Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Annex 2B - Sandwich Tern Nesting Habitat Improvements Site Selection

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Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Appendix 2 Annex 2B Sandwich Tern Nesting Habitat Improvements Site Selection

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GLOSSARY OF ACRONYMS

BBC	British Broadcasting Corporation
DEL	Dudgeon Extension Limited
DEP	Dudgeon Offshore Wind Farm Extension Project
HPAI	Highly Pathogenic Avian Influenza
JNCC	Joint Nature Conservation Committee
LBB	Lesser Black-Backed Gull
MAFF	Ministry of Agriculture, Forestry and Fisheries
NNC	North Norfolk Coast
PPE	Personal Protective Equipment
RSPB	Royal Society of the Protection of Birds
SAC	Special Area of Conservation
SEL	Scira Extension Limited
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SMP	Seabird Monitoring Programme
SPA	Special Protected Area
UK	United Kingdom

GLOSSARY OF ACRONYMS

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation, potential Special Protection Areas, Special Protection Areas, Ramsar sites, proposed Ramsar sites and sites compensating for damage to a European site and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017, although some of the sites listed here are afforded equivalent policy protection under the National Planning Policy Framework (2021) (paragraph 176) and joint Defra/Welsh Government/Natural England/NRW Guidance (February 2021).
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.

SEP wind farm site	The offshore area of SEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area.
The Applicant	Equinor New Energy Limited. As the owners of SEP and DEP, Scira Extension Limited (SEL) and Dudgeon Extension Limited (DEL) are the named undertakers that have the benefit of the Development Consent Order. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.

EXECUTIVE SUMMARY

This document sets out the logical steps taken to identify best candidate sites for measures intended to compensate for predicted impacts of Sheringham Extension and Dudgeon Extension offshore wind farms (SEP & DEP) on the Sandwich tern breeding population feature of North Norfolk Coast SPA (NNC SPA). It notes that the most effective compensation would be closure of sandeel fisheries but that measure can only be implemented by UK Government. No measures have been identified that could be implemented at NNC SPA or directly affecting Sandwich terns from NNC SPA, so it was necessary to consider sites away from NNC SPA. No sites near but outside NNC SPA appear to be suitable for compensation measures for breeding Sandwich tern, but sites are identified further from NNC SPA where compensation measures are possible. These include measures over and above routine management as identified in the management plan for Farne Islands SPA and/or Foulness SPA, and creation of new nesting habitat at Loch Ryan (south-west Scotland), with the aim to restore part of the lost breeding range of Sandwich tern which no longer nests at any site in the west of Scotland. Consideration was given to sites suggested by RSPB in June 2022 that were closer to NNC SPA, but these were scoped out because there was no history of Sandwich terns nesting so there was considered to be less chance of success with such sites. The Applicant spent eight months considering the Loch Ryan site and, in the light of consultation feedback and several site visits, considers it to be most appropriate site both ecologically and from a deliverability perspective. Actions at a distance from NNC SPA recognise that the Sandwich tern population of the British Isles is a meta-population with extensive movement of birds to breed at colonies far from their place of birth, so that improving conditions for this species at a site in south-west Scotland will help not only to increase population resilience by restoring lost breeding range, but will help all colonies through movements of birds among sites.

1 INTRODUCTION

1. This document outlines why compensation for predicted impacts of the Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP) on the Sandwich tern breeding population feature of North Norfolk Coast Special Protection Area (NNC SPA) is being proposed at a site near Scar Point, Loch Ryan (54.968°N, 5.061°W) in Scotland, as well as at Farne Islands SPA or Foulness SPA. It builds upon an initial review of compensatory measures for Sandwich tern (see **Appendix 1 Annex 1A: Initial Review of Compensatory Measures for Sandwich Tern and Kittiwake** (document reference 5.5.1.1) and is supported by ecological evidence presented in A**ppendix 1 Annex 1B: Sandwich Tern and Kittiwake Ecological Evidence** (document reference 5.5.1.2) to provide a complete overview of the process that has been undertaken to identify a suitable location to deliver compensation for Sandwich terns.

