



Hornsea Project Four: Derogation Information

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Volume B2, Annex 7.5: Compensation measures for FFC SPA: Artificial Nesting: Site Selection and Design

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound. Where the offshore cables come ashore east of Fraisthorpe.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, or PEIR or ES).
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Order Limits	The limits within which Hornsea Project Four (the 'authorised project') may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).

Acronyms

Term	Definition
AEoI	Adverse Effect on Integrity
AON	Apparently Occupied Nest
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
FFC	Flamborough and Filey Coast
OOEG	Offshore Ornithology Engagement Group

Term	Definition
PEIR	Preliminary Environmental Information Report
RIAA	Report to Inform Appropriate Assessment
SPA	Special Protection Area

1 Introduction

- 1.1.1.1 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four will be located approximately 69 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network.
- 1.1.1.2 The provision of an artificial nest site(s) to increase the annual recruitment of black-legged kittiwake *Rissa trydactyla* (kittiwake) and northern gannet *Morus bassanus* (gannet), into the regional population of the southern North Sea is considered a viable compensation measure for a potential Adverse Effect on Site Integrity (AEoSI) at the Flamborough and Filey Coast Special Protection Area (FFC SPA). Although, an offshore repurposed structure is the Applicant's preferred measure to compensate for kittiwake and gannet, a new offshore nesting structure or an onshore structure is also considered as a compensation measure, if deemed necessary by the Secretary of State.
- 1.1.1.3 This Artificial Nesting Site Selection and Design document provides the background on the site selection process and design development and refinement for both offshore and onshore artificial nesting structures.

2 Offshore Artificial Nesting Site Selection

- 2.1.1.1 While an offshore repurposed structure is the Applicant's preferred measure to compensate for kittiwake and gannet the following section summarises the heatmapping process which is primarily supporting site selection for a new offshore structure. The heatmapping process is also informing the feasibility of options for the repurposing of an oil and gas platform to some extent, however site selection for a repurposed offshore structure is discussed in full at [Section 2.3](#).

2.2 New Structure

2.2.1 Background

- 2.2.1.1 The location of a new offshore platform in terms of proximity to key foraging areas, is important to increase the chance of colonisation of a structure. The site selection process for the offshore artificial nesting structure has been undertaken via a heatmapping exercise using geographical information system (GIS). Ecological criteria is a primary consideration, with technical and commercial parameters also considered in the site selection analysis.

2.2.1 Methodology

- 2.2.1.1 Firstly, further to extensive consultation with the relevant statutory nature conservation bodies (SNCBs) on the approach to site selection (see [B.2.9 Record of Consultation](#) for further details) an area of search was established for the compensation measure in the

southern North Sea as presented in [A4.6.1 Volume A4 Annex 6.1 Compensation Project Description](#).

- 2.2.1.2 The new structure offshore nesting search area was then divided into 5 x 5 km search grids (25 km²), each with unique identifying codes (using A to BH for vertical in alphabetical order from top to bottom, 1 to 56 horizontal from left to right). This facilitates targeted discussion and easy reference to specific search areas. 25 km² search grids are being used as it is considered by the Applicant based on technical experience that the area is large enough to provide the flexibility required for ground conditions to ensure the structures can be suitably micro-sited and acquire the necessary site permits and licences.
- 2.2.1.3 The Applicant created a BRAG (Black, Red, Amber Green) site selection methodology for ecological criteria, that is consistent with the route planning and site selection process undertaken for other aspects of the Hornsea Four infrastructure. The criteria has been developed with input from technical consultants, utilising experience from recent work undertaken for the Hornsea Three onshore nesting site selection process and Hornsea Four compensation evidence gathering, and significant consultation with SNCBs. The BRAG rating is defined in [Table 1](#).

Table 1: New Structure BRAG Rating Definitions.

Rating	Summary
Black	Potential showstopper to development
Red	High potential to constrain development
Amber	Intermediate potential to constrain development
Green	Low potential to constrain development

- 2.2.1.4 Black and red constraints are critical in determining features or areas that should be avoided wherever possible to avoid consenting risk, reduce Environmental Impact Assessment (EIA) complexity and increase the likelihood of successful colonisation. Amber and green constraints are those that may be more readily minimised or managed by employing appropriate mitigation measures.

2.2.2 Criteria

2.2.2.1 The BRAG criteria identifies key environmental, consenting, commercial and technical constraints based on available information. These are outlined in [Table 3](#) and shown in [Figure 1](#).

2.2.2.2 Ecological criteria was developed based on factors influencing the geographic location of offshore colonies as discussed in the [B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence](#) report and feedback from SNCBs. This includes:

- Minke Whale and Harbour Porpoise distributions: Kittiwakes do appear to share the same foraging habitat as minke whales (Scott *et al.* 2010), therefore, information on minke whale distribution could also be used as a proxy to identify suitable areas further offshore for kittiwake. Although harbour porpoise forage in a very different way to kittiwake and there is only a weak association between kittiwake and harbour porpoise foraging habitat (Scott *et al.* 2010), they do share many of the same key prey species i.e. sandeel, whiting and sprats. Many of the key areas of abundance of the prey species of the Harbour Porpoise, in terms of calorific content, overlap with the locations of offshore platforms occupied by kittiwake in the southern North Sea, so may also provide a proxy for describing where additional key foraging areas for kittiwake are located. For both species, high level density distributions from SCANS III survey data was the best available data covering the study area. This data are shown overlaid on the study area as insets in [Figure 2](#).
- Sandeel distribution: Proximity to reliable food resources is key consideration and kittiwake preferred prey tends to be small fish, with sandeel being particularly important in the northern North Sea.
- Tidal front location: Location in terms of proximity to features which are likely to facilitate kittiwake prey availability such as tidal fronts, is important to increase the chance of colonisation of a new structure.
- FFC SPA foraging range: Statutory stakeholders have advised that site selection for new artificial nesting structures should avoid the core foraging range distance from FFC SPA (<55km) (as defined by Woodward *et al.* 2019), but that it would be beneficial for the location to be close enough to FFC SPA for colony interchange to be a possibility.
- Colonisation Potential – proximity to existing kittiwake colonies will increase chances of successful colonisation of an artificial nesting structure.

2.2.2.3 Prey availability and intraspecific competition for the same resources are key aspects of informing site selection. However, predicting these are challenging as many factors are likely to influence the availability and location of kittiwake prey resources. As such, a number of proxies which are likely to indicate: a) prey abundance and, b) its availability within the top 1 m of the water column (i.e. so as to be accessible to foraging kittiwakes), have been used in defining the preferential positioning of a ANS in relation to spatial availability of prey and likelihood of intraspecific competition between colonies (see [Table 3](#)).

2.2.2.4 In respect of commercial site selection criteria, existing assets have been identified using open data sources from The Crown Estate, including offshore wind farms, minerals and

aggregates, offshore mines, oil and gas and dredging disposal sites. Additionally, known future assets, such as Round Four offshore wind farm lease areas and carbon capture, utilisation and storage (CCUS), have been identified. A 500m buffer has been applied to all assets (aside from offshore windfarms for which a 5km buffer has been applied) and these areas will be excluded from site selection. The Applicant is undertaking continued consultation with The Crown Estate and operators to ensure commercial criteria, including the size of buffers associated with marine infrastructure, used for site selection is appropriate and robust. Engagement with stakeholders is ongoing and additional information is being gathered to inform and refine the site selection process.

