attributes and targets for the fulmar SCI of these SPAs are presented in **Table 12**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the fulmar SCI of these SPAs**.

Construction phase impact 2 – Changes in prey availability

Array site

Project only assessment

509. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the fulmar SCI of these SPAs.

510. Fulmar forages on a variety of food items, including fish species, crustaceans, squid and surface offal. Construction phase activities within the array site which may affect fulmar prey species have the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline
- Productivity rate – No significant decline
- Prey biomass available – No significant decline

511. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact fulmar prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging fulmar, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

512. As fulmar is a generalist forager, although fish species (including gadoids, sprats and sandeels) are anticipated to be impacted by underwater noise during the construction phase, these species are not considered to form a key part of the SCI's diet. Underwater noise impacts to gadoids, sprats and sandeels (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are therefore not considered to have potential to result in population level consequences to fulmar on account of the high-level of dietary flexibility demonstrated by this SCI.

513. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration

of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

514. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

515. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of fulmar breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

516. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by fulmar and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

517. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the fulmar SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of fulmar prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

518. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

519. As per project only assessment, above.

OECC

Project only assessment

520. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the fulmar SCI of these SPAs.

521. Fulmar forages on a variety of food items, including fish species, crustaceans, squid and surface offal. Construction phase activities within the OECC which may affect fulmar prey species have the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

522. In relation to these Conservation Objective attributes, construction of the CWP Project OECC may impact fulmar prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging fulmar, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

523. As fulmar is a generalist forager, and underwater noise impacts to prey fish species (including gadoids, sprats and sandeels) are anticipated to be very limited, given that no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten), the associated scale of changes in prey availability resultant from construction phase activities within the OECC will be negligible.

524. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 1,200.2 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

525. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

526. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of fulmar breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

527. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by fulmar and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey

availability impacts associated with construction phase activities within the OECC is considered to be negligible.

528. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging or lead to reductions in offspring provisioning rates for the fulmar SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of fulmar prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

529. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

530. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

531. The Conservation Objective and its attributes and targets for the fulmar SCI of these SPAs are presented in **Table 12** above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is no **project-only AESI for the fulmar SCI of these SPAs.**

Operation and maintenance phase impact 1 – Direct effects on habitat

Array site

532. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the fulmar SCI of these SPAs.

533. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline

534. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent

survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

535. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 1,200.2 km, Woodward *et al*., 2019) of fulmar breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

536. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

537. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

538. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

539. The Conservation Objective and its attributes and targets for the fulmar SCI of these SPAs are presented in **Table 12**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the fulmar SCI of these SPAs.**

Operation and maintenance phase impact 2 – Changes in prey availability

Array site

Project only assessment

540. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the fulmar SCI of these SPAs.

541. Fulmar forage on a variety of food items including fish, squid, crustaceans and surface offal. Operation and maintenance phase activities within the array site which may affect the fish prey species of fulmar

have the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

542. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact fulmar prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging fulmar, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

543. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

544. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

545. Key fish species, upon which fulmar predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

546. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

547. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of fulmar breeding within these SPAs (mean-maximum + 1. S.D. = 1,200.2 km, Woodward *et al.*, 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

548. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators,

the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

549. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the fulmar SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of fulmar prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass available to the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

550. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

551. As per project only assessment, above.

OECC

Project only assessment

552. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the fulmar SCI of these SPAs.

553. Fulmar forage on a variety of food items including fish, squid, crustaceans and surface offal. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the fulmar SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

554. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact fulmar prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging fulmar, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

555. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

556. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

557. Key fish species, upon which fulmar predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

558. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

559. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of fulmar breeding within these SPAs (mean-maximum + 1. S.D. = 1,200.2 km, Woodward *et al.*, 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

560. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

561. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the fulmar SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of fulmar prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the fulmar SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the fulmar SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

562. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

563. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

564. The Conservation Objective and its attributes and targets for the fulmar SCI of these SPAs are presented in **Table 12**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the fulmar SCI of these SPAs**.

2.7 Lesser black-backed gull

Table 13: Proxy CO, Attributes and Targets for lesser black-backed gull in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Lesser black-backed gull	• Lambay Island SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.7.1, below.	None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Collision [1,2]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.7.1 Lesser black-backed gull: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

565. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the lesser black-backed gull SCI of these SPAs.

566. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline

567. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

568. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 236 km, Woodward *et al*., 2019) of lesser black-backed gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

569. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

570. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

571. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

572. Lesser black-backed gull which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of activities which remove or alter areas of intertidal habitat which are utilised by this SCI. Cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to lesser black-backed gull connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

573. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline

574. In relation to this Conservation Objective attribute, construction of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

575. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 114.10 km and 'by-sea' distance of 133.87 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs lesser black-backed gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

576. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

577. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

578. The Conservation Objective and its attributes and targets for the lesser black-backed gull SCI of these SPAs are presented in **Table 13**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the lesser black-backed gull SCI of these SPAs**.

Construction phase impact 2 – Changes in prey availability

Array site

Project only assessment

579. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the lesser black-backed gull SCI of these SPAs.

580. Lesser black-backed gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Construction phase activities within the array site which may affect lesser black-backed gull prey species have the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

581. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact lesser black-backed gull prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging lesser black-backed gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

582. As lesser black-backed gull is a generalist forager, although fish species (including gadoids, sprats and sandeels) are anticipated to be impacted by underwater noise during the construction phase, these species are not considered to form a key part of the SCI's diet. Underwater noise impacts to

gadoids, sprats and sandeels (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are therefore not considered to have potential to result in population level consequences to lesser black-backed gull on account of the high-level of dietary flexibility demonstrated by this SCI.

583. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

584. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

585. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of lesser black-backed gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

586. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by lesser black-backed gull and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

587. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the lesser black-backed gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of lesser black-backed gull prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

588. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

589. As per project only assessment, above.

OECC

Project only assessment

590. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the lesser black-backed gull SCI of these SPAs.

591. Lesser black-backed gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Construction phase activities within the OECC which may affect lesser black-backed gull prey species have the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

592. In relation to these Conservation Objective attributes, construction of the CWP Project OECC may impact lesser black-backed gull prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging lesser black-backed gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

593. As lesser black-backed gull is a generalist forager, and underwater noise impacts to prey fish species (including gadoids, sprats and sandeels) are anticipated to be very limited, given that no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten), the associated scale of changes in prey availability resultant from construction phase activities within the OECC will be negligible.

594. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 236 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

595. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas, benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

596. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of lesser black-backed gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

597. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by lesser black-backed gull and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

598. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging or lead to reductions in offspring provisioning rates for the lesser black-backed gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of lesser black-backed gull prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

599. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

600. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

601. Lesser black-backed gull which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from construction phase activity for the OECC intertidal landfall may arise as a consequence of activities which remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct installation and cable laying activities during the construction phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to lesser black-backed gull is temporarily reduced within those areas.

602. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

603. In relation to these Conservation Objective attributes, construction of the CWP Project OECC intertidal landfall may reduce the extent and / or quality of intertidal areas in which individuals can undertake foraging behaviours or require individuals to use alternative areas for foraging behaviours. These potential consequences of construction phase activities within the OECC intertidal landfall may directly

affect demographic parameters (for example, use of alternative foraging areas may affect the energetic costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

604. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 133.87 km and 'by-sea' distance of 149.80 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from construction phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs lesser black-backed gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

605. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

606. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

607. The Conservation Objective and its attributes and targets for the lesser black-backed gull SCI of these SPAs are presented in **Table 13**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the lesser black-backed gull SCI of these SPAs**.

Operation and maintenance impact 1 – Direct effects on habitat

Array site

Project only assessment

608. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the Lesser black-backed gull SCI of these SPAs.

609. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline

610. In relation to these Conservation Objective attributes, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

611. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 236 km, Woodward *et al*., 2019) of lesser black-backed gull breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

612. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

613. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

614. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

615. Lesser black-backed gull which breed within these SPAs may also utilise intertidal areas within South Dublin Bay to undertake non-foraging behaviours (such as roosting, loafing or for maintenance activities). Impacts considered to be direct effects on habitat may arise as a consequence of maintenance activities which temporarily remove or alter areas of intertidal habitat which are utilised by

this SCI. Cable landfall duct maintenance activities during the operation and maintenance phase within South Dublin Bay have the potential to alter areas of intertidal habitat such that they become temporarily unavailable to lesser black-backed gull connected with these SPAs, which may otherwise utilise those areas for non-foraging behaviours.

616. This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline

617. In relation to these Conservation Objective attributes, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative roosting areas may increase vulnerability to predation and reduce survival rates), or may affect the energetic costs of non-foraging behaviours through increased occupancy of sub-optimal area and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

618. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area within these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 133.87 km and 'by-sea' distance of 149.80 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for non-foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience direct effect on habitat impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for direct effects on habitat impacts at the OECC intertidal landfall affecting these SPAs lesser black-backed gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

619. No specific mitigation is proposed or required in respect of direct effects on habitat during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

620. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

621. The Conservation Objective and its attributes and targets for the lesser black-backed gull SCI of these SPAs are presented in **Table 13**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the lesser black-backed gull SCI of these SPAs.**

Operation and maintenance phase impact 2 – Changes in prey availability

Array site

Project only assessment

622. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the lesser black-backed gull SCI of these SPAs.

623. Lesser black-backed gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

624. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact lesser black-backed gull prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for lesser black-backed gull prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging lesser black-backed gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

625. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

626. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

627. As lesser black-backed gull is a generalist forager, although potential prey species are anticipated to experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project, the loss of previously available benthic habitat impacts to lesser black-backed gull prey species are not considered to have potential to result in population level consequences to lesser black-backed gull on account of the high-level of dietary flexibility demonstrated by this SCI. The spatial extent of such prey species habitat loss is, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

628. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

629. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of lesser black-backed gull breeding within these SPAs (mean-maximum + 1. S.D. = 236 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

630. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

631. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the lesser black-backed gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of lesser black-backed gull prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

632. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

633. As per project only assessment, above.

OECC

Project only assessment

634. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the lesser black-backed gull SCI of these SPAs.

635. Lesser black-backed gull is a generalist and opportunist forager, whose diet comprises a range of fish and invertebrate species, as well as carrion and refuse. Operation and maintenance phase activities

within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

636. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact lesser black-backed gull prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging lesser black-backed gull, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

637. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

638. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

639. As lesser black-backed gull is a generalist forager, although potential prey species are anticipated to experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project, the loss of previously available benthic habitat impacts to lesser black-backed gull prey species are not considered to have potential to result in population level consequences to lesser black-backed gull on account of the high-level of dietary flexibility demonstrated by this SCI. The spatial extent of such prey species habitat loss is, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

640. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

641. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of lesser black-backed gull breeding within these SPAs (mean-maximum + 1. S.D. = 236 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

642. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

643. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the lesser black-backed gull SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of lesser black-backed gull prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

644. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

645. As per project only assessment, above.

OECC intertidal landfall

Project only assessment

646. Lesser black-backed gull which breed within these SPAs may utilise intertidal areas within South Dublin Bay for foraging. Changes to prey availability from operation and maintenance phase activity for the OECC intertidal landfall may arise as a consequence of activities which temporarily remove or alter areas of intertidal prey species habitat, or otherwise alter conditions so as to reduce foraging efficiency. Specifically, cable landfall duct maintenance and other activities which may require localised excavations during the operation and maintenance phase within South Dublin Bay have the potential to affect areas of intertidal habitat such that prey species availability to lesser black-backed gull is temporarily reduced within those areas.

647. This change in prey species availability has the potential to impact on the following Conservation Objective attributes and targets for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

648. In relation to these Conservation Objective attributes, operation and maintenance of the CWP Project OECC intertidal landfall may reduce the intertidal areas within South Dublin Bay in which individuals connected with these SPAs can undertake foraging behaviours or require individuals to use alternative areas for foraging. These potential consequences of operation and maintenance phase activities within the OECC intertidal landfall may directly affect demographic parameters (for example, use of alternative foraging areas may affect the energetic costs of foraging behaviours through increased occupancy of sub-optimal foraging habitats and in turn the condition of individuals and their consequent

survival and / or productivity rates), and thereby compromise the ability of the SCI to maintain its population.

649. Despite the above potential pathways to impact, these changes in prey availability do not affect any area within these SPAs (and hence do not affect the distribution of foraging habitat of this SCI within these SPAs). Furthermore, given the separation distance between this SPA and the OECC intertidal landfall (a minimum straight-line distance of 133.87 km and 'by-sea' distance of 149.80 km), only a minimal number of individuals connected with these SPAs are likely to be using impacted areas within South Dublin Bay for foraging behaviours at any given time. Accordingly, the numbers of such individuals expected to experience changes in prey availability impacts from operation and maintenance phase activities at the OECC intertidal landfall is considered negligible. As such, the potential for changes in prey availability impacts at the OECC intertidal landfall affecting these SPAs lesser black-backed gull population is *de minimis*. Accordingly, the level of impact is not considered capable of altering the extent of prey availability in such a way as to result in a significant decline in the breeding population abundance and productivity rate of, or prey biomass availability to, the lesser black-backed gull SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

650. No specific mitigation is proposed or required in respect of changes in prey availability during operation and maintenance within the OECC intertidal landfall, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

651. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

652. The Conservation Objective and its attributes and targets for the lesser black-backed gull SCI of these SPAs are presented in **Table 13**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the lesser black-backed gull SCI of these SPAs.**

Operation and maintenance impact 3 – Collision

Array site

Project only assessment

653. During the operation and maintenance phase of the CWP Project the presence of operational WTGs within the array site may result in the mortality of lesser black-backed gull from these SPAs through the collision of individuals with turbine blades. Collision mortality has the potential to impact on the following Conservation Objective attribute and target for the lesser black-backed gull SCI of these SPAs:

- Breeding population abundance – No significant decline; and
- Productivity rate – No significant decline.

654. In relation to this Conservation Objective attribute, mortality resultant from collision with operational WTGs within the array site may directly affect the overall survival rate of this SCI at these SPAs. Furthermore, collision mortality may also adversely affect the overall productivity rate of this SCI at these SPAs, through reductions to offspring provisioning rates and other parental care metrics. These potential consequences may compromise the ability of the SCI to maintain its population on a long-term basis.

655. Flight activity by lesser black-backed gull recorded within the array site during baseline surveys was extremely low throughout the baseline survey period (only ten lesser black-backed gull was recorded in flight within the array site during baseline digital aerial surveys; see **Appendix 10.5 Ornithology Baseline characterisation report of the EIAR**). Consequently, CRM has not been undertaken for this species on the basis that flight densities within the array site are extremely low and that resultant mortality rates to this SCI would be negligible.

656. As additional mortality to the lesser black-backed gull SCI of these SPAs resulting from collision with operational WTGs is estimated to represent only a negligible potential increase to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the lesser black-backed gull SCI of these SPAs. Specifically, collision mortality will not affect the breeding population abundance or productivity rate of the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

657. No specific mitigation is proposed or required in respect of collision during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

658. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

659. The Conservation Objective and its attributes and targets for the lesser black-backed gull SCI of these SPAs are presented in **Table 13**, above. With regards to collision impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is no project-only AESI for these SPAs lesser black-backed gull SCI.