2. Draft Defra guidance (2021) states that compensation should be carried out, where possible, to benefit the impacted species at the focal SPA (in this case Sandwich tern at NNC SPA). Where that is not possible, compensation should be carried out at a nearby site to benefit the same species. Where that is not possible, compensation should be carried out at a more distant site to benefit the same species. Only as a last resort, compensation could be considered that is not 'like-for-like'. The Applicant has followed these guidelines during the evolution of the compensatory measures for Sandwich tern.

3. This work was carried out before Highly Pathogenic Avian Influenza (HPAI) hit Sandwich terns in spring/summer 2022. The impact of HPAI on Sandwich tern colonies is unclear at present but appears to have been very severe in some colonies but not to have affected others. At this point in the HPAI epidemic it is unclear whether HPAI will require changes to compensation plans, but it reinforces the point that restoring lost breeding range of Sandwich tern in Britain would be a measure that would improve the resilience of the population. All population estimates discussed in this document are from before impacts of HPAI on Sandwich tern became evident.

2 COMPENSATION FOR SANDWICH TERNS AT NNC SPA

4. Firstly, the Applicant considered whether compensation could be carried out at, or affecting Sandwich terns at, NNC SPA. Furness et al. (2013) reviewed the evidence regarding factors that reduce survival rates or breeding success of Sandwich terns. They identified three main factors affecting breeding success: predation (especially by foxes, large gulls, mink, stoats and rats), reduction in abundance of key prey fish (sandeels, sprats, juvenile herring), and environmental impacts on nesting habitat (tidal flooding, extreme weather conditions, vegetation overgrowth). Based on this evidence, and the literature identifying management opportunities to reduce these impacts, the four management options most likely to be effective as compensation for breeding Sandwich terns were identified as:

- closure of sandeel and sprat fisheries to recover depleted stocks of these prey fish,
- exclusion of foxes from Sandwich tern colonies,
- flood and vegetation control to maintain the quality of colony nesting habitat, and
- measures to exclude large gulls from Sandwich tern colonies.

2.1 Closure of sandeel and sprat fisheries

5. Furness (2021) updated the earlier Furness et al. (2013) review and concluded that studies published since 2013 "strengthen the evidence that measures to increase abundance of sandeels and sprats in waters near to Sandwich tern colonies can be expected to result in an increase in breeding success and probably an increase in adult survival of Sandwich terns". Ecopath and Ecosim modelling of the North Sea Area IV by Natural England (Bayes and Kharadi 2022) concluded that "with a full closure of the sandeel fishery sandeel biomass increases by 40%, with a 42% increase in seabird population within the first 10-15 years of a closed fishery". Sandwich tern is one of the seabird species considered to be most dependent on sandeels while breeding (Frederiksen and Wanless 2006, Stienen et al. 2015, Fijn et al. 2017, reviewed by MacArthur Green 2021). Foraging effort and breeding success are strongly influenced by food availability (Stienen et al. 2015, Fijn et al. 2017), with adult body condition at colonies where forage fish are scarce being reduced by high breeding effort, suggesting that shortage of forage fish probably affects adult survival as well as colony breeding success (Stienen et al. 2015). Stienen et al. (2015) suggest that the evidence supports the hypothesis that Sandwich tern parents use their own body mass to evaluate future fitness costs so that the degree of flexibility in parental foraging effort depends on adult body reserves. Considering the situation in eastern Scotland when the sandeel stock collapsed after heavy fishing mortality had been imposed, Frederiksen and Wanless (2006) concluded that 'Sandwich terns may have been affected by reduced sandeel availability during the 1990s in a similar way to black-legged kittiwakes'. Considering Sandwich terns breeding in England, Brown and Grice (2005) note that "overfishing and poor weather are likely to have significant impacts on food availability and hence breeding success".

6. Sandeel fishing has greatly reduced sandeel stock biomass, and reduced fishing effort is predicted to allow stock recovery (Lindegren et al. 2018). Further details are presented in **Appendix 1 Annex 1B Sandwich Tern and Kittiwake Ecological Evidence** (document reference 5.5.1.2).