2.2.2.5 Each ecological criteria has been ranked, based on ecological importance and SNCB responses. * indicates a lower importance, ranging up to *** which indicates a high importance (included in the 'Criteria' column of [Table 3](#)). The * rank acts as a multiplier value to the initial RAG scoring, which adds a weighting based on importance. Green in the heatmap shows the lowest score and therefore indicates a more suitable location for a new structure. This can be seen summarised in [Table 2](#).

Table 2: Star ratings

Rating	1 Star Score *	2 Star Score **	3 Star Score ***
Red – 2 points	2 points	4 points	6 points
Amber – 1 point	1 point	2 points	3 points
Green – 0 points	0 points	0 points	0 points

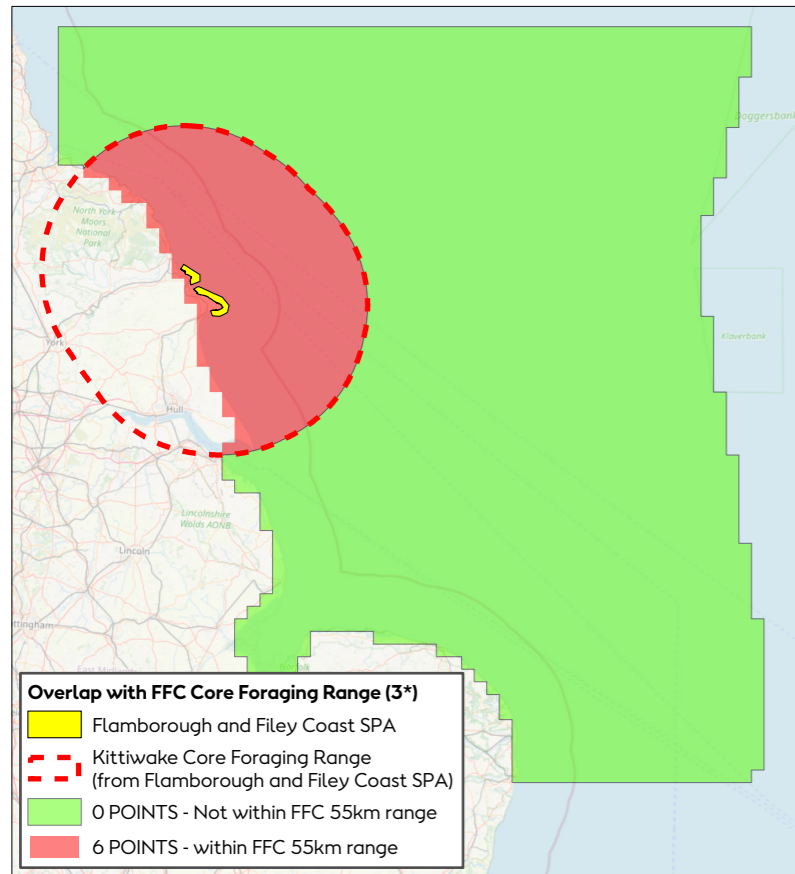
2.2.2.6 The 5km x 5km search grid was then overlaid with the GIS zonal data for each criteria, and a score cumulated for each box based on the intersection of the box with these zones. The final score for each box is symbolised as a heat map in [Figure 2](#), indicating more favourable to less favourable areas of search.

Table 3: Offshore Artificial Nest Site Selection Criteria (New Structure).

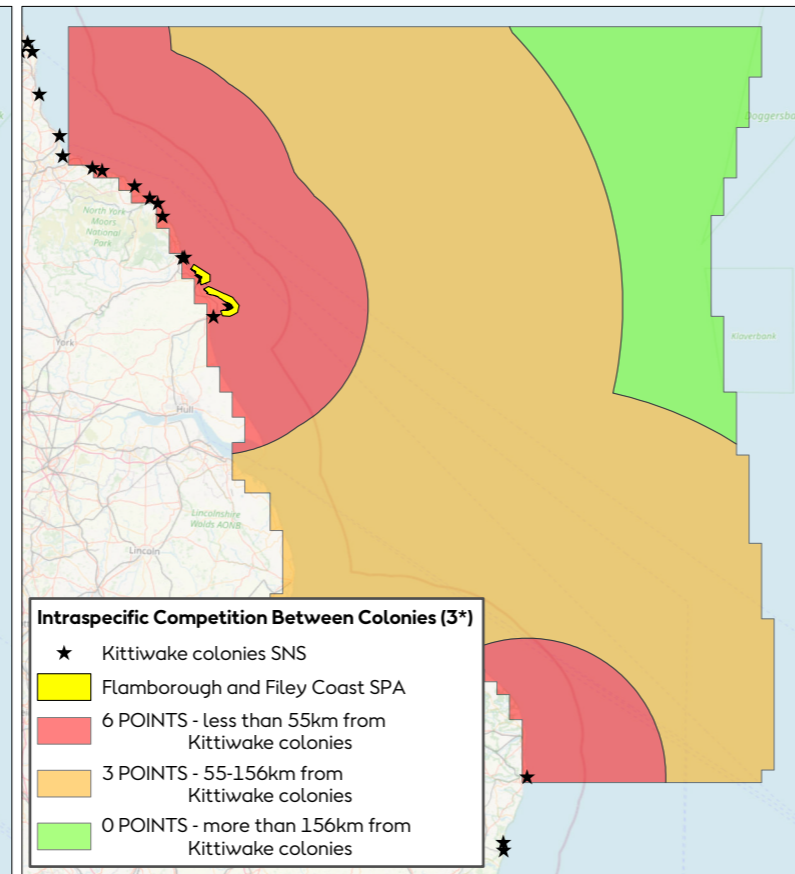
Criteria	Sliding scale criteria			
	Black	Red	Amber	Green
Environment and consents				
Within UK Waters	No	Not applicable	Not applicable	Yes
<i>Physical descriptors of prey abundance and availability</i>				
*Tidal front location – most recent mean summer position of Flamborough front if data exists	N/A	Front location beyond mean-max foraging range (156 km) of new structure	Front location within mean max (156 km) and beyond mean (55 km) foraging range of new structure	Front location within mean foraging range (55 km) of new structure
<i>Biological descriptors of prey abundance and availability</i>				
***Overlap of kittiwake foraging areas as identified from tracking data from FFC SPA (Wakefield et al.)	Not applicable	Above 95% UD (core foraging area) of FFC SPA birds	Within 55-90% UD of known FFC SPA foraging areas	Below 55% UD of known foraging areas of FFC
**Sandeel distribution (from Jensen et al. maps)	Not applicable	Where a sandeel ground intersects the centre of a 5km x 5km box. A scoring of -6 points is applied.		
<i>Intraspecific competition between colonies</i>				
***Intraspecific competition between colonies (avoiding overlap of ANS foraging area with that of existing North Sea colonies – UK and Europe)	Not applicable	The mean foraging ranges of the ANS and an existing coastal colony overlaps UK/Europe/Baltic (within 55 km)	Beyond mean foraging range but within mean max-foraging range of any coastal colony UK/Europe/Baltic (i.e. 55-156 km)	Beyond mean max foraging range of range of any coastal colony UK/Europe/Baltic (>156 km)
<i>Other spatial considerations</i>				
***Colonisation potential	Not applicable	Beyond 100 km of any known colony and beyond 100 km of FFC SPA	More than 100km from Kittiwake colonies other than FFC SPA	Within 100 km of FFC SPA
***Nature conservation – Designated and non-designated sites (FFC SPA, SACs, MCZs)	Located within a designated site with benthic features	Not applicable	Not applicable	Not applicable

