Muir Mhòr Offshore Wind Farm

Derogation Case

Appendix B: Artificial Nesting Structures for Kittiwake Evidence and Roadmap

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Glossary

Term	Definition
Array Area	The area in which the generation infrastructure (including Wind Turbine Generators and associated foundations and inter-array cables), Offshore Electrical Platform(s), and an interconnector cable will be located.
CIMP	Compensation Implementation and Monitoring Plan
Developer	Muir Mhòr Offshore Wind Farm Limited.
Hammock	Artificial structures drilled into a cliff side and designed for kittiwake to nest on.
Inter-array cables	Cables which link the wind turbines generators to each other and the Offshore Electrical Platform(s).
Interconnector cable	Cable which links the Offshore Electrical Platforms to one another, allowing for power to be transferred between the platforms.
Landfall	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS) where the offshore export cables are brought onshore.
National Site Network	A National Site Network covering both land and sea, including the UK's inshore and offshore marine areas. This network encompasses existing SACs and SPAs, as well as new SACs and SPAs designated under these Habitats Regulations.
Offshore Electrical Platform (OEP)	Offshore platform consisting of High Voltage Alternating Current (HVAC) equipment, details depending on the final electrical set up of the Project.
Offshore export cable(s)	The subsea electricity cable circuits running from the Offshore Electrical Platform to the landfall which will transmit the electricity generated by the offshore wind farm to the onshore export cables for transmission onwards to the onshore substation and the national electrical transmission system along with auxiliary cables such as fibre optic cables.
Philopatry	Philopatry refers to an organism's tendency to remain in or frequently return to a specific location. There are many reasons for this behaviour, but one of the most common is natal philopatry, where animals return to their birthplace to reproduce.
Productivity	Productivity and nesting refer to data and statistics concerning bird breeding performance, including metrics such as number of chicks produced per nesting attempt.
Project	Muir Mhòr Offshore Wind Farm – comprises the wind farm and all associated offshore and onshore components.
Proposed Development	The offshore Muir Mhòr Offshore Wind Farm project elements to which this Offshore EIA Report relates.
Quantum	The level of compensation that should be granted to a species that has experienced harm or mortality due to an offshore wind farm.
Wind Turbine Generator (WTG)	The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment.

Acronyms

Term	Definition
AA	Appropriate Assessment
AEoSI	Adverse Effect on Site Integrity
ANS	Artificial Nesting Structure
AON	Apparently Occupied Nest
DCO	Development Consent Order
HPAI	Highly Pathogenic Avian Influenza
MHWS	Mean High-Water Springs
NSN	National Site Network
OEP	Offshore Electrical Platform
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
WTG	Wind Turbine Generator

1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. Muir Mhòr Offshore Wind Farm Limited (hereafter referred to as 'the Developer') is proposing to develop the Muir Mhòr Offshore Wind Farm (hereafter 'the Project'). The Project is made up of both offshore and onshore components. The subject of this document is the offshore infrastructure of the Project seaward of Mean High-Water Springs (MHWS) which is hereafter referred to as 'the Proposed Development'.

1.1.2. The Muir Mhòr Array Area covers an area of approximately 200 km^2 and is located approximately 63 km east of Peterhead on the east coast of Scotland. The offshore infrastructure of the Proposed Development includes Wind Turbine Generators (WTGs) and associated floating foundations, the Offshore Electrical Platform(s) (OEP(s)) and associated foundations, the inter-array cables, an interconnector cable, offshore export cables and landfall.

1.2. DOCUMENT PURPOSE

1.2.1. This document supports the compensation aspect of a derogation case for the Proposed Development, should, following Appropriate Assessment (AA) by the Scottish Ministers, compensation be deemed necessary for impacts due to potential Adverse Effect on Site Integrity (AEoSI) on ornithological features of Special Protection Areas (SPAs). A derogation case has been brought forward for black-legged kittiwake (*Rissa tridactyla*, hereafter referred to as kittiwake).

1.2.2. The Ornithological Compensation Plan (Derogation Case: Appendix A – Ornithological Compensation Plan, hereafter referred to as 'the Plan') provides an overview of the proposed ornithological compensation measures for the Proposed Development. It summarises the conclusions and impacts from the RIAA, outlines the site-selection and selection of compensation measures. This document focusses on Artificial Nesting Structures (ANS) as a compensation measure for kittiwake. An overview of kittiwake ecology, conservation status, and threats and pressures at SPAs can be found in the Plan (Derogation Case: Appendix A – Ornithological Compensation Plan).

1.2.3. A site investigation was carried out by the Developer on Scotland's east coast in July 2024 to identify pressures at various non-SPA seabird colonies. Details of these surveys can be found in the Compensation Site Investigation Report (Derogation Case: Appendix E– Compensation Measures: Site Investigation Report). The results of that site investigation helped inform the development of the proposed compensation measures set out in the Plan.

1.2.4. This appendix reviews the evidence and potential for the installation of ANS in the form of stainless-steel ledges, drilled into cliffs in locations where ledges are currently unavailable to kittiwake. These ledges provide additional nesting spaces within thriving colonies, with the aim to increase the colony size and productivity thus increasing the annual recruitment of kittiwake into the regional populations of eastern Scotland – part of the wider northeast Atlantic populations and with connectivity to the National Site Network. An outline roadmap for design and delivery is also provided as part of this document.

2. EVIDENCE REVIEW-EFFECTIVENESS OF THE MEASURE

2.1. INTRODUCTION

2.1.1. This section explores the available evidence to support the proposal of artificial nesting structures in the form of stainless-steel artificial structures (in the form of ledges known as 'hammocks') to increase kittiwake productivity at existing colonies. The measure aims to improve the productivity of kittiwakes in the region, which evidence currently suggests is extremely low, by providing additional nesting space at successful colonies, which can be optimised to reduce pressures from predation, disturbance and extreme weather. A literature review was undertaken to support the use of ANS to increase kittiwake productivity. The literature explored included, but was not limited to, scientific journals, government reports, nature blogs, and Statutory Nature Conservation Bodies (SNCB) websites (such as NatureScot).