7. The Applicant therefore considers that the most effective compensation measure for Sandwich terns breeding at NNC SPA would be closure of the sandeel fishery in UK waters, or adjustment of the fishery management to provide ecosystem-based management such as adopting 'one-third for the birds' as a threshold stock biomass that must be maintained (Cury et al. 2011, Hill et al. 2020). While this can be predicted to have a strong positive influence on breeding Sandwich terns at NNC SPA, such a measure cannot be put into effect by Equinor. It would require UK Government action to close this fishery, or to adjust management. This therefore is considered a strategic compensation option that would be effective but requires UK Government action to implement – further information is provided within **Strategic and Collaborative Approaches to Compensation and Measures of Equivalent Environmental Benefit** (document reference 5.8).

2.2 Management of NNC SPA Sandwich tern colony habitat

8. According to Perrow et al. (2017) factors influencing productivity of Sandwich terns at North Norfolk Coast SPA include weather and predators, of which foxes are probably the most damaging. Other predators include stoats, large gulls, an increasing population of Mediterranean gulls, and occasional raptors. Further details are presented in **Appendix 1 Annex 1B Sandwich Tern and Kittiwake Ecological Evidence** (document reference 5.5.1.2).

9. Despite this, over a 31-year period, breeding success of Sandwich terns at the two main colonies in NNC SPA, Blakeney and Scolt Head, averaged 0.56 chicks per pair at both sites (JNCC SMP database). This is higher than breeding success monitored at many other Sandwich tern colonies in the UK (JNCC SMP database), suggesting relatively little scope for measures to improve breeding success within NNC SPA. Exclusion of foxes by electric fence has also improved productivity in recent years compared to periods affected by fox access.

10. Breeding numbers of Sandwich terns in NNC SPA remained around 4,000 pairs from 1969 to 2016 but increased markedly between 2016 and 2020 (1). Because north Norfolk coast is also protected for its coastal ecology and geomorphology, there is no scope for engineering solutions to reducing flood risk at Sandwich tern colonies. Predator control is currently effective and also would not be available as a compensation measure for these colonies.

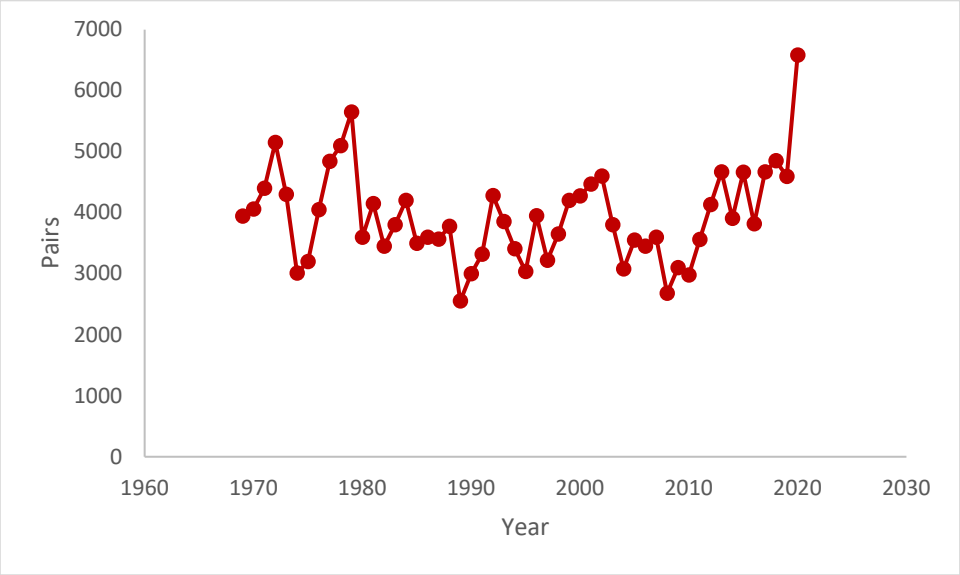

Figure 1: Numbers of pairs of Sandwich terns nesting at North Norfolk Coast SPA 1969-2020 (data from JNCC Seabird Monitoring Programme online database).