<p>***Kittiwake foraging range - to not overlap with FFC core foraging range</p>	Beyond max Foraging Range	Within FFC core foraging range (<55km)	Not applicable	Beyond FFC core foraging range (<55km)
<p>Offshore wind farms (in planning, consented or built) + 5km buffer.</p>	Within offshore wind farm constraint.	Not applicable	Not applicable	Outside offshore wind farm constraint
<p>Other infrastructure and development + 500m buffer including:</p> <ul style="list-style-type: none"> • CCUS infrastructure; • Minerals and aggregates • Offshore mines • Oil and gas • Dredging disposal sites 	Within infrastructure and development constraint.	Not applicable	Not applicable	Outside an infrastructure and development constraint.

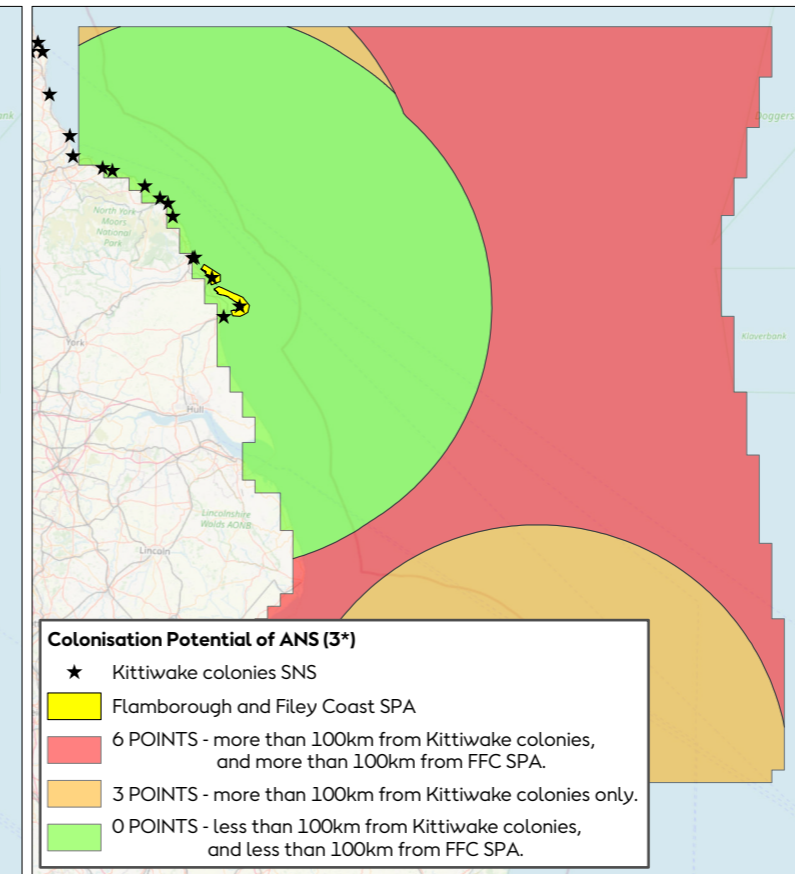
Overlap with FFC Core Foraging Range (3*)



Intraspecific Competition Between Colonies (3*)



Colonisation Potential of ANS (3*)

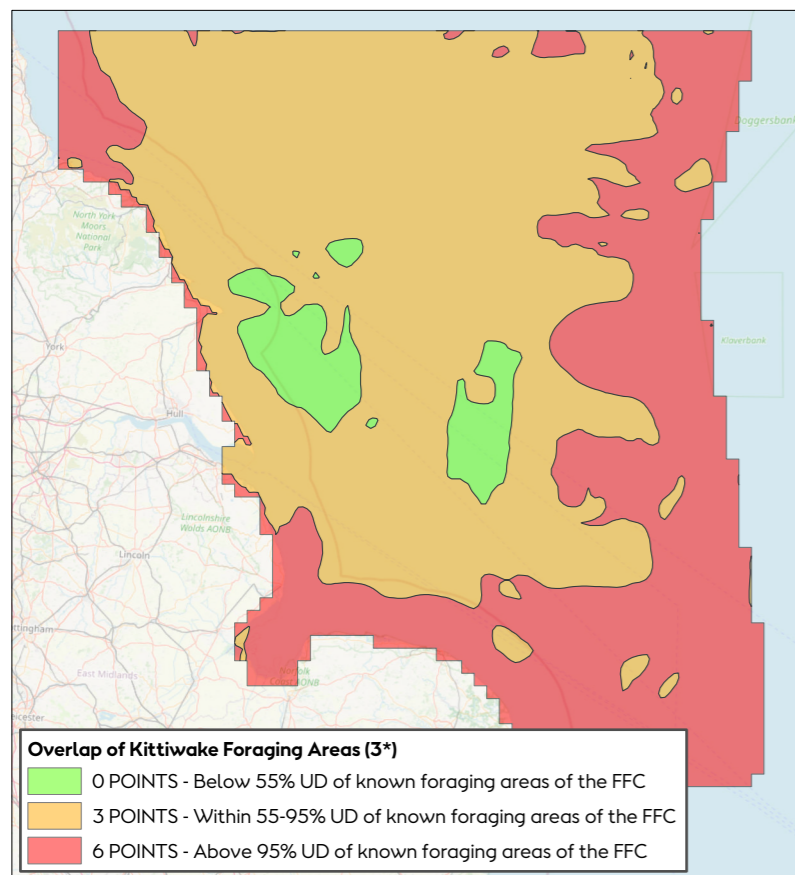


Hornsea Four

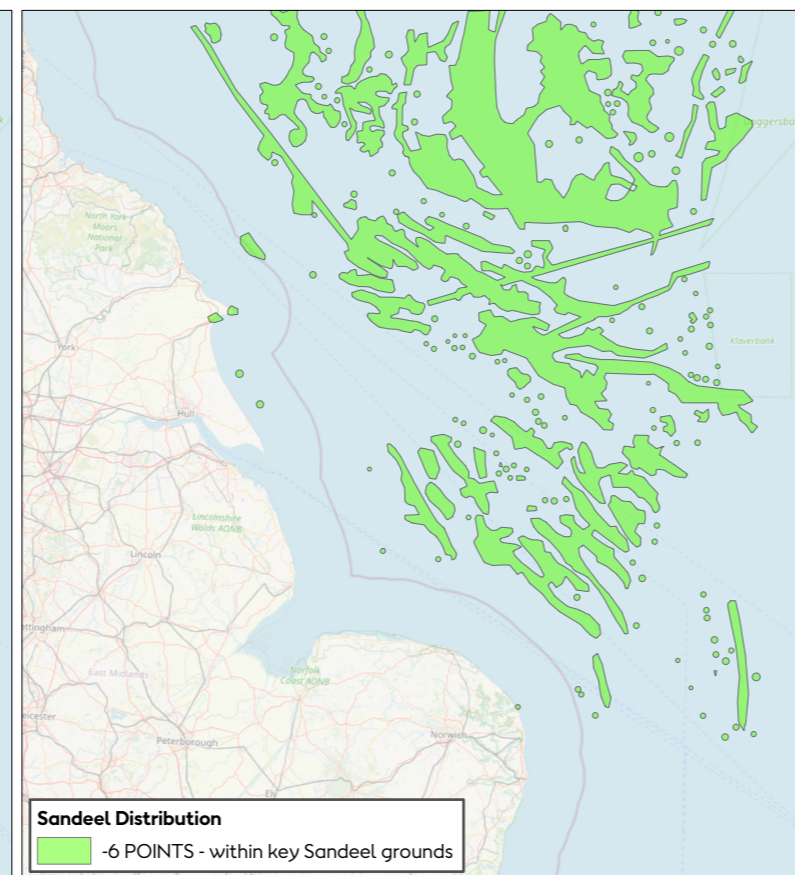
Figure 1: Offshore nesting heatmapping methodology