2.8 Puffin

Table 14: Proxy CO, Attributes and Targets for puffin in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Puffin	• Lambay Island SPA	**From Saltee Islands SPA:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase 7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Direct effects on habitat [1]	See Section 2.8.1, below.	None	No change	No AESI
			Disturbance and displacement (including barrier effects) [1,2,5]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.8.1 Puffin: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

660. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

661. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline

662. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

663. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 265.4 km, Woodward *et al*., 2019) of puffin breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

664. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the puffin SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

665. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

666. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

667. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

Construction phase impact 2 – Disturbance and displacement

Array site

Project only assessment

668. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for puffin this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

669. Due to a lack of evidence in relation to puffin behavioural sensitivity to vessel disturbance and responses to the presence of OWF infrastructure, razorbill is used as a proxy for this SCI. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

670. As such, during the construction phase of the CWP Project, vessel traffic and, as it is installed, the presence of above sea level WTG infrastructure may result in the disturbance and displacement of puffin which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

671. In relation to these Conservation Objective attributes, disturbance leading to displacement of puffin from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are erected within the array site during the construction phase, puffins which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

672. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of

individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

673. Total bio-seasonal and total annual estimated construction phase puffin displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 15**. Note that for seabird receptors such as puffin, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

674. In the general absence of information relating to construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel y Môr EIAR, 2022), displacement mortalities have been determined on the basis that displacement rates during construction are half of those during the operation and maintenance phase.

675. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 15**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 15**, below.

Table 15: Total bio-seasonal and annual displacement mortalities to puffin (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season				Annual
		Migration Free Breeding (May – Jul)	Post Breeding Migration (Aug)	Migration Free Non-breeding (Sep – Feb)	Return Migration (Mar – Apr)	
Total impact	15% / 1%	0.141	0.083	0.067	0.010	0.300
	25% / 1%	**0.235**	**0.139**	**0.112**	**0.016**	**0.501**
	35% / 1%	0.328	0.194	0.156	0.023	0.700
	25% / 2%	0.469	0.277	0.223	0.032	1.000
	35% / 2%	0.656	0.387	0.312	0.045	1.400

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Lambay Island SPA	Table 4.33	Table 4.34

676. Increases to these SPAs puffin mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2014 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus puffin adult annual survival rate (taken from Horswill and Robinson, 2015).

The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to puffin mortality in **NIS Volume 5 Part 2** are also given in **Table 15**, above.

677. As additional mortality to the puffin SCI of these SPAs resulting from construction phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value and also for the more precautionary potential displacement scenarios presented) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase in barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

678. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

679. As per project only assessment, above.

OECC

Project only assessment

680. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

681. Due to a lack of evidence in relation to puffin behavioural sensitivity to vessel disturbance and responses to the presence of OWF infrastructure, razorbill is used as a proxy for this SCI. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)). As such, during the construction phase of the CWP Project, vessel traffic may result in the disturbance and displacement of puffin which breed within these SPAs from areas within and immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population – No significant decline; and
- Productivity rate – No significant decline.

682. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of puffin from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

683. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

684. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for puffin. Works within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by construction vessels, will cover only an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of puffin breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 265.4 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 78% of razorbill (used as a proxy species for puffin) were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 395 m; an area of approximately 0.490 km^2 around each vessel, which equates to 1.28% of the total OECC area. Construction phase activities within the OECC will include up to a maximum of seven vessels at any one time in offshore areas. These vessels will typically be operating in close proximity to accomplish specific construction activities and therefore have overlapping areas in which they may be causing disturbance.

685. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from construction phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from construction phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering puffin mortality in such a way as to result in a significant decline in the breeding population abundance or productivity of the puffin SCI of Ireland's Eye SPA, nor will there be any significant increase in barriers to connectivity for this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

686. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

687. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

688. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

Construction phase impact 3 – Changes in prey availability

Array site

Project only assessment

689. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the puffin SCI of these SPAs.

690. Puffin depredates a range of fish species. Construction phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

691. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact puffin prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging puffin, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

692. Of puffin's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury-inducing underwater noise impacts to this group (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are, however, calculated to occur within only very small areas (up to 34 km^2 and 94 km^2, respectively) of this SCI's breeding season foraging range (mean-maximum + 1 S.D. = 265.4 km, Woodward *et al*., 2019). Although TTS inducing underwater noise impacts to sandeels are predicted to occur to a larger, although still very small, proportion of theoretical puffin breeding season foraging areas (up to 3,500 km^2), TTS impacts to prey species are considered to have very limited potential to result in population level consequences to their seabird predators.

693. Areas affected by increased SSC levels during construction phase activities within the array site are also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents and occur over considerably shorter durations. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm.

694. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

695. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of puffin breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

696. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

697. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the puffin SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of puffin prey species in such a way as to result in a significant decline in the breeding population abundance or productivity of the puffin SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

698. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

699. As per project only assessment, above.

OECC

Project only assessment

700. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the puffin SCI of these SPAs.

701. Puffin depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

702. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact puffin prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging puffin, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates.

These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

703. Of puffin's key prey species groups, sandeels are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten).

704. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 265.4 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

705. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

706. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of puffin breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

707. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

708. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the puffin SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of puffin prey species in such a way as to result in a significant decline in the breeding population abundance or productivity of the puffin SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

709. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

710. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

711. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being **met** for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

Operation and maintenance phase impact 1 – Direct effects on habitat

Array site

Project only assessment

712. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

713. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline.

714. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

715. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 265.4 km, Woodward *et al*., 2019) of puffin breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

716. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a

significant decline in the breeding population abundance of the puffin SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

717. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

718. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

719. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

Operation and maintenance phase impact 2 – Disturbance and displacement

Array site

Project only assessment

720. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for puffin this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

721. Due to a lack of evidence in relation to puffin behavioural sensitivity to vessel disturbance and responses to the presence of OWF infrastructure, razorbill is used as a proxy for this SCI. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019)) and in relation to the presence of OWF infrastructure (specifically WTGs) (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

722. As such, during the operation and maintenance phase of the CWP Project, vessel traffic and installed WTG infrastructure may result in the disturbance and displacement of puffin which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

723. In relation to these Conservation Objective attributes, disturbance leading to displacement of puffin from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, due to the presence of operational WTGs within the array site, puffins which would otherwise pass through these areas, may avoid flying through, or close to, the operational array site and alter flightpaths so as to go round this area, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

724. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to areas in which operational WTGs are present, may affect the energetic costs of those behaviours and, in turn, the affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

725. Total bio-seasonal and total annual estimated operation and maintenance phase puffin displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 16**. Note that for seabird receptors such as puffin, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

726. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 16**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 16**, below.

Table 16: Total bio-seasonal and annual displacement mortalities to puffin (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season				Annual
		Migration Free Breeding (May – Jul)	Post Breeding Migration (Aug)	Migration Free Non-breeding (Sep – Feb)	Return Migration (Mar – Apr)	
Total impact	30% / 1%	0.281	0.166	0.134	0.019	0.600
	50% / 1%	**0.469**	**0.277**	**0.223**	**0.032**	**1.001**
	70% / 1%	0.656	0.387	0.312	0.045	1.400
	50% / 2%	0.937	0.553	0.446	0.064	2.000
	70% / 2%	1.312	0.774	0.624	0.09	2.800

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Lambay Island SPA	Table 4.35	Table 4.36

727. Increases to these SPAs puffin mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2016 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus puffin adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to puffin mortality in **NIS Volume 5 Part 2** are also given in **Table 16**, above.

728. As additional mortality to the puffin SCI of these SPAs resulting from operation and maintenance phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. Specifically, operation and maintenance phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

729. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

730. As per project only assessment, above.

OECC

Project only assessment

731. As the OECC does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the OECC, all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the puffin SCI of these SPAs.

732. Potential for disturbance and displacement within the OECC during the operational phase of the project is limited to works associated with routine monitoring activity and maintenance or repair events over the operational lifetime of the project. During such activities, displacement and disturbance would potentially occur only within a limited range of any vessels involved.