2.1.2. ANS may provide additional nesting spaces where natural sites are unsuitable for breeding. While kittiwake have been shown to benefit from offshore nesting sites due to their proximity to foraging areas and the absence of terrestrial predators (Christensen-Dalsgaard *et al*., 2019), evidence to support onshore ANS for kittiwake has been found around the world, as kittiwake seemingly do not show any preference for natural over artificial nesting sites, particularly where space is limited (Coulson, 2011). They have been found to exploit warehouses, bridges, and harbour walls (Coulson, 2011), as well as nesting sites designed specifically for them, such as in Boulogne-sur-Mer (France), where ledges were built onto Tower PP3 of the city's ferry terminal during its renovation, which displaced the kittiwake from their previous nesting sites (Ville de Boulogne-sur-Mer, 2022; see Figure 2-1). These anthropogenic sites provide nesting sites, can incorporate predator protection and can be located in-proximity to foraging areas (Christen-Dalsgaard *et al*., 2019). Indeed, the ledges in Boulogne-sur-Mer have been successfully colonised by kittiwake since their erection, with 900 pairs counted across the Éperon site, 300 of which nest on Tower PP3 (Ville de Boulogne-sur-Mer, 2022). Other Developers have developed ANS, focussing on creating new colonies: Ørsted (2023) built offshore kittiwake hotels, while Vattenfall (2023) built onshore ANS along the Suffolk coast that could provide nesting sites for 430 pairs and include horizontal ledges for nesting as well as predator deterrence mechanisms.

Figure 2-1 Tower PP3 at the ferry terminal of Boulogne-sur-Mer's Éperon site, where 300 kittiwake pairs have been found nesting. Source: Ville de Boulogne-sur-Mer, 2022.

2.1.3. Artificial structures have successfully increased productivity in other ledge-nesting birds. A steel ledge constructed using expansion bolts to hold the ledge into place in the cliff face was promptly colonised by prairie falcon (*Falco mexicanus*) in California (Boyce *et al.*, 1980). Additionally, there is evidence from the Karlsö Auk Lab in Sweden, wherein artificial structures have successfully hosted a sub-colony of guillemot for scientific research for over a decade (Hentati-Sunberg *et al.*, 2012; Olin *et al.*, 2023).

2.1.4. Successful use of artificial structures made from stainless steel has been demonstrated by the Royal Society for the Protection of Birds (RSPB) at Coquet Island on the Northumberland Coast (Wrobel, 2021). An unexpected expansion of the colony in the 2010s caused kittiwake to run out of natural cliff ledges and as such, the RSPB carved some 50 extra ledges into the cliff face at the end of the breeding season in 2019. In 2020, all ledges were occupied, and 453 pairs were counted (Wrobel, 2021). As kittiwake were occupying ledges quicker than the RSPB could carve them, the idea of creating artificial structures made of stainless steel was put forward and these were installed (Wrobel, 2021).

2.2. KITTIWAKE ECOLOGY

NESTING ECOLOGY AND HABITAT REQUIREMENTS

2.2.1. This section provides an overview of the nesting ecology and habitat requirements of kittiwake to support the proposal of artificial nesting structures in the form of ledges as a potential measure to increase productivity.

2.2.2. Mortality rates of kittiwake have remained stable the past few decades, indicating that a decline in population numbers may be due to low productivity (Coulson, 2011). As evidenced above, ANS will aim to help promote productivity and address this decrease in kittiwake populations.

2.2.3. Kittiwake typically nest in dense colonies on narrow ledges along steep cliffs (Coulson, 2011; Eveillard-Buchoux *et al.*, 2019). On larger cliff faces over 100 metres (m) high, their nests are usually concentrated in the middle to lower sections of the cliff (Coulson, 2011; Eveillard-Buchoux *et al.*, 2019). In contrast, on smaller cliffs, kittiwake tend to nest across the entire cliff face, leaving a gap at both the top and bottom — typically about 5 m above the sea and 6 m

below the cliff's edge — to reduce exposure to wave action and predators (Coulson, 2011; Eveillard-Buchoux *et al.*, 2019).

2.2.4. Kittiwake generally avoid nesting sites with overhangs or ceilings, using them in only 16% of cases, though they have been found to nest in coastal caves (Coulson, 2011; Eveillard-Buchoux *et al.*, 2019). Despite their tendency to avoid covered sites, they prefer nests with at least one sheltered side, which provides protection from avian predators (Massaro *et al.*, 2001).

2.2.5. The nest is bowl-shaped and built from mud, vegetation, and other fibrous material (such as textile and other manmade materials) and constructed upon a mud base that allows the nest to be level with the ledge surface (16 to 25 degrees) (Olsthoorn and Nelson, 1990; Coulson, 2011; Eveillard-Buchoux *et al.*, 2019). Foraging for these materials occurs within 2 to 10 km from the nesting site (Coulson, 2011).

2.2.6. Kittiwake lay two to three eggs into the nest to prevent them from rolling off the cliff edge (Coulson, 2011). Chicks fledge after around 40 days and fledglings must return to the natal nest for feeding by their parents (Mulard and Danchin, 2008). Once independent, juvenile kittiwake will spend two to three years at sea before returning to land to breed (British Trust for Ornithology, 2024).

KITTWAKE DISPERSAL BETWEEN SPA AND NON-SPA COLONIES

2.2.7. Although not all kittiwake are philopatric (i.e., return to their natal colony to nest), they tend to nest within 100 km of their natal nesting site (Coulson and Nève de Mévergnies, 1992; Boulinier and Danchin, 1997). While 36% of kittiwake are philopatric (mostly males), another 43% breed within 100 km of their natal colony, meaning that only 10% of kittiwake nest further than 100 km from where they were born (Coulson and Nève de Mévergnies, 1992). In addition, it has been determined that kittiwake that are not philopatric are more likely to nest south rather than north of their colony of birth (Coulson and Nève de Mévergnies, 1992). Following their first breeding season, kittiwake show high nest fidelity (Coulson, 2011). Consequently, it can be expected that increased productivity at non-SPA colonies will significantly contribute to and support SPA population numbers within 100km.