- Black Constraint Layers / Designations**
- Southern North Sea SAC
 - Wreck
 - CCUS Infrastructure 500m Buffer
 - Wind Farm 500m Buffer
 - The Crown Estate Wind Cable Agreements
 - CEFAS Disposal Site
 - Offshore Mines 500m Buffer
 - Minerals and Aggregates 500m Buffer
 - SPAs
 - Marine SACs
 - MCZs
 - HOW04 Array Area
 - HOW04 Offshore Temporary Works Area
 - HOW04 Offshore Export Cable Corridor
 - UKOG 500m Safety Zones

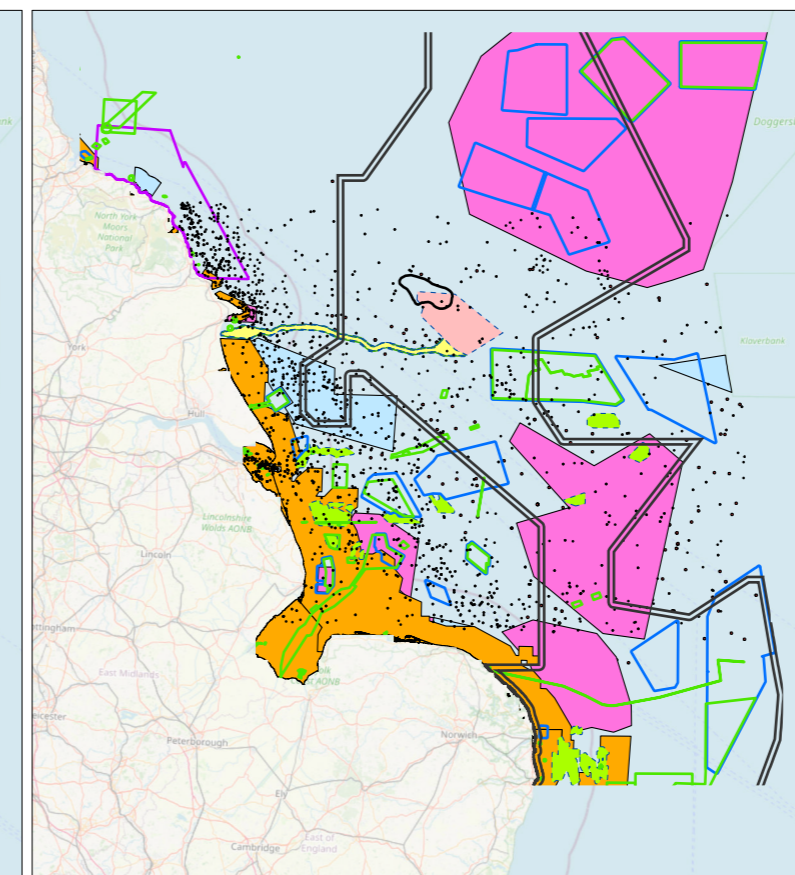
Overlap of Kittiwake Foraging Areas (3*)



Sandeel Distribution



Black Constraint Layers / Designations



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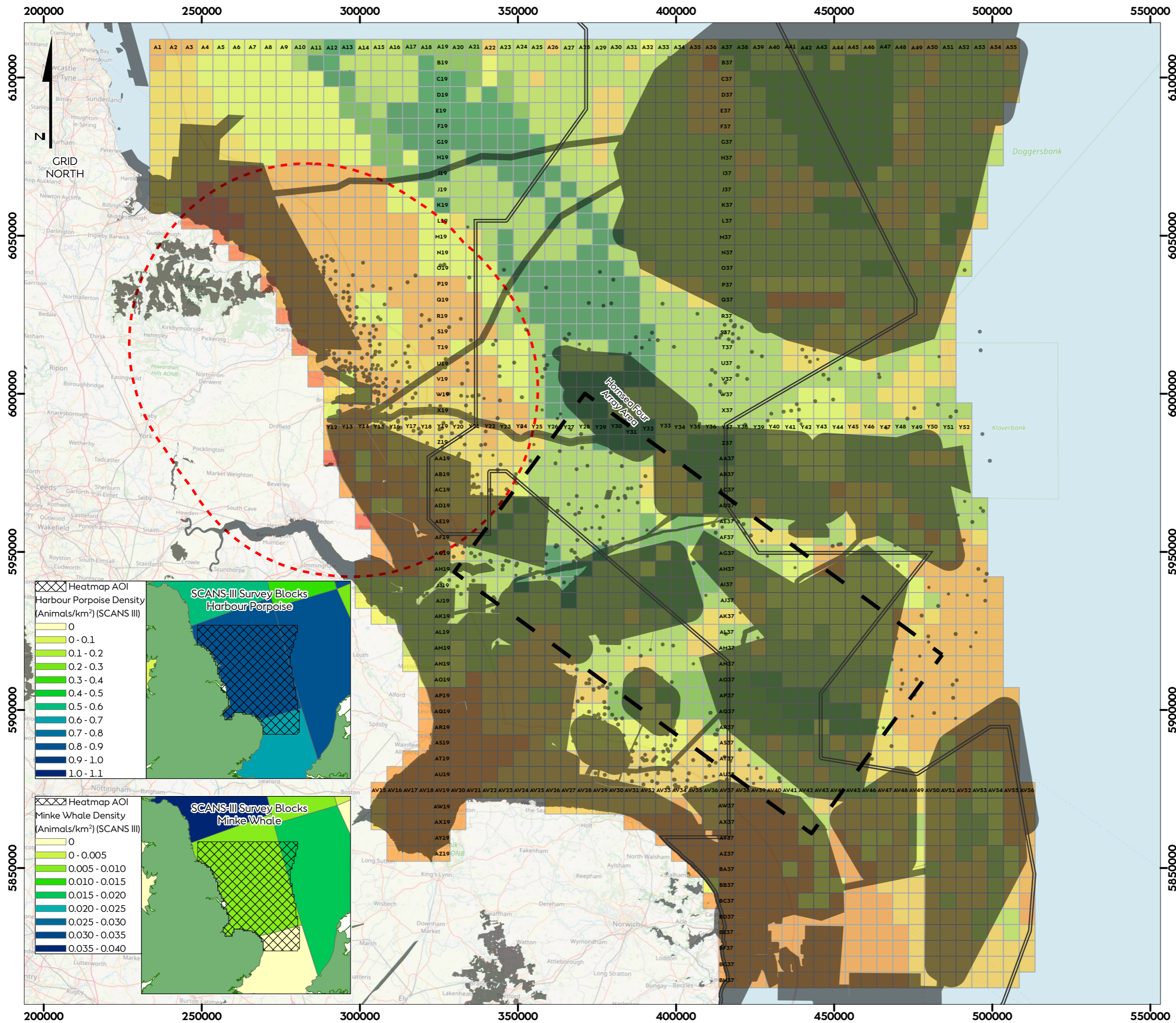
Coordinate system:
Scale@A3: 1:3,000,000