733. Due to a lack of evidence in relation to puffin behavioural sensitivity to vessel disturbance and responses to the presence of OWF infrastructure, razorbill is used as a proxy for this SCI. Razorbill are considered to be somewhat sensitive to disturbance and displacement impacts around vessel traffic (i.e. moderate [3/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and moderate/high [16/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019). As such, during the operation and maintenance phase of the CWP Project, vessel traffic may result in the disturbance and displacement of puffin which breed within these SPAs from areas within and

immediately surrounding the OECC. Disturbance and displacement effects have the potential to impact the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population – No significant decline; and
- Productivity rate – No significant decline.

734. In relation to these Conservation Objective attributes, disturbance leading to temporary displacement of puffin from locations around vessel activity within the OECC and surrounding areas may lead to the temporary and localised exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. temporary indirect habitat loss).

735. Temporary localised reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, which may require individuals to use alternative areas for such behaviours, may affect the energetic costs of those behaviours and, in turn, may affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

736. Visual aerial surveys of the western Irish Sea (ObSERVE data – Jessopp *et al*., 2018) indicate that the OECC lies within an area of regionally relatively high importance regionally (inferred from relatively high observed counts within area) for puffin. Maintenance activities within the OECC at any period in time, and the associated extent of areas in which the receptor may experience potential disturbance or displacement by vessels during the operation and maintenance phase, will cover only, at most, an extremely small proportion of the overall OECC area and a much smaller still proportion the area within the foraging range of puffin breeding within these SPAs (mean-maximum foraging range (+ 1 SD) = 265.4 km, Woodward *et al*., 2019). From studies undertaken within the North and Baltic Seas (Fliessbach *et al*., 2019), 78% of razorbill (used as a proxy species for puffin) were observed to demonstrate escape responses (either in the form of diving or taking off) in response to approaching vessels. The mean distance at which these responses occurred was 395 m; an area of approximately 0.490 km^2 around each vessel, which equates to 1.28% of the total OECC area. Operation and maintenance phase activities within the OECC will include up to a maximum of seven vessels at any one time in offshore areas. These vessels will typically be operating in close proximity to accomplish specific operation and maintenance activities and therefore have overlapping areas in which they may be causing disturbance.

737. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion that will experience potential disturbance impacts from operation and maintenance phase vessel activity within the OECC, and the temporary nature of such disturbance, the scale of disturbance and displacement impacts from operation and maintenance phase activities within the OECC is considered to be negligible. In particular, any temporary localised exclusion from areas within or immediately surrounding the OECC is not expected to affect the energetic costs to individuals in such a way as to reduce the condition of individuals and their consequent survival rates. Accordingly, the level of impact is not considered capable of altering habitat availability to puffin in such a way as to result in a significant decline in the breeding population abundance or productivity of the puffin SCI of these SPAs, nor will there be any significant increase in barriers to connectivity for this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

738. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

739. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

740. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14** above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

Operation and maintenance phase impact 3 – Changes in prey availability

Array site

Project only assessment

741. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the puffin SCI of these SPAs.

742. Puffin depredates a range of fish species. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline

743. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact puffin prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging puffin, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

744. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

745. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact

to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

746. Key fish species, upon which puffin predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

747. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

748. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of puffin breeding within these SPAs (mean-maximum + 1. S.D. = 265.4 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

749. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

750. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the puffin SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of puffin prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the puffin SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

751. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

752. As per project only assessment, above.

OECC

Project only assessment

753. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the puffin SCI of these SPAs.

754. Puffin depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the puffin SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline

755. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact puffin prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging puffin, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

756. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

757. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

758. Key fish species, upon which puffin predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

759. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

760. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of puffin breeding within these SPAs (mean-maximum + 1. S.D. = 265.4 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

761. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

762. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the puffin SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of puffin prey species in such a way as to result in a significant decline in the breeding population abundance, productivity rate or prey biomass availability of the puffin SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the puffin SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

763. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

764. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

765. The Conservation Objective and its attributes and targets for the puffin SCI of these SPAs are presented in **Table 14**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the puffin SCI of these SPAs.**

codling wind park

2.9 Manx shearwater

Table 17: Proxy CO, Attributes and Targets for Manx shearwater in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Manx shearwater	• Deenish Islands and Scariff Islands SPA • Puffin Island SPA • Skelligs SPA • Blasket Islands SPA	**In the absence of SCI-specific COs being available from any Irish SPAs, COs of Gannet from Saltee Islands SPA used:** CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase	Direct effects on habitat [1]	See Section 2.9.1, below.	None	No change	No AESI
			Disturbance and displacement (including barrier effects) [1,2,5]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
		7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.9.1 Manx shearwater: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

766. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the Manx shearwater SCI of these SPAs.

767. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline

768. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

769. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 2,365.5 km, Woodward *et al.*, 2019) of Manx shearwater breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

770. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

771. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

772. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

773. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs.**

Construction phase impact 2 – Disturbance and displacement

Array site

Project only assessment

774. Although Manx shearwater are insensitive to disturbance and displacement from presence of vessels (i.e. low behavioural sensitivity to vessel disturbance – Cook & Burton, 2010), they are however considered sensitive to disturbance from the presence of array site infrastructure (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

775. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for Manx shearwater this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the Manx shearwater SCI of these SPAs.

776. As such, during the construction phase of the CWP Project, the presence of partially and fully installed above-sea level WTG infrastructures may result in the disturbance and displacement of Manx shearwater which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

777. In relation to these Conservation Objective attributes, disturbance leading to displacement of Manx shearwater from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are erected within the array site during the construction phase, Manx shearwaters which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

778. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours,

or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

779. Total bio-seasonal and total annual estimated construction phase Manx shearwater displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 18**. Note that for seabird receptors such as Manx shearwater, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

780. In the general absence of information relating to construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel y Môr EIAR, 2022), displacement mortalities have been determined on the basis that displacement rates during construction are half of those during the operation and maintenance phase.

781. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 18**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 18**, below.

782. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 18: Total bio-seasonal and annual displacement mortalities to Manx shearwater (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season			Annual
		Migration Free Breeding (Jun – Jul)	Post Breeding Migration (Aug – Oct)	Return Migration (Mar – May)	
Total impact	15% / 1%	0.270	1.688	1.171	3.128
	25% / 1%	**0.451**	**2.813**	**1.951**	**5.214**
	35% / 1%	0.631	3.938	2.732	7.300

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Deenish Islands and Scariff Islands SPA	Table 4.121	Table 4.122
Puffin Island SPA	Table 4.127	Table 4.128
Skelligs SPA	Table 4.138	Table 4.139
Blasket Islands SPA	Table 4.149	Table 4.150

783. Increases to these SPAs Manx shearwater mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2000 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus Manx shearwater adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to Manx shearwater mortality in **NIS Volume 5 Part 2** are also given in **Table 18**, above.

784. As additional mortality to the Manx shearwater SCI of these SPAs resulting from construction phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value and also for the more precautionary potential displacement scenarios presented) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase in barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

785. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

786. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

787. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs.**

Construction phase impact 3 – Changes in prey availability

Array site

Project only assessment

788. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the Manx shearwater SCI of these SPAs.

789. Manx shearwater forages on a variety of food items, including fish species, crustaceans, squid and surface offal. Construction phase activities within the array site which may affect Manx shearwater prey species have the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

790. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact Manx shearwater prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging Manx shearwater, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

791. As Manx shearwater is a generalist forager, although fish species (including gadoids, sprats and sandeels) are anticipated to be impacted by underwater noise during the construction phase, these species are not considered to form a key part of the SCI's diet. Underwater noise impacts to gadoids, sprats and sandeels (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are therefore not considered to have potential to result in population level consequences to Manx shearwater on account of the high-level of dietary flexibility demonstrated by this SCI.

792. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

793. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

794. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of Manx shearwater breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

795. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by Manx shearwater and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

796. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the Manx shearwater SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of Manx shearwater prey species in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

797. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

798. As per project only assessment, above.

OECC

Project only assessment

799. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the Manx shearwater SCI of these SPAs.