2.2.8. First-time breeding pairs arriving at a nesting site late may be subject to lower-quality breeding sites and unsuccessful first breeding attempts (Coulson, 2011). Dispersal rates may be higher if breeding failure is widespread across the colony (Ponchon *et al.*, 2015) and higher dispersal rates have been noted at low-density colonies and those with first-time breeders (Acker *et al*., 2017). McKnight *et al*. (2019) states that larger colonies in the UK are more likely to produce individuals who select new sites when their breeding season comes.

2.3. BENEFITS OF KITTIWAKE ARTIFICIAL STRUCTURES ON PRODUCTIVITY

2.3.1. It can be expected that kittiwake will be quicker to colonise new ledges within an existing colony than a new structure. As demonstrated at Coquet Island, kittiwake were shown to colonise the new ledges quicker than RSPB volunteers could carve them, resulting in the need for artificial structures to be built (Wrobel, 2021). Where space is saturated and colonies cannot grow, kittiwake may colonise adjacent structures (Turner, 2010). The site-investigations during July 2024 on Scotland's east coast, undertaken as part of this application, showed kittiwake occupying every available space and the unsuitable geology and overgrown vegetation of some cliffs resulted in sporadic distribution of kittiwake on the cliffside (see Figure 4-3 to Figure 4-9 below).

NESTING DENSITY

2.3.2. As lower-density colonies face a higher risk of predation (Massaro *et al.*, 2001), bolstering low or declining populations, or increasing the nest density of the colony, can help reduce the risk of predation. According to Massaro *et al.* (2001), kittiwake nesting at high density tend to be more successful at raising chicks than those in lower or medium density sites, in part due to mob response to avian predators. Poor reproductive success has been found in smaller nesting aggregations, which can lead to long-term effects on recruitment (Massaro *et al.*, 2001). For example, social effects are strong in kittiwake and birds that breed in close proximity to others are more likely to have higher productivity and survival (Ruffino *et al.*, 2020). As such, providing additional artificial structures at existing colonies can support the productivity through the creation of denser colonies that are more resilient to predation.

SHELTER FROM EXTREME WEATHER

2.3.3. Nest sites should be oriented in such a way as to promote successful breeding. While in Portugal there is evidence that kittiwake prefer north-facing nest sites, this may be attributed to the region's heat (Coulson, 2011). In the UK and Ireland, the nests tend to be located in places that can withstand storm and wind conditions, and this is particularly important as intense storms early in the breeding season can impact site attendance (Coulson, 2011; see Section 2.3.3). Exposure to adverse weather, particularly wind (Christensen-Dalsgaard et al. 2018a, b) and rain (Alvestad 2015) may impact kittiwake productivity through effects on thermoregulation or in more extreme cases nests may be washed away or damaged (e.g., Newell et al. 2015). Sheltered ledges such as those in Figure 2-1 have shown to have a higher success rate than those exposed to direct sunlight (Ørsted, 2020).

2.3.4. In recent years storms have been directly linked to lower kittiwake breeding success. For example, Newell et al. (2015) observed a net reduction in annual kittiwake population production of 10.7% following a storm at the Isle of May. Nests were damaged and washed away during the storm, with 15.6% of kittiwake nests failing in exposed areas of the colony compared to 1.9% in sheltered areas (Newell et al., 2015). This suggest the addition of at existing colonies in sheltered locations can maximise kittiwake productivity and minimise the number of colonies and birds being displaced by extreme weather. Furthermore, as shown in Figure 4.1, structures can be designed to reduce the risk of nests being flooded or the ledges being eroded by storms by allowing water to filter through; as well as protect kittiwake from predators through the provision of a roof or overhang (Turner, 2010; Equinor, 2023; Ørsted, 2023).

3. IMPLEMENTATION

3.1. INTRODUCTION

3.1.1. This section serves as an outline Compensation Implementation and Monitoring Plan (CIMP), which details how the compensation measure of providing artificial nesting ledges to kittiwake at non-SPA colonies on Scotland's east coast can be implemented and monitored. This section also details the benefits of ANS at the selected sites and how these can address compensation requirements for kittiwake.

3.2. COMPENSATION REQUIREMENTS

3.2.1. This section defines the compensation quantum calculations, which determine the amount of compensation necessary to address the impacts on seabirds due to the Proposed Development, and how these are addressed by the ANS compensation measure for kittiwake populations on Scotland's east coast.

3.2.2. When calculating the requirement for artificial nesting spaces, the basic compensation calculation inputs the number of individual birds to be compensated for (i.e. the impact from the proposed development) and outputs the number of additional breeding pairs necessary to generate enough fledglings to ensure the population levels remain constant or increase. The compensation calculation developed by Hornsea Three (Stage 1) is considered the most appropriate and is used here to determine the number of fledglings and breeding pairs required to compensate for the Proposed Development's impact on kittiwake (see The Crown Estate, 2024, for further details on the calculation methodology). In addition to calculating the number of breeding pairs required to recruit the necessary number of breeding adults back into the regional population, this method includes a correction for the philopatry rate, which accounts for the proportion of birds that will disperse from their colony of birth (89%). The calculation inputs and outputs can be found in Table 3-1.

Table 3-1 Maximum compensation requirements for kittiwake based on the higher distributional response scenario.

Population	New recruits required	Fledglings required	Breeding pairs required
Buchan Ness to Collieston Coast SPA	13.91	30.54	41.90
East Caithness Cliffs SPA	7.22	15.85	21.75
Fowlsheugh SPA	4.95	10.87	14.91
Troup, Pennan and Lion's Heads SPA	9.35	20.53	28.17
Forth Islands SPA	1.81	3.97	5.45
Total	**37.24**	**81.76**	**112.18**

3.2.3. It should be noted that this calculation does not account for two key factors: (1) that some kittiwake occupying the artificial structures may have successfully bred elsewhere, and (2) the productivity boost that may be received by the surrounding colony from the presence of the ledges. The Developer will work with NatureScot to agree on an appropriate quantum but remains confident that the measure has the capability to compensate fully for impacts to kittiwake from the Proposed Development.