0 30 60 120 Kilometres

0 15 30 60 Nautical Miles

GRID NORTH

REV	REMARK	DATE
1	First issue	13/09/2021



Hornsea Four

Figure 2:
Offshore Nesting Heatmapping
Overall Results

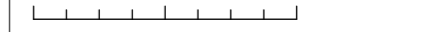
- Potential Area of Highest Ecological Opportunity
- Heatmap RAG Score
 - 0.0 (More Suitable)
 - 19 (Less Suitable)
- Kittiwake Core Foraging Range (from Flamborough and Filey Coast SPA)
- Black constraints overlaid:
 - CCUS Infrastructure 500m Buffer
 - Wind Farms 5km Buffer
 - Minerals and Aggregates 500m Buffer
 - Offshore Mines 500m Buffer
 - UKOG 500m Safety Zones
 - CEFAS Disposal Site
 - Wrecks
 - Marine Conservation Zones
 - Special Areas of Conservation
 - Southern North Sea indicated as black outlines
 - Special Protection Areas

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SCANS-III revised report on estimates of abundance, (University of St Andrews)



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:1,150,000



REV	REMARK	DATE
1	First issue	20/09/2021

Offshore nesting heatmapping overall results

Document no: HOW040510

Created by: XDAOO

Checked by: JOHLE

Approved by: SRAND

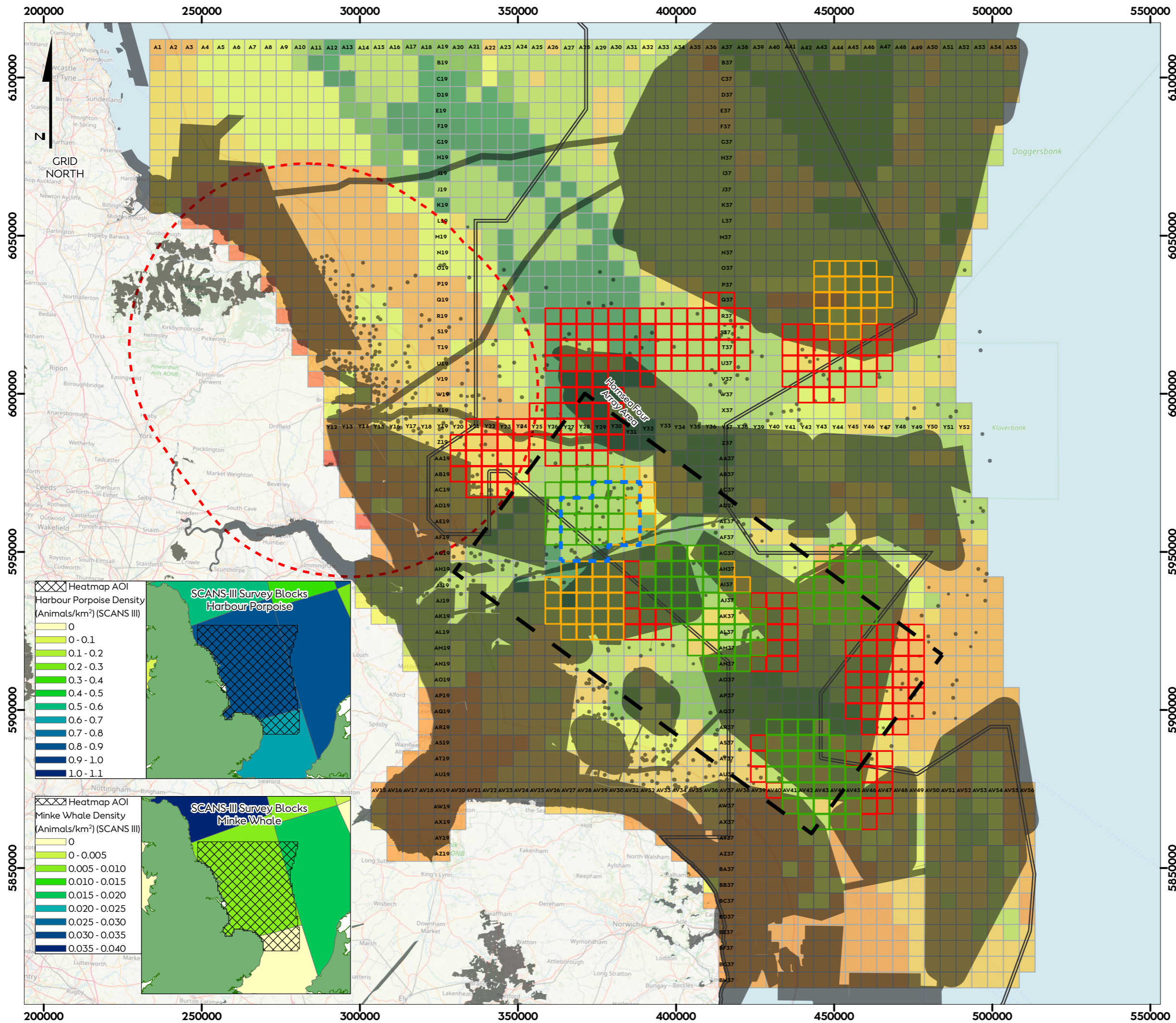


2.2.3 Seabird nesting surveys of oil and gas platforms in the Southern North Sea.

2.2.3.1 To support the site selection process and to increase the knowledge base surrounding the number and location of kittiwakes breeding on offshore installations in the UK southern North Sea, the Applicant commissioned boat based and aerial surveys during the 2021 breeding season. These comprised:

- 1) June Boat-Based Survey of nesting birds of oil and gas platforms in the southern North Sea;
- 2) July Boat-Based Survey of nesting birds of oil and gas platforms in the southern North Sea; and
- 3) July Aerial Survey of nesting birds of oil and gas platforms in the southern North Sea.

2.2.3.2 The surveys and relevant data obtained are discussed and presented in B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence. Figure 3 presents the spread of platforms with kittiwakes present and those platforms with kittiwakes not present, that were included in the survey scopes. It should be noted that operators requested that platforms remain anonymous and therefore platforms are not named and locations are shown at a broader scale so that identification of the platform is not possible. In addition, consultation with operators revealed that some had undertaken their own surveys of nesting birds on their assets in the southern North Sea. Reports from these surveys were provided to the Applicant and the data included in the evidence base for site selection. Again, this is included in the review of evidence presented in B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence. It should also be noted that there are other factors contributing to likelihood of colonisation other than purely geographical location, such as platform design and human intervention (deterrents). These are discussed in the B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence.