800. Manx shearwater forages on a variety of food items, including fish species, crustaceans, squid and surface offal. Construction phase activities within the OECC which may affect Manx shearwater prey species have the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

801. In relation to these Conservation Objective attributes, construction of the CWP Project OECC may impact Manx shearwater prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging Manx shearwater, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

802. As Manx shearwater is a generalist forager, and underwater noise impacts to prey fish species (including gadoids, sprats and sandeels) are anticipated to be very limited, given that no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten),

the associated scale of changes in prey availability resultant from construction phase activities within the OECC will be negligible.

803. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 2,365.5 km, Woodward *et al.*, 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. These areas affected by increased SSC levels during construction phase activities are assessed to be of negligible size in relation to seabird breeding and non-breeding season range extents, with impacts occurring over considerably shorter durations than underwater noise effects and are similarly considered unlikely to affect a key part of the very wide dietary range of this SCI.

804. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents. Within these areas, benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

805. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of Manx shearwater breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

806. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, the wide range of foraging resources used by Manx shearwater and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

807. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging or lead to reductions in offspring provisioning rates for the Manx shearwater SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of Manx shearwater prey species in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs

Proposed mitigation

808. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

809. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

810. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs.**

Operation and maintenance impact 1 – Direct effects on habitat

Array site

Project only assessment

811. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the Manx shearwater SCI of these SPAs.

812. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline.

813. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

814. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 2,365.5 km, Woodward *et al*., 2019) of Manx shearwater breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

815. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors,

it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

816. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

817. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

818. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs**.

Operation and maintenance impact 2 – Disturbance and displacement

Array site

Project only assessment

819. Although Manx shearwater are insensitive to disturbance and displacement from presence of vessels (i.e. low behavioural sensitivity to vessel disturbance – Cook & Burton, 2010), they are however considered sensitive to disturbance from the presence of array site infrastructure (i.e. overall behavioural response characterised as 'Avoidance' – Dierschke *et al*., 2016).

820. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for Manx shearwater this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the Manx shearwater SCI of these SPAs.

821. As such, during the operation and maintenance phase of the CWP Project, the presence of above-sea level WTG infrastructures may result in the disturbance and displacement of Manx shearwater which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

822. In relation to these Conservation Objective attributes, disturbance leading to displacement of Manx shearwater from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, given the presence of WTGs within the array site during the operation and maintenance phase, Manx shearwaters which would otherwise pass through these areas, may

avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

823. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

824. Total bio-seasonal and total annual estimated operation and maintenance phase Manx shearwater displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 19**. Note that for seabird receptors such as Manx shearwater, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

825. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 19**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 19**, below.

826. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 19: Total bio-seasonal and annual displacement mortalities to Manx shearwater (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season			Annual
		Migration Free Breeding (Jun- Jul)	Post Breeding Migration (Aug – Oct)	Return Migration (Mar- May)	
Total impact	30% / 1%	0.54	5.635	2.341	6.256
	50% / 1%	**0.901**	**5.625**	**3.902**	**10.428**
	70% / 1%	1.261	7.875	5.463	14.599

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Deenish Islands and Scariff Islands SPA	Table 4.123	Table 4.124
Puffin Island SPA	Table 4.129	Table 4.130
Skelligs SPA	Table 4.140	Table 4.141
Blasket Islands SPA	Table 4.151	Table 4.152

827. Increases to these SPAs Manx shearwater mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part**

2. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2000 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus Manx shearwater adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to Manx shearwater mortality in **NIS Volume 5 Part 2** are also given in **Table 19**, above.

828. As additional mortality to the Manx shearwater SCI of these SPAs resulting from operation and maintenance phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. Specifically, operation and maintenance phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

829. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

830. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

831. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs.**

Operation and maintenance phase impact 3 – Changes in prey availability

Array site

Project only assessment

832. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the Manx shearwater SCI of these SPAs.

833. Manx shearwater forage on a variety of food items including fish, squid, crustaceans and surface offal. Operation and maintenance phase activities within the array site which may affect the fish prey species

of Manx shearwater have the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

834. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact Manx shearwater prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging Manx shearwater, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

835. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

836. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

837. Key fish species, upon which Manx shearwater predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

838. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

839. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of Manx shearwater breeding within these SPAs (mean-maximum + 1. S.D. = 2,365.5 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

840. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential

impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

841. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the Manx shearwater SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of Manx shearwater prey species in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

842. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

843. As per project only assessment, above.

OECC

Project only assessment

844. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the Manx shearwater SCI of these SPAs.

845. Manx shearwater forage on a variety of food items including fish, squid, crustaceans and surface offal. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the Manx shearwater SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline .

846. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact Manx shearwater prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging Manx shearwater, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may

compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

847. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

848. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

849. Key fish species, upon which Manx shearwater predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

850. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

851. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of Manx shearwater breeding within these SPAs (mean-maximum + 1. S.D. = 2,365.5 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

852. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

853. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the Manx shearwater SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of Manx shearwater prey species in such a way as to result in a significant decline in the breeding population abundance of the Manx shearwater SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the Manx shearwater SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

854. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

855. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

856. The Conservation Objective and its attributes and targets for the Manx shearwater SCI of these SPAs are presented in **Table 17**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the Manx shearwater SCI of these SPAs.**

2.10 Gannet

Table 20: Proxy CO, Attributes and Targets for gannet in Irish SPAs

SCI	SPAs	Proxy CO, Attributes and Targets	Predicted effects	Assessment	Mitigation	Residual effect	Conclusion
Gannet	• The Bull and the Cow Rocks SPA • Skelligs SPA	From Saltee Islands SPA: CO: To maintain the favourable conservation condition of the SCI in the SPA Attributes and Targets: 1. Breeding population abundance – No significant decline 2. Productivity rate – No significant decline 3. Distribution: breeding colonies – No significant decline 4. Prey biomass available – No significant decline 5. Barriers to connectivity – No significant increase 6. Disturbance at the breeding site – No significant increase 7. Disturbance at marine areas immediately adjacent to the colony – No significant increase	Direct effects on habitat [1]	See Section 2.10.1, below.	None	No change	No AESI
			Disturbance and displacement (including barrier effects) [1,2,5]		None	No change	No AESI
			Changes in prey availability [1,2,4]		None	No change	No AESI
			Collision [1,2]		None	No change	No AESI
			Introduction or spread of INNS [1,2,3,4]	See high level assessment in Section 1.1			No AESI

2.10.1 Gannet: Assessment against proxy SCI-specific COs

Construction phase impact 1 – Direct effects on habitat

Array site

Project only assessment

857. With regards to the array site, relevant construction phase direct effects on habitat relate to the alteration of sea surface areas as they become occupied by the footprint of installed infrastructure and, therefore, unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the gannet SCI of these SPAs.

858. As construction of the array site progresses through its planned duration of approximately 2.5 years, the above sea level spatial extent of infrastructure will increase to a maximum of less than 0.005 km^2 within the array site (i.e. combined sea level area of all WTGs and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline.

859. In relation to this Conservation Objective attribute, construction of the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of construction phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

860. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 509.4 km, Woodward *et al.*, 2019) of gannet breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

861. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be lost within the array site during construction, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the gannet SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

862. No specific mitigation is proposed or required in respect of direct effects on habitat during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

863. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

864. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to direct effects on habitat impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Construction phase impact 2 – Disturbance and displacement

Array site

Project only assessment

865. Although gannet are insensitive to disturbance and displacement from presence of vessels (i.e. low [2/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low [4.7/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019), they are however considered sensitive to disturbance from the presence of array site infrastructure (i.e. overall behavioural response characterised as ‘Strong avoidance’ – Dierschke *et al*., 2016).

866. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for gannet this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the gannet SCI of these SPAs.

867. As such, during the construction phase of the CWP Project, the presence of partially and fully installed above sea level WTG infrastructures may result in the disturbance and displacement of gannet which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase.

868. In relation to these Conservation Objective attributes, disturbance leading to displacement of gannet from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are erected within the array site during the construction phase, gannets which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat ‘behind’ installed infrastructure (i.e. experience ‘barrier effects’).

869. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

870. Total bio-seasonal and total annual estimated construction phase gannet displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 21**. Note that for seabird receptors such as gannet, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

871. In the general absence of information relating to construction-specific displacement rates and following the precedent of recent UK OWF assessment of construction phase disturbance and displacement impacts to seabirds (for example, Awel y Môr EIAR, 2022), displacement mortalities have been determined on the basis that displacement rates during construction are half of those during the operation and maintenance phase.

872. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 21**. These apportioned displacement proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 21**, below.

873. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 21: Total bio-seasonal and annual displacement mortalities to gannet (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season			Annual
		Migration-Free Breeding (Apr – Aug)	Post-Breeding Migration (Sep – Nov)	Return Migration (Dec – Mar)	
Total impact	30% / 1%	0.315	0.166	0.315	0.795
	35% / 1%	**0.367**	**0.194**	**0.367**	**0.928**
	40% / 1%	0.420	0.222	0.420	1.061

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
The Bull and the Cow Rocks SPA	Table 4.113	Table 4.114
Skelligs SPA	Table 4.132	Table 4.133

874. Increases to these SPAs gannet mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2014 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus gannet adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase

displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to gannet mortality in **NIS Volume 5 Part 2** are also given in **Table 21**, above.

875. As additional mortality to the gannet SCI of these SPAs resulting from construction phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value and also for the more precautionary potential displacement scenarios presented) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. Specifically, construction phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase in barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

876. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the construction phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

877. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

878. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to disturbance and displacement impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Construction phase impact 3 – Changes in prey availability

Array site

Project only assessment

879. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the gannet SCI of these SPAs.

880. Gannet depredates a range of fish species. Construction phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

881. In relation to these Conservation Objective attributes, construction of the CWP Project array site may impact gannet prey species through underwater noise effects, increases to suspended sediment

concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging gannet, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

882. Of gannet's key prey species groups, gadoids are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury-inducing underwater noise impacts to this group (primarily in relation to pile driving for WTG and OSS foundation installation which may occur over a total duration of 78 days [if a single piling event per 24-hour period is undertaken], within a broader construction window of 262.5 days) are, however, calculated to occur within only very small areas (up to 34 km^2 and 94 km^2, respectively) of this SCI's breeding season foraging range (mean-maximum + 1 S.D. = 509.4 km, Woodward *et al*., 2019). Although TTS inducing underwater noise impacts to sandeels are predicted to occur to a larger, although still very small, proportion of theoretical gannet breeding season foraging areas (up to 3,500 km^2), TTS impacts to prey species are considered to have very limited potential to result in population level consequences to their seabird predators.

883. Areas affected by increased SSC levels during construction phase activities within the array site are also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents and occur over considerably shorter durations. Suspended sediment plumes created during dredge disposal operations within the array site are predicted to enhance SSC levels over up to c. 7-9 km (depending on tidal conditions), for a duration of c.10-15 days and resulting in cumulative deposition thicknesses of c. 1-2 cm. Suspended sediment plumes created during trenching operations within the array site are predicted to enhance SSC levels over up to c. 10 km (depending on tidal conditions), for a duration of c. 15 days and resulting in cumulative deposition thicknesses of <1 cm.

884. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the array site (up to 6.30 km^2) is also assessed to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

885. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of gannet breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

886. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the array site is considered to be negligible.

887. In particular, potential changes to prey availability resultant from construction phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the gannet SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of gannet prey species in such a way as to result in a significant decline in the breeding population abundance or productivity rate of the gannet SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

888. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

889. As per project only assessment, above.

OECC

Project only assessment

890. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from construction phase works, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the gannet SCI of these SPAs.

891. Gannet depredates a range of fish species. Construction phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

892. In relation to these Conservation Objective attributes, construction within the CWP Project OECC may impact gannet prey species through underwater noise effects, increases to suspended sediment concentrations or temporary disturbance of important benthic habitats for those prey species. Should these impacts to prey species reduce the availability of those prey species to foraging gannet, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

893. Of gannet's key prey species groups, gadoids are anticipated to be most impacted by underwater noise during the construction phase. Mortality or injury inducing underwater noise impacts to this group (and to prey species more generally) are however anticipated to very limited, as no pile driving activities are proposed in relation to the installation of the export cable within OECC, with high energy underwater noise sources limited to the potential treatment of a small number of UXO (fewer than ten).

894. Areas affected by increased SSC levels during construction phase activities within the OECC are assessed to be of negligible size in relation to this SCI's breeding (mean-maximum foraging range + 1 S.D. = 509.4 km, Woodward *et al*., 2019) and non-breeding season range extents and occur over relatively short durations. Suspended sediment plumes created during dredge disposal operations within the OECC are predicted to enhance SSC levels over up to c. 4-5 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm. Suspended sediment plumes created during trenching operations within the OECC are predicted to enhance SSC levels over up c. 7 km (depending on tidal conditions), for a duration of c.10 days and resulting in cumulative deposition thicknesses of c. 1 cm.

895. The spatial extent of temporarily disturbed of areas of benthic habitat during construction phase activities within the OECC (up to 5.63 km^2) is also assessed to be of negligible size in relation to this

SCI's breeding and non-breeding season range extents. Within these areas, benthic communities are typically resilient to localised habitat disturbance, demonstrating high or very high-levels of recoverability (i.e. within weeks or months).

896. Despite the above potential pathways to impact, the areas in which impacts to prey species availability may occur represent a negligible proportion of sea area within the foraging range of gannet breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

897. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential temporary impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with construction phase activities within the OECC is considered to be negligible.

898. In particular, potential changes to prey availability resultant from construction phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the gannet SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of gannet prey species in such a way as to result in a significant decline in the breeding population abundance or productivity rate of the gannet SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

899. No specific mitigation is proposed or required in respect of changes in prey availability during construction within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

900. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

901. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to changes in prey availability impacts during the construction phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Operation and maintenance phase impact 1 – Direct effects on habitat

Array site

Project only assessment

902. With regards to the array site, relevant operation and maintenance phase direct effects on habitat relate to the occupation of sea surface areas by the footprint of operational infrastructure and unavailable for use by seabird SCIs to undertake non-foraging behaviours. As the array site does not

overlap this SPA, all direct effects on habitat will occur entirely outside of these SPAs, i.e. all direct effects assessed here relate to ex situ habitats which may support the gannet SCI of these SPAs.

903. As the operation and maintenance phase progresses through its planned duration of 25 years, the above sea level spatial extent of infrastructure will at no point exceed 0.005 km^2 within the array site (i.e. combined sea level area of all turbines and OSSs). This direct effect on habitat has the potential to impact on the following Conservation Objective attributes and targets to the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline.

904. In relation to this Conservation Objective attribute, the footprint of operational infrastructure within the CWP Project array site may reduce the marine areas in which individuals can undertake non-foraging behaviours or require individuals to use alternative areas for non-foraging behaviours. These potential consequences of operation and maintenance phase activities within the array site may affect the energetic costs of non-foraging behaviours and in turn the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

905. Despite the above potential pathways to impact, these direct effects on habitat do not affect any area of these SPAs (and hence do not affect the distribution of non-foraging habitat of this SCI within these SPAs). Further, the area of habitat loss represents a negligible proportion of sea area within the foraging range (mean-maximum + 1. S.D. = 509.4 km, Woodward *et al.*, 2019) of gannet breeding within these SPAs and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

906. In the context of the extent of available habitat within foraging range of these SPAs, and the negligible proportion that will be occupied by operational infrastructure, the scale of direct effects on habitat within the array site is considered to be negligible. In particular, the reduction in marine areas in which to undertake non-foraging behaviours, or requirement to use alternative areas for non-foraging behaviours, is not expected to give rise to energetic costs of non-foraging behaviours in such a way as to affect the condition of individuals and consequent survival rates. Accordingly, the level of impact is not considered capable of altering the extent of available habitat in such a way as to result in a significant decline in the breeding population abundance of the gannet SCI of these SPAs. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

907. No specific mitigation is proposed or required in respect of direct effects on habitat during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

908. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

909. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to direct effects on habitat impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Operation and maintenance impact 2 – Disturbance and displacement

Array site

Project only assessment

910. Although gannet are insensitive to disturbance and displacement from presence of vessels (i.e. low [2/5] disturbance reaction to vessels – Garthe and Hüppop, 2004; and low [4.7/25] behavioural sensitivity to vessel disturbance – Fliessbach *et al*., 2019), they are however considered sensitive to disturbance from the presence of array site infrastructure (i.e. overall behavioural response characterised as 'Strong avoidance' – Dierschke *et al*., 2016).