3.3. MONITORING

3.3.1. Monitoring to determine the effectiveness of the kittiwake nesting ledges can be carried out from land, similarly to the July 2024 site-surveys (see Derogation Case: Appendix F – Compensation Measures: Site Investigation Report for more information). The accessibility of the colony from land means that a vessel is not required to carry out monitoring, reducing costs and improving the temporal coverage and the reliability with which the site can be measured. This also allows surveyors to collect productivity data, which is vital to quantifying the success of the measure.

3.3.2. Surveys will be carried out every breeding season to establish whether and when the artificial structures are being colonised. Productivity will need to be assessed during the breeding season to establish a baseline at each colony from which potential benefits can be measured. It is anticipated that at least three visits to each site will be required to collect robust productivity data. There are several options available to assess the benefits of the ledges, but it is anticipated that productivity rates will be analysed within different subsets of the colony to infer a benefit relative to a control site. In addition, while the ledges are made of stainless steel and designed to last several years, surveyors should report any damaged or lost artificial structures so that these can be assessed and replaced as appropriate.

3.3.3. Enlisting surveyors to assess these sites every breeding season may be done via freelance ornithologists or through a company specialised in ornithological surveys. To ensure the replicability of surveys year after year, the hiring of the same ornithologist(s) or team is recommended to avoid any differences in survey methods.

3.4. COMPENSATION CHECKLIST

3.4.1. The following checklist has been provided to summarise the information contained within this report and aid Scottish Ministers with their decision on the appropriateness of artificial structures at an existing colony as a compensation measure Table 3-2.

Table 3-2- Compensation measure checklist.

Checklist Question	Explanation
Is this measure technically feasible?	Yes. There is evidence of kittiwake nesting on ANS around the world, with kittiwake seemingly not showing any preference for natural over artificial nesting sites, particularly where space is limited (Coulson, 2011). This measure has been implemented by other Developers including Ørsted (2023) (built three onshore and nearshore kittiwake ANS with a fourth structure in development), and Vattenfall (2023) (built onshore ANS that could provide nesting sites for 430 pairs). This measure is therefore technically feasible.
Is this measure financially viable?	Yes. The Developer is committed to securing funding for the construction, installation, repair, and monitoring of kittiwake ANS. Therefore, the measure is financially feasible.
Is the measure legally securable?	Yes. Any necessary consents for the implementation of these measures will be sought post-submission. The Developer will liaise and work with all landowners to secure any necessary rights and/or permissions to implement this measure.
Is this measure ecologically effective (i.e. sufficient)?	Yes. This measure has strong ecological evidence to suggest success to kittiwake around the world. Therefore, is ecologically effective and will maintain the coherence of the network.
Will this measure be effective before adverse effects arise?	Yes. Compensation will be implemented and active before impacts from the Proposed Development have occurred. Monitoring of the measure will evidence the effectiveness of this measure. Adaptive management options will be identified if success is not provided or less than expected.

4. ROADMAP FOR DELIVERY

4.1. DESIGN CONSIDERATIONS

4.1.1. Designs for any ANS must consider species-specific nesting strategies. This section focusses on the needs of kittiwake in terms of nesting space. Kittiwake nest on steep, cliff-face ledges that are least 8 x 8 cm, but 20 x 20 cm ledges that are level are preferable (Olsthoorn and Nelson, 1990). Larger ledges (over 50 cm) are often avoided by kittiwake, due to their use by other species (auks, fulmar) which displace kittiwake at these nesting sites (Olsthoorn and Nelson, 1990).

4.1.2. Kittiwake prefer nesting at the mid- to -low level off a cliff face, about 5 m above sea level and 6 m below the cliff top (Coulson, 2011; Eveillard-Buchoux *et al.*, 2019). Kittiwake choose nest sites with at least one protective wall (Massaro *et al*., 2001) and avoid fully enclosed nesting sites (Olsthoorn and Nelson, 1990). North-facing ANS for kittiwake have proven successful (Coulson, 2011; Vattenfall, 2023).

COLONISATION RATES

4.1.3. Colony growth rates on man-made structures have been found to be similar to those of natural sites (Coulson, 2011). New colonies tend to be established by as few as three young birds, with the colony doubling in size every year for the first two to four years then slowing to a growth of about 10% to 20% per year (Kidlaw, 2005; Coulon, 2011). As demonstrated by the RSPB at Coquet Island, the colonisation rate of additional ledges at existing colonies is likely to be much higher. In 2019, the RSPB carved 50 ledges into the cliff, by summer 2020 the ledges were full, and the population of kittiwake had risen to 453 pairs (RSPB, 2024). Midway through, they adopted a faster method by installing stainless steel ‘hammocks’ on the cliff, which were also fully occupied within a year (Wrobel, 2021). According to Stephen Lunn, the blacksmith and artist behind the ledges, ‘within hours of putting [the hammocks] up, they were prospected and used as nest sites, allowing more chicks to be raised than would have been possible without our small contribution’ (RSPB, 2024).

4.1.4. The installation of artificial structures at already-thriving kittiwake colonies ensures that kittiwake are able to continue foraging for nesting materials within an appropriate range (two to ten km) from the nesting site (Coulson, 2011). Decoy birds and playing bird calls (Arnold *et al*., 2011; Friesen *et al.*, 2017), as well as using old nests (Ørsted, 2023) to trigger seabird olfactory abilities, have been successful at attracting birds to new sites. These methods could attract kittiwake to ANS located in proximity to natural nesting sites.

DESIGN CRITERIA

4.1.5. Past ANS for kittiwake that have been successful include predator-control measures, such as protective fencing at the base of a structure to prevent access from mammalian predators and sloped roofs to deter avian predators (Vattenfall, 2023). However, at the identified compensation sites, no predator pressures were identified and the measure will be designed to complement existing ledges and as such will not feature sloped roofs. However, predator-control measures may be considered as adaptive management should evidence of predator presence arise.