Hornsea Four

Figure 3:
Offshore nesting heatmapping overall results with 2021 oil and gas platform survey results

- Potential Area of Highest Ecological Opportunity
- Heatmap RAG Score
 - 0.0 (More Suitable)
 - 19 (Less Suitable)
- Surveyed Platform Areas
 - GREEN: 50+ Apparently Occupied Nests (AONs)
 - AMBER: 5 – 50 Apparently Occupied Nests (AONs)
 - RED: 0 – 5 Apparently Occupied Nests (AONs)
 - Kittiwake Core Foraging Range (from Flamborough and Filey Coast SPA)
- Black constraints overlaid:
 - CCUS Infrastructure 500m Buffer
 - Wind Farms 5km Buffer
 - Minerals and Aggregates 500m Buffer
 - Offshore Mines 500m Buffer
 - UKOG 500m Safety Zones
 - CEFAS Disposal Site
 - Wrecks
 - Marine Conservation Zones
 - Special Areas of Conservation
 - Southern North Sea indicated as black outlines
 - Special Protection Areas

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SCANS-III revised report on estimates of abundance, (University of St Andrews)



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:1,150,000



REV	REMARK	DATE
1	First issue	20/09/2021

Offshore nesting heatmapping and O&G Platform survey
Document no: HOW040511
Created by: XDAOO
Checked by: JOHLE
Approved by: SRAND



2.2.4 Discussion and Analysis

- 2.2.4.1 The broad-scale ecological, environmental and commercial criteria have been mapped in [Figure 2](#). The heatmap shows areas to the north, south and south-east of Hornsea Four as being potentially suitable for the creation of a new artificial nesting structure.
- 2.2.4.2 As a result, a potential area of highest ecological opportunity measuring 140km and 70km (shown in black dashed line in [Figure 3](#)) has been identified focusing on the area the heatmapping identified as most suitable. This area is the most suitable location in terms of meeting habitat requirements and suitable distance from FFC SPA, while the black constraints ensure that a good distance from existing and future windfarms is maintained and placement of a new structure within a designated site with benthic features is excluded. The 2021 summer survey results showed platforms within this area colonised by kittiwake, some with more than 400 apparently occupied nests (AONs). The area above the Hornsea Four site, while showing green in the overall heatmap, was discounted from being included in the refined search area at this stage, due to the position of the area in relation to the Hornsea Four windfarm and FFC SPA (ie. birds may have to transit through the windfarm) and the fact that very few birds were shown to be nesting on platforms in that area included in the scope of the Summer 2021 surveys.
- 2.2.4.3 The search area will continue to be refined following application, focusing on the areas with the most favourable results (green) from the heatmapping process that are located out with the black hard constraints. This will be informed by technical, environmental and commercial considerations as well as further consultation with relevant stakeholders. For example, shipping density data will be reviewed to ensure avoidance of key shipping routes within the preferred search area. Supporting this, geophysical surveys and geotechnical investigations will be undertaken in 2022 to inform the selection of a precise location, to ensure suitable ground conditions for construction.
- 2.2.4.4 During the refinement process, the preferred search area will also be further reviewed for gannet suitability.
- 2.2.4.5 It is anticipated that the final location will be determined before the end of the Examination in consultation with the stakeholders identified in the Roadmap ([Volume B2 Compensation Measures for FFC SPA Offshore Artificial Nesting Roadmap](#)) and the delivery overseen by the Offshore Ornithology Engagement Group (OOEG).

2.3 Repurposed Structures

2.3.1 Background

- 2.3.1.1 In addition to the provision of a new artificial nesting structure, the Applicant's preferred option (based upon the ecological evidence and stakeholder advice) is to utilise an existing offshore platform (potentially an oil and gas structure or similar). The proposed approach would be to use the jacket foundation structure and then design, construct and maintain a new topside for the specific purpose of supporting kittiwake and gannet nesting once the existing topside structure has been removed and decommissioned.

2.3.1.2 The Applicant has undertaken boat-based surveys to acquire baseline information on seabird nesting at a selection of oil and gas platforms within the southern North Sea as described in [Section 2.2.3](#). It is acknowledged that the site selection criteria for a repurposed structure will differ somewhat from that of the new structure presented in [Table 3](#). For example, the new structure criteria conforms with Natural England's advice in respect of colonisation potential and proximity to the FFC SPA; however, it is understood by the Applicant following stakeholder advice that, for repurposing an existing structure, this criteria wouldn't apply where there is already an existing kittiwake colony, as there is even greater confidence that the measure will be successful

2.3.1 Engagement and Consultation

2.3.1.1 Extensive engagement with the oil and gas industry has been undertaken to build an evidence base regarding the presence or absence of nesting seabirds (particularly kittiwake) on existing oil and gas installations in the Southern North Sea. This included the distribution of a questionnaire to operators in March 2021 to ascertain which, if any, of their assets had nesting birds presently or historically.

2.3.2 Selection of suitable platforms for repurposing

2.3.2.1 These consultations with operators also aimed to ascertain suitability and appetite for a collaborative approach involving the Applicant repurposing an operator's existing platform for use as an offshore artificial nesting structure. A number of operators put forward potential platforms to be considered for repurposing and with further engagement and review of available survey data the Applicant reviewed the suitability of these options using the following criteria:

- Timeframes for platform decommissioning: does the operator's programme for decommissioning the platform align with the Hornsea Four programme, allowing the repurposed platform to be in place in good time?
- Structural integrity and age of the platform: is there significant life left in the platform?
- Presence of nesting kittiwake: platforms were discounted if they did not have any AONs.
- Location: platforms were discounted if they were within or in close proximity to existing or future offshore windfarms (including Round 4 leasing areas). Regarding proximity thresholds, consideration was given to the orientation of a platform to a windfarm and the Flamborough and Filey SPA. Due to the number of existing and future windfarms in the southern North Sea a number of otherwise suitable platforms were discounted on this basis.

2.3.2.2 Following this process, to date a number of platforms have been identified as highly feasible options with existing colonies, scope to provide additional nesting, in suitable locations, suitable timeframes for decommissioning and operators keen to collaborate in repurposing the platforms to carry forward. The Applicant is now progressing discussions with the platform owners/operators and will follow the process outlined in [Volume B2 Compensation Measures for FFC SPA Offshore Artificial Nesting Roadmap](#).

2.4 Design

2.4.1.1 Detailed design and engineering assessment works will continue to refine the design following identification of an exact location for a new structure and to develop technical design criteria for a specific repurposed structure. The following provides a summary of design work to date.

2.4.2 New Offshore Platforms

2.4.2.1 The Applicant could design a new foundation and topside for the specific purpose of supporting kittiwake nesting. The maximum design parameters for a new offshore nesting foundation and platform are presented in [A4.6.1 Volume A4 Annex 6.1 Compensation Project Description](#).

2.4.3 Repurposing Existing Offshore Platforms

2.4.3.1 The Applicant could utilise an existing offshore platform (potentially an existing oil and gas structure or similar), and use the foundation to:

- A. Design, construct and install a new topside once the existing topside structure has been removed and decommissioned; or
- B. Repurpose the existing topside structure by adding additional nesting.