911. As the array site does not overlap this SPA and these SPAs are beyond the extent of areas in which disturbance and displacement impacts are considered to occur surrounding the array site (for gannet this is regarded as a 2 km buffer) all disturbance and displacement impacts will occur entirely outside of these SPAs, i.e. all disturbance and displacement impacts assessed here relate to ex situ habitats which may support the gannet SCI of these SPAs.

912. As such, during the operation and maintenance phase of the CWP Project, the presence of above-sea level WTG infrastructures may result in the disturbance and displacement of gannet which breed within these SPAs from areas within and surrounding the array site. Disturbance and displacement has the potential to impact the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Barriers to connectivity – No significant increase

913. In relation to these Conservation Objective attributes, disturbance leading to displacement of gannet from the CWP Project array site and surrounding areas may lead to the exclusion of individuals from areas of habitat which would otherwise be used for foraging or other behaviours (i.e. indirect habitat loss). Similarly, as WTGs are present within the array site during the operation and maintenance phase, gannets which would otherwise pass through these areas, may avoid flying through, or close, to standing WTG infrastructure and alter flightpaths so as to go round such areas, with potential reductions in habitat 'behind' installed infrastructure (i.e. experience 'barrier effects').

914. Resultant reductions in the extent of marine areas in which individuals can undertake foraging and non-foraging behaviours, or the requirement of individuals to use alternative areas for such behaviours, or the requirement for individuals to increase flight lengths to avoid passage through or close to installed WTGs, may affect the energetic costs of those behaviours and, in turn, affect the condition of individuals and their consequent survival and / or productivity rates; and thereby compromise the ability of the SCI to maintain its population.

915. Total bio-seasonal and total annual estimated operation and maintenance phase gannet displacement mortalities, as determined in **Appendix 10.4 and 10.11 of the EIAR**, are presented for a range of displacement scenarios in **Table 22**. Note that for seabird receptors such as gannet, which are potentially displaying frequent distributional responses to the presence of array site infrastructure (as opposed to migrants which typically may display one-off responses to avoid such infrastructure), indirect habitat loss and barrier effects are treated collectively when displacement matrices are used to calculate displacement mortality figures.

916. These displacement mortality rates are apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS, and also presented in **Table 22**. These apportioned displacement proportions and resulting

predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 22**, below.

917. Displacement mortalities are presented for an evidence-led central displacement scenario, highlighted in bold, and a range of other displacement and/or displacement mortality proportions.

Table 22: Total bio-seasonal and annual displacement mortalities to gannet (evidence-led central value highlighted) and table numbers relevant to apportioned displacement rates and mortalities within Volume 5 Part 2

	Displacement scenario (percentage of individuals displaced from array site and surrounding 2 km buffer / percentage of displaced individuals experiencing mortality)	Bio-season			Annual
		Migration-Free Breeding (Apr – Aug)	Post-Breeding Migration (Sep – Nov)	Return Migration (Dec – Mar)	
Total impact	60% / 1%	0.629	0.332	0.629	1.590
	70% / 1%	**0.734**	**0.387**	**0.734**	**1.855**
	80% / 1%	0.839	0.443	0.839	2.121

SPA	NIS Volume 5 Part 2 table number	
	Apportioned displacement mortalities	Increase to SPA mortality
Saltee Islands SPA	Table 4.63	Table 4.64
The Bull and the Cow Rocks SPA	Table 4.115	Table 4.116
Skelligs SPA	Table 4.134	Table 4.135

918. Increases to these SPAs gannet mortality rates resultant from apportioned annual construction phase disturbance and displacement impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of displacement impacts from the CWP Project, the most recent colony count from these SPAs (2014 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus gannet adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to this baseline SPA annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional construction phase displacement associated with the CWP Project. The relevant tables displaying the SPA-specific increases to gannet mortality in **NIS Volume 5 Part 2** are also given in **Table 22**, above.

919. As additional mortality to the gannet SCI of these SPAs resulting from operation and maintenance phase displacement impacts within the array site and a surrounding 2 km buffer area is estimated to represent only a very small potential increase (much less than 1%, for the evidence-led central value) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. Specifically, operation and maintenance phase displacement mortality will not affect the breeding population abundance or productivity rate, or increase barriers to connectivity for the SCI in such a way as to compromise its ability to maintain itself on a long-term basis as a viable component of its natural habitats. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

920. No specific mitigation is proposed or required in respect of disturbance and displacement impacts during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

921. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

922. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to disturbance and displacement impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Operation and maintenance phase impact 3 – Changes in prey availability

Array site

Project only assessment

923. As the array site does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the gannet SCI of these SPAs.

924. Gannet depredates a range of fish species. Operation and maintenance phase activities within the array site which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

925. In relation to these Conservation Objective attributes, maintenance activities during the operational phase of the CWP Project array site may impact gannet prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging gannet, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

926. As operational phase activities within the array site will not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

927. Similarly, as operational phase activities within the array site do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

928. Key fish species, upon which gannet predate, may experience the loss of up to 0.49 km^2 of previously available benthic habitat within the array site as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

929. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

930. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of gannet breeding within these SPAs (mean-maximum + 1. S.D. = 509.4 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

931. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the array site is considered to be negligible.

932. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the array site are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the gannet SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of gannet prey species in such a way as to result in a significant decline in the breeding population abundance or productivity rate of the gannet SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

933. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

934. As per project only assessment, above.

OECC

Project only assessment

935. As the OECC does not overlap this SPA and these SPAs are beyond the range in which prey species may experience potential impacts from operation and maintenance phase activities, potential changes in prey availability impacts will occur entirely outside of these SPAs, i.e. all impacts assessed here relate to prey species within ex situ habitats which may support the gannet SCI of these SPAs.

936. Gannet depredates a range of fish species. Operation and maintenance phase activities within the OECC which may affect those prey species have the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline;
- Productivity rate – No significant decline; and
- Prey biomass available – No significant decline.

937. In relation to these Conservation Objective attributes, operation and maintenance phase activities within the CWP Project OECC may impact gannet prey species through underwater noise effects, increases to suspended sediment concentrations, removal or alteration of important benthic habitats for those prey species, or electromagnetic field effects affecting prey species distributions around electrical infrastructure. Should these impacts to prey species reduce the availability of those prey species to foraging gannet, this may result in effects to the demographic parameters, and resultant population dynamics, of this SCI through processes such as increased energetic consequences of foraging reducing individual condition and survival or productivity rates, or reduced provisioning rates to offspring reducing productivity rates. These potential consequences may compromise the ability of the SCI to maintain its population, with prey availability changes potentially resulting in there being insufficient habitat to support the SCI's population on a long-term basis.

938. As operational phase activities within the OECC do not include piling works or any other very high energy underwater noise inducing activities, and operational noise impact magnitudes to all potential prey species are assessed to be very low, there is not considered to be a pathway for operation and maintenance phase underwater noise impacts to have the potential to cause perceptible changes to prey availability in such a way that could impact this SCI.

939. Similarly, as operational phase activities within the OECC do not routinely require disturbance of the seabed (in the form of trenching or dredging activities) except within localised areas in which this is necessary to facilitate repairs, increased SSC levels, are considered to occur only potentially infrequently and locally during the operational phase and there is no perceptible pathway for this impact to have the potential to cause changes to prey availability during the operational phase in such a way that could impact this SCI.