4.1.6. Artificial nesting structures can be created by a blacksmith using two steel rods attached to a stainless steel ‘hammock’ (Figure 4-1). The hammock is pinned to the cliff using epoxy resin (Wrobel, 2021). Two 12 mm holes are bored into the cliff side and within minutes, a new ledge becomes available to kittiwake (Wrobel, 2021). The RSPB reports that these artificial structures were quickly colonised by breeding pairs and can last for several years (Wrobel, 2021). The proposed artificial structures for the non-SPA colonies identified can be designed

to optimise kittiwake productivity by addressing nest structure integrity issues, such as the need for irrigation to prevent flooding or the addition of a roof or overhang to protect kittiwake from avian predators.

Figure 4-1 Stephen Lunn, a local blacksmith artist and RSPB volunteer, building an artificial ledge for kittiwake. Source: Wrobel, 2021.

4.2. SITE SELECTION

4.2.1. This section outlines the selection process to determine appropriate colonies for artificial structures at surveyed sites. The full site-selection process used to shortlist the sites for investigation can be found in the Plan (Derogation Case: Appendix A – Ornithological Compensation Plan).

4.2.2. The presence of occupied ledges at the proposed sites would suggest the cliffs are appropriately sheltered, located within range of suitable foraging habitat, within proximity of nesting materials, away from anthropogenic disturbance and may be predator- or parasite-free (Danchin *et al.*, 1998), which in turn encourages successful breeding (Lewis et al., 2001; Daunt et al., 2002). Consequently, the Developer is confident that the locations identified within this Section are suitable for the implementation of artificial structures. Furthermore, a proposed site within or next to an existing colony should maximise the probability and rate of colonisation.

4.2.3. Work is ongoing to progress understanding regarding the feasibility of these sites and as such will continue post-submission. Depending upon the outcomes of discussions with relevant landowners, some adjustments to site selection may be required to finalise the implementation sites, and as such, the exact location for (part of) the structures may deviate from those proposed below.

4.2.4. As set out in the Plan (Derogation Case: Appendix A – Ornithological Compensation Plan), non-SPA colonies became the focus for measures on the east coast due to lack of engagement from site-managers and information on management and monitoring at relevant SPAs. Non-SPA sites were identified using the Seabird Monitoring Programme database. Following surveying in July 2024 (see Derogation Case: Appendix F – Compensation Measures: Site Investigation Report), ornithologists identified key sites which could benefit from additional nesting structures.

4.2.5. Figure 4-2 maps out the potential sites for ANS in the form of artificial structures. In total, seven sites were identified. The number of artificial structures that could be fitted at each site was estimated, with a conservative estimate of one artificial structure per square metre and the potential to install up to four artificial structures per square metre, as kittiwake tend to nest in close proximity to one another to reduce the risk of predation (Massaro *et al*., 2001).

4.2.6. The colonies identified in Figure 4-2 appeared to be healthy with the potential to increase productivity but appeared to be limited by the amount of nesting space available due to the geology of the cliffs (Figure 4-3 to Figure 4-9). The identified sections of cliffside that could potentially be suitable for artificial structures are characterised by their proximity to existing nests but feature unsuitable habitat (e.g., absence of ledges or overgrown vegetation) that prevent kittiwake from nesting more densely. There are a mixture of north and south aspect facing colonies the majority of which are reasonably protected from extreme weather.

4.2.7. Although, these surveyed sites have potential for ANS, other sites may be revisited as required.

555000

560000

6330000

6325000

Potental ANS location 1

Burnbanks

Cove Bay

Potental ANS location 2

Cove Bay to Hare Ness

Potental ANS location 3

Hare Ness to Seal's Cove

Potental ANS location 4

Potental ANS location 5

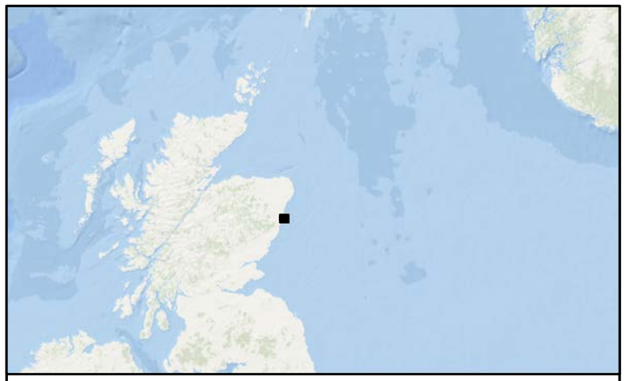
Seal's Cove to Findon Ness

Potental ANS location 6

Potental ANS location 7

Findon Ness

Black Slough to Burn of Daff



Legend:

- Aberdeen to Stonehaven Survey Sites
- Potential ANS Locations

Project:	Report:
Muir Mhòr	Derogation Case Appendix B Artificial Nesting Structures for Kittiwake Evidence and Roadmap

Potential ANS locations at survey sites between Aberdeen and Stonehaven

Figure:	Drawing No:		
4-2	GoBe-0204		
Revision:	**Date:**	**Drawn:**	**Checked:**
01	19/11/24	EV	BPHB

Map scale 1:30,000 @ A3

0 1 km

Co-ordinate system: ETRS 1989 UTM Zone 30N **EPSG:** 25830

MUIR MHÒR OFFSHORE WIND FARM

A joint venture between Fred. Olsen Seawind & Vattenfall

Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

Figure 4-3 Potential ANS location 1 featuring nesting kittiwake (123 Apparently Occupied Nests (AON) in July 2024).

Figure 4-4 Potential ANS location 2 (598 AON). There is potential space for artificial structures where vegetation and geology have prevented the establishment of nests in between two groups of nesting kittiwake.