2.4.3.2 Indicative design parameters are provided in [A4.6.1 Volume A4 Annex 6.1 Compensation Project Description](#).

2.4.4 Design Features

The design features of the topside are provided below and details of the ecological evidence to support these design features is provided in ([B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence](#)).

Kittiwake

Offshore artificial nesting structures suitable for kittiwake comprise vertical walls with horizontal nesting 'ledges', with a vertical drop to water below ledges. Ledges should be of sufficient protrusion from the back wall to support a nest, but sufficiently narrow to discourage predation by large gulls. Each kittiwake nest requires minimum 20 cm wide, 30 cm of length along a ledge, 40 cm of vertical space between the ledge and the ledge (or 'roof') above and 15 cm depth/protrusion of ledge.

Gannet

Offshore artificial nesting facilities suitable for gannet nesting feature a top level landscaped as a flat, gently sloping or undulating surface, resembling a rocky summit. Gannets preferentially establish nests adjacent to an existing gannet nest, therefore a cluster of decoys and decoy nests is indicated as a potential mechanism for attracting nesting. Each gannet nest requires approximately 80 cm diameter hexagonal space based on measurement between adjacent nest centres at various colonies. Gannet colonisation of new sites in response to decoys and playback of calls is indicated to be potentially successful from published studies of drivers of colony formation.

2.4.4.1 **Table 4** below summarises the provisions made to satisfy the ornithological features identified as requirements.

Table 4: Key ornithological design features for offshore nesting site. Text in italics represents features which are thought to be important from visual observations (though have not been scientifically tested/reported).

Feature	Optimal design features based on review of ecological evidence	Provision made
Angle to vertical	Faces vertical, or small angle beyond vertical (achieved either by slightly beyond-vertical back wall or increasing ledge width with increasing height).	A vertical rear wall is provided.
Water depth	No preference, proximity to food sources more important (tidal fronts where foraging is most accessible)	Incorporated into heatmapping to ensure optimal location
Aspect	All nesting faces must have view to water. Kittiwakes prefer leeward side of structures in offshore sites. Nesting space on west through south faces (prevailing wind) would benefit from shelter from wind (small vertical walls every 30 cm) but consider wind resistance of resulting structure.	All nesting faces have a view to water. Structure will be oriented to minimise faces exposed to the prevailing wind. Separation walls between nest spaces are provided to increase shelter.
Ledges: height range	Natural cliffs (and therefore artificial structures) under 100 m are occupied at all available nesting heights except narrow band at top and bottom (predators and wave action respectively) (Coulson 2011).	All ledges will be within this range.
Ledges: height between	Minimum 40 cm between ledges. Recommended maximum of 60 cm.	50cm between ledges adopted.
Ledges: length	Minimum length of ledge per nest: 30 cm. Kittiwakes prefer to nest in dense clusters (Kildaw 1999).	30cm per nest has been allowed for.
Ledges: width	Range of widths from 15 cm to 25 cm could be adopted with increasing height (see 'Angle to vertical') which would also increase variety of nesting ledges available.	20cm ledge width adopted.
Ledges: angles	Ledge itself (or innermost 15 cm) should be horizontal due to possibility of poor cementing of nests. Outer 0-10 cm of ledge could be angled downwards to reduce accessibility for large gulls to land or walk along.	Ledges are will be horizontal.
Ledges: shelter	Horizontal shelter from prevailing wind more important offshore (see 'Aspect'). Shade from midday sun (on south face, potentially west and east faces) increasingly	Structure has been oriented to minimise faces exposed to the prevailing wind. Separation walls between nest spaces are provided to increase shelter.

Feature	Optimal design features based on review of ecological evidence	Provision made
	important at lower latitudes including southern North Sea (see 'Angle to vertical').	
Small-scale design features	Kittiwakes will make use of girders, beams and other features underneath the main topside structure if height above water, aspect and ledge width are suitable. Situated under platforms/with small roof/side walls for shelter and protection from predators.	Open beams will be used to form the platform beneath the nesting structure – these provide additional nesting opportunity.
Anti-predator features	Narrowest, most sheltered ledges are most protected from predators (Regehr <i>et al.</i> 1998). A roof or overhang is likely to deter swooping avian predators like large gulls. Dividers every 30 cm (see 'Aspect') may also aid in defence of ledges from predatory gulls.	Overhangs implemented on uppermost ledges (with shelf above providing shelter for lower ledges). Dividing walls included every 30cm along the ledges may also offer shelter from predators.

2.4.5 Topside designs

2.4.5.1 Taking into account the design features detailed above, initial design work for topsides has been undertaken and an early stage topside design for either a repurposed or new structure is shown in [Figure 4](#) below.

2.4.5.2 The predicted impact for Hornsea Four and the relevant breeding population required to provide a comparable number of young that would survive to adulthood to offset the impact of Hornsea Four is presented in [B2.6 RP Volume B2 Chapter 6 Compensation measures for FFC SPA Overview Table 2](#). In summary, this initial design would provide space on nesting ledges for the required number of nests with a vertical back wall and 30 cm length of shelf allowed for each nest. A vertical dividing wall would be installed between each 30cm length of provide shelter from the wind and predators. Ledges are designed to be 20cm wide with 50 cm vertical gap between ledges. An overhanging roof would be provided at the top of the nesting structure to provide shelter and to deter predators. Further, the design would provide surface space for the required number of gannet nests with a centre to centre spacing of 75cm to 80cm between nests. The gannets should have an uninterrupted approach (i.e. without hand railings etc) and are expected to approach predominantly in a head-to-wind orientation. The nesting surface for the gannets will be engineered to replicate the rock that they naturally nest on. This design would be further refined should this compensation option be carried forward.

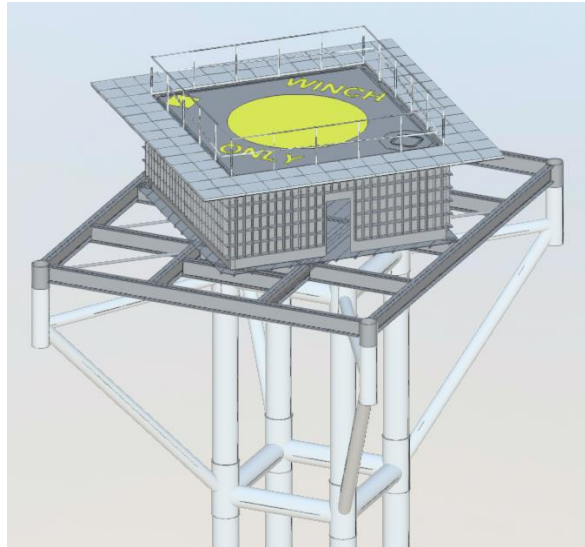


Figure 4: Potential topside design¹

3 Onshore Artificial Nesting

3.1 Site Selection

3.1.1.1 Site selection and the consideration of alternatives for onshore artificial nesting structure locations, identifying the ecological, land acquisition and technical constraints and requirements, will be further developed. The Applicant has been exploring the analysis undertaken for Hornsea Three to build upon the extensive site selection work and considering the potential opportunities for Hornsea Four. Two onshore search areas (Caton Bay to Newbiggin by the Sea and East Suffolk) are being considered for Hornsea Four within which to establish specific sites on which artificial nests will be developed. The search areas are presented in [A4.6.1 Volume A4 Annex 6.1 Compensation Project Description](#). Potential opportunities have been identified within these search areas however discussions are currently commercially sensitive.