940. Key fish species, upon which gannet predate, may experience the loss of up to 0.11 km^2 of previously available benthic habitat within the OECC as a result of occupancy of the seabed by infrastructure during the operation and maintenance phase of the CWP Project. The spatial extent of such prey species habitat loss is, however, considered to be of negligible size in relation to this SCI's breeding and non-breeding season range extents.

941. During the operation and maintenance phase, one additional potential impact to seabird receptor prey species which does not occur during the construction phase is considered, namely EMF effects, associated with electricity passing along infrastructure cables. Any effects on fish are anticipated to occur within the immediate vicinity of the cable and effect levels are likely to be low in relation to background levels associated with the Earth's magnetic field. The magnitude of such impacts to potentially sensitive fish species are assessed as being very low. Consequently, there is not considered to be a pathway for operation and maintenance phase EMF impacts to have the potential to cause impacts to prey availability in such a way that could impact this SCI.

942. Despite the above potential pathway to impact in the form of benthic habitat loss, the area in which impacts to prey species availability may occur represents a negligible proportion of sea area within the foraging range of gannet breeding within these SPAs (mean-maximum + 1. S.D. = 509.4 km, Woodward *et al*., 2019) and a smaller still proportion of the wider Irish Sea and Western UK-waters region likely used by the majority of SPA individuals outside of the breeding period.

943. In the context of the extent of available habitat within foraging range of these SPAs, the negligible proportion of that habitat in which potential impacts to prey species may occur, and that potential impacts to prey species may be of limited (if any) demographic consequence to their seabird predators, the scale of changes in prey availability impacts associated with operation and maintenance phase activities within the OECC is considered to be negligible.

944. In particular, potential changes to prey availability resultant from operation and maintenance phase activities within the OECC are not expected to perceptibly increase the energetic costs of foraging, or lead to reductions in offspring provisioning rates for the gannet SCI of these SPAs in such a way as to affect demographic parameters. Accordingly, the level of impact is not considered capable of altering the availability of gannet prey species in such a way as to result in a significant decline in the breeding population abundance or productivity rate of the gannet SCI of these SPAs, nor will there be any significant decline in prey biomass available to this SCI. The CWP Project will therefore not impede the overall objective of maintaining / restoring the favourable conservation condition of the gannet SCI of these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

945. No specific mitigation is proposed or required in respect of changes in prey availability during the operation and maintenance phase within the OECC, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

946. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

947. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to changes in prey availability impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

Operation and maintenance impact 4 – Collision

Array site

Project only assessment

948. During the operation and maintenance phase of the CWP Project the presence of operational WTGs within the array site may result in the mortality of gannet from the above-listed SPAs through the collision of individuals with turbine blades. Collision mortality has the potential to impact on the following Conservation Objective attributes and targets for the gannet SCI of these SPAs:

- Breeding population abundance – No significant decline; and

- Productivity rate – No significant decline.

949. In relation to these Conservation Objective attributes, mortality resultant from collision with operational WTGs within the array site may directly affect the overall survival rate of this SCI at these SPAs and thereby potentially contribute to declines in the breeding population abundance of the SCI. Furthermore, collision mortality may also adversely affect the overall productivity rate of this SCI at these SPAs, through reductions to offspring provisioning rates and other parental care metrics (should parents experience collision mortality).

Total bio-seasonal and total annual estimated gannet collision mortalities, as derived in **Appendix 10.3 CRM of the EIAR**, are presented in **Table 23**. Collision mortalities are presented in relation to Representative Scenarios A and B and CRM Band Option 1 and 2 models. As described in **Appendix 10.3 CRM of the EIAR**, Band Option 1 CRMs (which utilise site-specific flight height data for this SCI) are considered most appropriate and associated values highlighted in bold. Detailed justification regarding why Band Option 1 models are considered most appropriate for this SCI, and the CRM parameters used, is presented in **Appendix 10.3 CRM of the EIAR**. To summarise, baseline site-specific flight height data for this SCI are considered sufficiently robust to inform collision risk modelling and the use of site-specific data in assessment (alongside a generic Band Option 2 approach) was assessed to be 'an attractive option' in an NPWS review of ornithological assessment methods for east coast Phase 1 projects (ABPmer, 2023). Band Option 2 model outputs are also presented to facilitate comparison with the outputs of other projects (particularly other Irish OWFs with potentially concurrent construction and operational timelines).

950. These collision mortality values have been apportioned to the above-listed SPAs according to the apportioning ratios determined in **Appendix 3 Apportioning impacts to SPAs** in **Volume 7** of this NIS. These apportioned collision proportions and resulting predicted SPA mortalities are presented in **NIS Volume 5 Part 2** and the relevant table numbers within this volume are also provided in **Table 23**, below.

Table 23: Total bio-seasonal and annual collision mortalities to gannet and table numbers within NIS Volume 5 Part 2 relevant to mortalities apportioned to these SPAs and resultant increases to SPA mortality rates

	Design option	CRM Band Option	Bio-season			Annual
			Return Migration (Dec - Mar)	Migration Free Breeding (Apr - Aug)	Post Breeding Migration (Sep - Nov)	
Total impact	A	**1**	**0.326**	**0.432**	**0.136**	**0.894**
		2	0.932	1.222	0.406	2.560
	B	**1**	**0.274**	**0.372**	**0.116**	**0.762**
		2	0.830	1.065	0.338	2.233
Impact accounting for 70% macro-avoidance	A	**1**	**0.098**	**0.130**	**0.041**	**0.268**
		2	0.280	0.367	0.122	0.768
	B	**1**	**0.082**	**0.112**	**0.035**	**0.229**
		2	0.249	0.320	0.101	0.670

SPA	NIS Volume 5 Part 2 table number	
	Apportioned collision mortalities	Increase to SPA mortality
Saltee Islands SPA	Table 4.65	Table 4.66

The Bull and the Cow Rocks SPA	Table 4.117	Table 4.118
Skelligs SPA	Table 4.136	Table 4.137

951. Increases to SPA gannet mortality rates resultant from apportioned annual impacts are also presented in **NIS Volume 5 Part 2**. In order to calculate the increase in SPA-specific mortality rates to this SCI as a result of collision impact from the CWP Project, the most recent colony count from these SPAs (2014 count - SMP, 2023) has been used to estimate the average number of breeding adults from these SPA colonies which die each year by multiplying by one minus gannet adult annual survival rate (taken from Horswill and Robinson, 2015). The percentage of the apportioned mortality compared to the above-listed SPAs annual mortality is derived to show the proportional increase to SPA mortality rates owing to additional collision mortality associated with the CWP Project. The relevant tables displaying the SPA-specific increases to gannet mortality in **NIS Volume 5 Part 2** are also given in **Table 23**, above.

952. As additional mortality to the gannet SCI of these SPAs resulting from collision with operational WTGs is estimated to represent only a very small potential increase (much less than 1%, for preferred Band Option 1 models) to SPA baseline mortality rates, this impact is considered not to impede the overall objective of maintaining the favourable conservation condition of the gannet SCI of these SPAs. Specifically, collision mortality will not result in significant decline to the breeding population abundance or productivity of this SCI at these SPAs. In light of these factors, it can be concluded beyond reasonable scientific doubt that the CWP Project will not give rise to any AESI to these SPAs.

Proposed mitigation

953. No specific mitigation is proposed or required in respect of collision during the operation and maintenance phase within the array site, as this impact will not give rise to any AESI in relation to these SPAs.

Residual effect

954. As per project only assessment, above.

Project-only effect on site integrity conclusion for impact

955. The Conservation Objective and its attributes and targets for the gannet SCI of these SPAs are presented in **Table 20**, above. With regards to collision impacts during the operation and maintenance phase of the CWP Project, it can be concluded that there is no impediment to the Conservation Objective being met for this SCI and, in turn, that there is **no project-only AESI for the gannet SCI of these SPAs.**

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