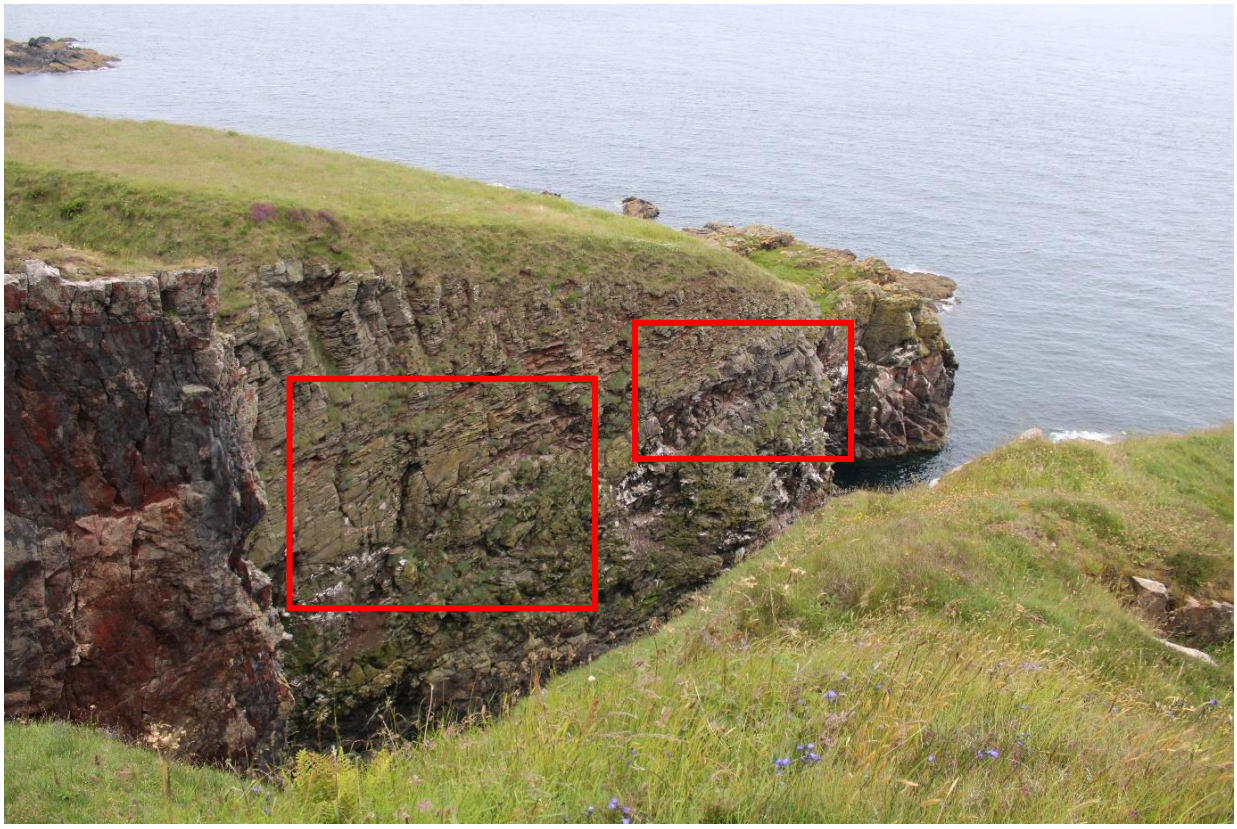


Figure 4-5 Potential ANS location 3 (36 AON).

Figure 4-6 Potential ANS location 4 (55 AON).

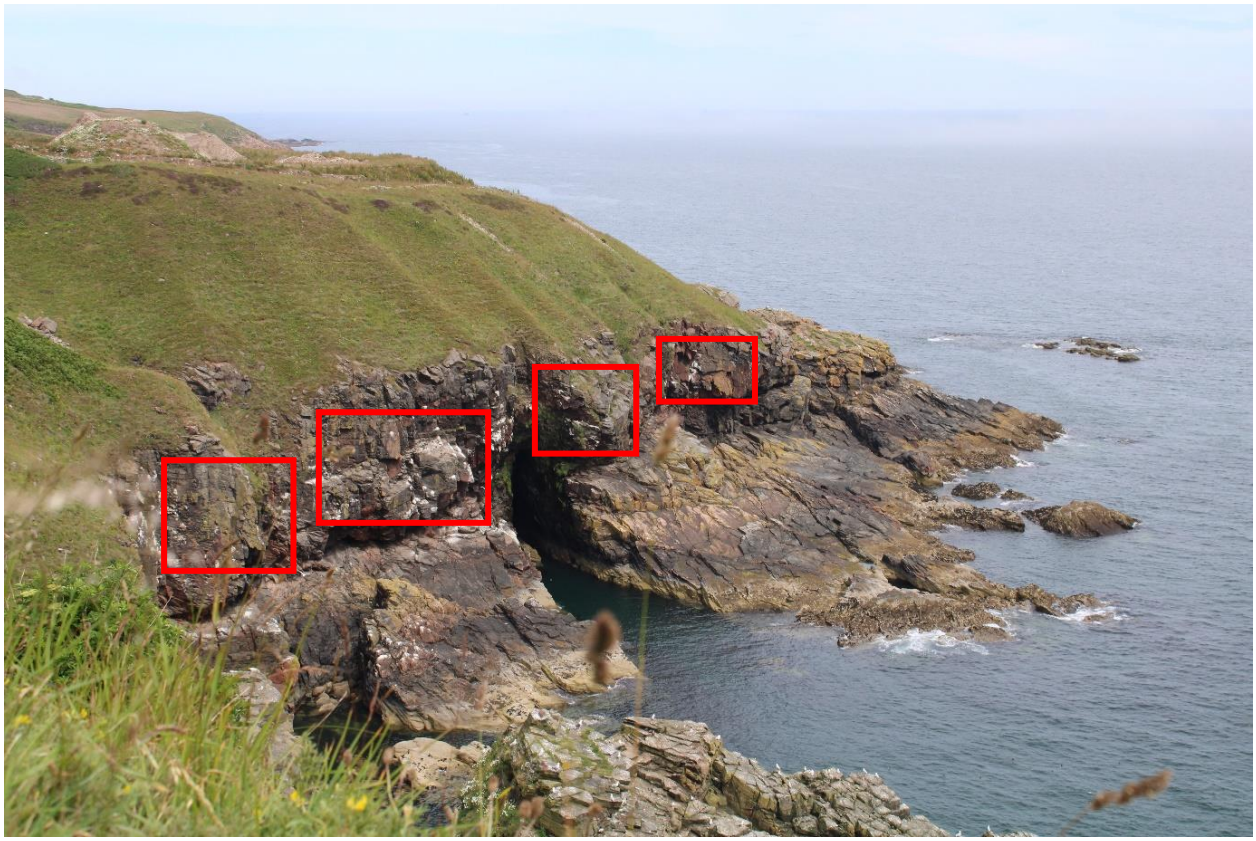


Figure 4-7 Potential ANS location 5 (23 AON).