3.1.1.2 The constraints and requirements established as a part of the site selection process have been led by the evidence-based approach, which are described in the Ecological Evidence reports ([B2.7.1 Compensation measures for FFC SPA: Offshore Artificial Nesting: Ecological Evidence](#), [B2.7.3 Compensation measures for FFC SPA: Onshore Artificial Nesting: Ecological Evidence](#)). Initial consultation has been carried out and no significant obstacles to development have been identified.

3.1.1.3 The purpose of site selection has been to identify an area to host onshore artificial nesting sites that will be occupied by new recruits, whilst contributing to an increase of breeding adults to the biogeographic region. The principles influencing this initial site selection work comprise:

- Locations which kittiwake will with certainty be able to find (for example either locations where there are existing (smaller) populations of kittiwake, or where there are factors which attract kittiwake);

¹ The winched deck and guard rails location could be relocated and segregated away from the nesting area or placed away from the majority of nests, such as in the south-west corner to minimise disturbance and potential impacts.

- Locations where there is evidence of stable/increasing productivity and evidence of an expanding population (as a proxy for favourable prey resource);
- Locations where there is a lack of existing natural or man-made suitable nesting habitat (locations where kittiwake are attempting to nest in unfavourable conditions such as ground nesting);
- Waterfront locations away from urban housing which minimise human interaction and where purpose built onshore artificial nests can ideally overhang water, to mimic the natural nesting conditions of the target species as far as possible.

3.1.1.4 The preferred zone for installing onshore artificial nesting sites is located within the onshore to nearshore environment. Further site selection, engagement with landowners and stakeholders and final site selection will be undertaken in 2021/2022.

3.2 Design

3.2.1.1 Further design and engineering assessment works are required to determine the exact location and technical design criteria for any onshore artificial nesting structure, but for the purpose of the Application, the following is assumed.

3.2.1.2 It is anticipated that the structures will be located either at a waterfront location, or at a set-back location, dependant on land availability. The structures may be permanent buildings, allowing for internal access for monitoring, or may be prefabricated structures without internal access. An allowance for both has been included within the project description as the appearance and construction methodology would differ considerably.

3.2.1.3 The maximum design parameters for a new offshore nesting foundation and platform are presented in [A4.6.1 Volume A4 Annex 6.1 Compensation Project Description](#). Each kittiwake pair will require a ledge of up to 20cmx40cmx60cm (width, length, height). The distribution of these ledges can be tailored to a taller structure (by stacking more ledges on top of each other), or a longer structure (by providing more ledges on each row). This is based on ecological requirements in addition to the surrounding landscape and available land. The shape of each structure is dependent on the detailed design stage and the surrounding landscape – the shape may be triangular, rectangular, hexagonal, etc.

3.2.1.4 Design principles of direct relevance to the size or appearance of the structures are as follows:

- Steep sided with a near vertical back wall and narrow horizontal ledges.
- Located close to water, facing out to sea (i.e. nest adjacent to/above harbour waters/sea).
- Inaccessible to predators (additional anti-predation features may be required at some sites – e.g. fences/ barriers to deter mammalian predators (e.g. foxes and rats) and dependent on design bird spikes may be required as avian predator deterrents).
- Nesting ledges located above the level of highest astronomical tide and beyond the reach of wave or tidal action.
- Adequate ledge dimensions: Horizontal ledges 20 cm width; length per pair from 30 cm (working length 40 cm); and height between ledges at a minimum of 40 cm and maximum of 60cm. (Note these may be subject to change based on feedback from the stakeholders during detailed design).

- Minimum height at which the lowest shelves should begin depends whether the structure is located directly over water or set back slightly, as well as the level of human disturbance anticipated.
- Overhang/roof to buffer against weather conditions as to act as and additional predator deterrents.
- Vertical wall leaning slightly forward (working angle of 5°; to minimise lower ledges becoming fouled by droppings and reduce predation risk).
- Using materials which are in-keeping with the structure's surroundings whilst ensuring they meet the requirements of kittiwake's natural habitat as much as possible.
- Higher ledges could be wider than lower ledges (to prevent lower ledges becoming fouled by droppings) (BTO Field Guide No. 23, du Feu (2015)). However, wider upper ledges may increase predation risk/ allow non target species to nest.
- Inclusion of features within the onshore nesting site to support breeding gannets such as allocation of existing flat area and landscaping using flat slabs of granite or similar to replicate rock they naturally nest on.

3.2.1.5 The final design of any artificial nesting structure, whether a new structure or adaption of an existing building or structure, will be developed alongside the detailed site selection process as it will be location specific. This will be an iterative process and will consider health and safety, as well as potential impacts related to landscape and visual impacts, historic environment, land use and marine/coastal processes. The designs will be developed in consultation with the LPA, landowners and other relevant consultees where required.

4 Next steps

- 4.1.1.1 Prior to obtaining consent of Hornsea Four, the Applicant will continue to refine the site selection and design details for an offshore nesting structure. This will involve continuing to engage with SNCBs on the suitability of proposed locations and following the steps set out in [Volume B2 Compensation Measures for FFC SPA Offshore Artificial Nesting Roadmap](#). The exact location within this refined search area will be determined via ongoing site refinement informed by technical, environmental and commercial considerations. It is anticipated that a suitable location will be determined before DCO consent award in consultation with the stakeholders identified in the Roadmap ([Volume B2 Compensation Measures for FFC SPA Offshore Artificial Nesting Roadmap](#)) and the delivery overseen by the OOEG.
- 4.1.1.2 For the preferred option of repurposing, the Applicant will continue to engage with oil and gas operators to explore options and feasibility for repurposing an existing oil and gas platform. The topside design will be developed specifically to the platform in question to ensure as many elements of the existing platform can remain in situ and be repurposed where appropriate.
- 4.1.1.3 For the compensation measure of onshore nesting, the Applicant will continue to refine the site selection and design details for an onshore nesting structure following the submission of the Hornsea Four Application. The Gannet and Kittiwake Compensation Plan and Roadmap included in the Application will continue to be updated based on stakeholder feedback and new relevant evidence prior to the close of Examination.

5 References

Coulson, J.C. (2011). *The Kittiwake*. T. & A.D. Poyser, London.

Kidlaw, S.D. (1999). Competitive displacement? An experimental assessment of nest site preferences of cliff-nesting gulls. *Ecology* 80, 576–586

Regehr, H.M., Rodway, M.S. and Montevecchi, W.A. (1998). Antipredator benefits of nest-site selection in Black-legged Kittiwakes. *Canadian Journal of Zoology*, 76(5), pp.910-915.

Scott, B.E., Sharples, J., Ros, s ON., Wang, J., Pierce G.J., Camphuysen, C.J. (2010) Sub-surface hotspots in shallow seas: fine-scale limited locations of top predator foraging habitat indicated by tidal mixing and sub-surface chlorophyll. *Mar Ecol Prog Ser* 408:207-226.

Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019). Deskbased revision of seabird foraging ranges used for HRA screening. Report of work carried out by the British Trust for Ornithology on behalf of NIRAS and The Crown Estate. BTO Research Report No. 724. Thetford, Norfolk.