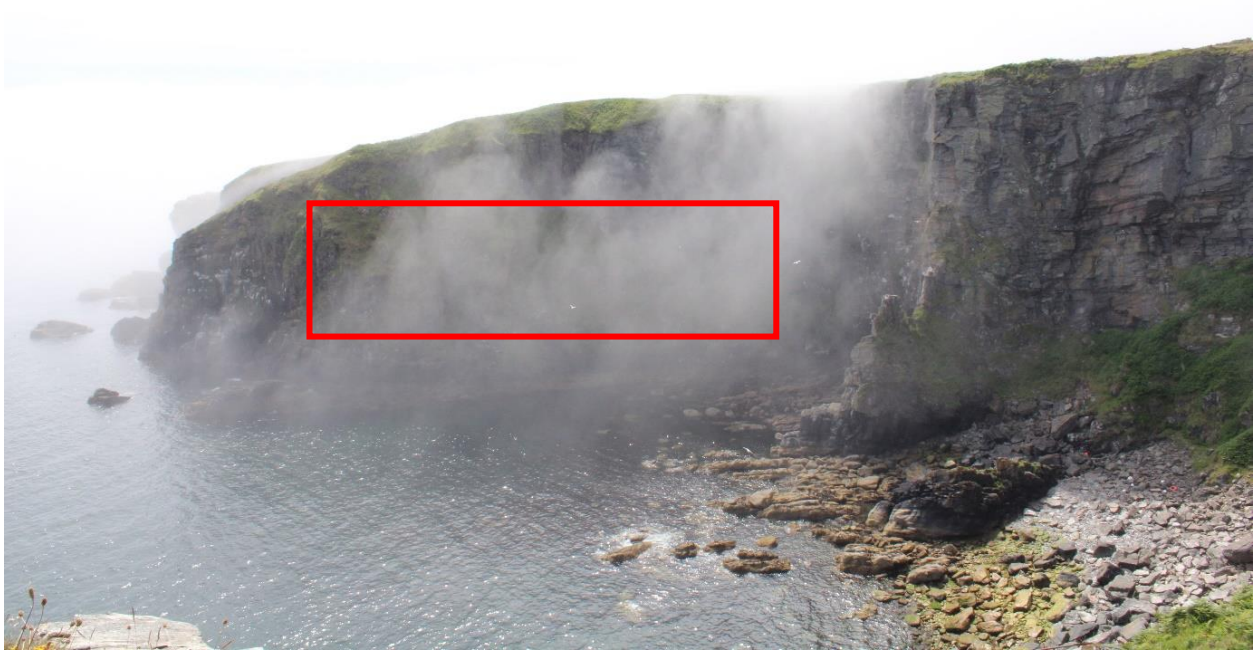


Figure 4-8 Potential ANS location 6 (23 AON).

Figure 4-9 Potential ANS location 7 (21 AON).

CONNECTIVITY TO NATIONAL SITE NETWORK

4.2.8. All the colonies identified are within MMFR +1SD from the array area and in close proximity (<100km) to several impacted SPAs. Given that roughly 89% of fledged kittiwake relocate to new colonies within 100km it is highly likely that kittiwake nesting on these artificial structures will feed into several of the large SPA colonies along Scotland's east coast. In addition, due to the high philopatry rate, the likelihood of a fledgling being recruited into an SPA colony increases if the compensation measure is implemented in proximity to existing sites.

4.3. COMPENSATION QUANTUM

4.3.1. The maximum predicted impact of the Proposed Development is 37.24 adult kittiwake (see Derogation Case: Appendix A – Ornithological Compensation Plan). For a measure to compensate at a 1:1 ratio for the impacted breeding adults, a minimum of that number of additional breeding adults recruited into the chosen non-SPA breeding population per annum is thus required, respectively. The key benefit of the delivery of the artificial nesting structures compensation measure is the recovery or continuation of colony growth, as well as an opportunity for an expansion in range and density.

4.3.2. The Developer aims to implement the disturbance reduction programme in advance of the Proposed Development becoming operational.

TIME SCALES

4.3.3. Most kittiwake first breed at around four years old, or in their fifth calendar year (Coulson and Coulson, 2008; Horswill and Robinson, 2015). It must be noted that 37.9% of kittiwake do not recruit until age 5 or above (Coulson and Coulson, 2008) and this should be considered when assessing the results of the measure after four years. There is evidence of rapid colony growth, however, within the first few years of a colony's establishment (Turner, 2010). Given

the known maturation times, therefore it will take four years following the implementation of the measure before additional breeding adults are delivered, however this ecological deficit (mortality debt) accumulated during the first years of operation will be vastly outweighed by the gains over the operational lifetime of the Proposed Development.

POTENTIAL FLEDGING NUMBERS

4.3.4. As productivity is not generally recorded at non-SPAs, productivity data from Buchan Ness to Collieston Coast SPA was used as a proxy. Both 2019 and 2023 data are shown here, due to 2023 being a season potentially biased by highly pathogenic avian influenza (HPAI). Notes accompanying the data reported that many chicks died in the nest in 2023, with a total of 83 kittiwake (adult and juvenile) seen dead in the water or on the shoreline at the Bullers of Buchan colony. Productivity data from 2019 and 2023 for Buchan Ness to Collieston Coast SPA is found in Table 4-1. Productivity for 2019 showed a mean productivity rate of 1.03, suggesting a healthy breeding season for kittiwake, while HPAI decreased productivity in 2023 (mean: 0.59). Table 4-2 provides information on potential artificial structures and the colonies they would supplement.

Table 4-1 Productivity data for Buchan Ness and Collieston Coast SPA for 2019 and 2023. Source: Seabird Monitoring Programme (SMP), 2024.A plot is a survey area within a site, used to break down sites during counts.

Year	Plot	Count (AON)	Fledged Count	Productivity	Mean
2019	Bay N of Pot	120	148	1.23	
2019	Camel's Back	72	76	1.06	
2019	SE Pot	18	10	0.56	1.03
2019	SW Pot	72	95	1.32	
2019	W Pot	83	82	0.99	
2023	SW Pot	153	111	0.73	
2023	SE Pot	18	6	0.33	
2023	Camel's Back	113	95	0.84	0.59
2023	W Pot	103	55	0.53	
2023	Bay N of Pot	147	77	0.52	

Table 4-2 Number of possible artificial structures at each non-SPA and the potential resulting fledging numbers, following 2019 and 2023 productivity data. Range represents one and four artificial structures per square metre, respectively.

Potential ANS Location	Count (AON)	Artificial structures (Range)	Fledging numbers (2019 prod.)	Fledging numbers (2023 prod.)
1	123	20-80	20.6-82.4	11.8-47.2
2	598	300-1200	309-1236	177-708
3	36	50-200	51.5-206	29.5-118
4	55	100-400	103-412	59-236
5	23	100-400	103-412	59-236
6	23	100-400	103-412	59-236
7	21	20-80	20.6-82.4	11.8-47.2

4.3.5. A conservative estimate (2023 productivity rate, one hammock per square metre) would yield a potential 407.1 fledglings per breeding season, while the maximum yield (2019 productivity rate, four artificial structures per square metre) could potentially add 2,430.8 kittiwake to the non-SPA populations in eastern Scotland. As only up to 36% of kittiwake are philopatric (Coulson and Nève de Mévergnies, 1992), at least two-thirds of fledglings have the potential to breed at nearby SPAs, such as Buchan Ness and Collieston Coast SPA (north) and Fowlsheugh SPA (south), thus contributing to the NSN.

4.3.6. Based on the evidence provided here, this measure thus has the potential to deliver compensation at a ratio of well over 1:1.

4.4. CONSULTATION

4.4.1. Prior to application submission, the selected compensation measure was consulted on with local and national stakeholders, such as NatureScot. A summary of stakeholder exchanges is found in Table 4-3.

4.4.2. Landowners, where known, have been identified. The Project is in discussions with relevant landowners of the sites that show potential for artificial structures to be constructed.

Table 4-3 Exchanges with stakeholders with regards to the proposed ANS compensation measure.

Stakeholder	Communication	Date(s)	Topic(s) of discussion
NatureScot	Meeting	08/08/2024; 10/10/2024	Ornithological surveys and their results were presented to NatureScot, and a subsequent meeting discussed potential compensation measures.
RSPB	Meeting	18/06/2024	Ornithological surveys and their methodology were presented to the RSPB.
Aberdeenshire Council	E-mail	15/08/2024 to 24/09/2024	Landownership and current council seabird conservation/mammalian predator eradication programmes were discussed.

4.4.3. Post-consent, the Developer will create a steering committee to support in defining the details of site refinement, implementation, monitoring, maintenance, reporting, and other measures necessary for the successful implementation of the measure. Core members will likely include any SNCBs, as well as RSPB, site owners and local council(s). These discussions will inform the CIMP and support the implementation of the measure.

4.5. ADAPTIVE MANAGEMENT

4.5.1. An adaptive management approach is essential to ensure success of disturbance reduction measure, to ensure compensation is achieved when conditions change. Constant review, and where needed adjustment, of the programme is needed to ensure flexibility and success (Kelly *et al.*, 2008) should post- implementation monitoring indicate the programme is unsuccessful or less successful than anticipated.

4.5.2. For example, alterations to the design and look of the artificial structures be considered, if it is deemed during implementation that they are inappropriate for the cliff morphology.

4.5.3. The compensation measure focuses on delivering the artificial structures, not on guaranteeing an increase in ecological productivity due to the wide range of factors outside of the Developer's control which affects ecology (such as climate change and prey availability). The Developer will however monitor ecological productivity, accounting for natural population fluctuations, where possible. If deemed appropriate based on the monitoring findings, the

Developer may opt to implement adaptive management strategies to enhance colonisation or productivity to thereby increase the benefits provided by the implemented artificial structures. This could include the installation of additional artificial structures where appropriate. Alternatively, methods to attract kittiwake to the artificial structures may be considered, should the presence of breeding conspecifics not be sufficient to convince kittiwake to utilise the artificial structures. These methods include the use of decoys (artificial kittiwake placed on certain ledges) and audio playback to stimulate a reaction (Arnold *et al*., 2011; Friesen *et al.*, 2017).

4.6. KEY CONSENTS AND LEGAL REQUIREMENTS

4.6.1. The feasibility of the artificial structures as a compensation measure must be assessed alongside the ecological constraints of kittiwake, the socioeconomics of the ANS programme, the legal framework, public support, and available funds. All impacts predicted to arise from the works have been fully assessed within the EIAR, RIAA, and the documentation accompanying the application.

4.6.2. The Developer is confident that this measure is legally securable. The Developer will liaise and work with relevant landowners to secure any necessary rights and/or permissions to implement this measure. Post-submission, the Developer will work with the steering group to consult on final site selection and formalise all relevant contracts and permissions, including formal agreements, contracts, or land purchases. Consultations with the steering committee, as well as any and all processes and outcomes, will be recorded in the CIMP.

4.7. STRATEGIC COMPENSATION

4.7.1. Strategic compensation involves developers working together, potentially with government, to deliver a joint, wide-reaching compensation measure or series of measures which compensate for the predicted impacts of all projects part of the strategic compensation initiative. This includes the delivery of compensation through the planned Marine Recovery Fund, a strategic fund for the UK which developers pay into to discharge their compensation obligations.

4.7.2. The Project may be open to working strategically on this measure. However, this measure is feasible and deliverable by the Project alone. There may have potential for this measure to be expanded to provide further nesting space should it be successful, which may interest other developers.

4.7.3. The Developer plans to continue to be involved in the development of strategic compensation and is considering the potential for strategic compensation to be used i) in combination with, ii) instead of, or iii) as adaptive management for, the project level compensation proposed in the derogation case for the Project. In addition, the developer is actively engaging with other developers to explore the potential to collaborate and jointly deliver compensation.

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