11. In light of feedback received during the ornithology compensation Expert Topic Group (ETG) meeting in January 2022, and the lack of clear advice and guidance from Defra on navigating current challenges around demonstrating 'additionality', there is considered to be no scope for compensation through management of Sandwich tern nesting habitat or predators at Blakeney or Scolt Head (see the **Consultation Report Appendices** (document reference: 5.2) for a record of the ETG meeting minutes and **Appendix 1 Annex 1D Record of HRA Derogation Consultation** (document reference: 5.5.1.4) for an overview of consultation feedback and the regard given to this by the Applicant).

12. In 2020, NNC SPA held nearly 50% of the total breeding numbers of Sandwich tern in Great Britain (MacArthur Green 2021). Having such a high concentration of a species in a single site makes the national population more vulnerable to any catastrophic event at NNC SPA, so reduces the resilience of the European site network for Sandwich tern. Catastrophic events affecting particular colonies of terns do occur. For example, Sandwich tern breeding numbers in The Netherlands fell from about 40,000 pairs in the 1950s to fewer than 1,000 pairs in 1965 as a direct consequence of pesticide poisoning caused by local pollution (Mitchell et al. 2004). The risk of catastrophic events also suggests that compensation actions away from NNC SPA could be more successful in maintaining the European site network for Sandwich tern.

2.3 Creation of a third Sandwich tern colony site within NNC SPA

13. Where an SPA holds more than one breeding site suitable for Sandwich terns, there is evidence that breeding numbers fluctuate more on individual sites within an SPA than they do for the SPA population as a whole. For example, at NNC SPA over the years 1969 to 2020 (all the years for which census data are available from JNCC SMP database), the Coefficient of Variation for the total SPA population was 0.19, whereas for individual sites within the SPA it was 0.75, 0.75, and 4.05 (1).

Table 1: Variability in annual counts of numbers of breeding Sandwich terns at North Norfolk Coast SPA, 1969 to 2020 (52 annual counts, data from JNCC SMP database).

Site	Mean number of pairs	Standard deviation	Coefficient of Variation
North Norfolk Coast SPA	3,939.3	756.1	**0.19**
Blakeney	1,802.2	1,354.5	0.75
Scolt Head	2,007.8	1,510.5	0.75
Stiffkey/Holkham	129.3	523.2	4.05

14. The same pattern can be seen for the Forth Islands SPA, Morecambe Bay & Duddon SPA and Anglesey terns SPA (see further details in **Appendix 1 Annex 1B Sandwich Tern and Kittiwake Ecological Evidence** (document reference 5.5.1.2)). The fact that numbers are relatively less variable for the combined sites within an SPA implies that Sandwich terns may move between sites within an SPA from year to year, causing higher variability in breeding numbers at individual sites than for the SPA as a whole. Such movements have been demonstrated by colour ringing, showing movements not only within but also between SPAs. These data provide a clear message: having more sites within an SPA that can be used by Sandwich terns will increase resilience and stability of the SPA population. This provides a case for seeking the possibility of developing a third site within NNC SPA that could be made suitable for nesting by Sandwich terns. Because NNC SPA now holds almost 50% of the breeding population of Sandwich terns in Great Britain, the increased resilience of having a third breeding site within the SPA would be beneficial not only to the SPA population, but also to the wider population within Great Britain.

15. While this appears to be clear in principle, discussions with Natural England and National Trust through the ornithology compensation ETG meeting in January 2022 indicated that it was unlikely that a third site could be created within NNC SPA, and that this approach might not be considered acceptable as compensation because of additionality concerns. Furthermore, creating a third site for Sandwich tern nesting within NNC SPA might simply result in redistribution of birds from Blakeney and Scolt Head rather than any increase in breeding numbers, as there is no evidence to suggest that breeding numbers are constrained by limited nesting habitat at Blakeney or at Scolt Head. The Applicant therefore accepted the general conclusion reached by the ETG that this was not appropriate to take forward as compensation. For a record of this feedback see the **Consultation Report Appendices** (document reference: 5.2) and **Appendix 1 Annex 1D Record of HRA Derogation Consultation** (document reference: 5.5.1.4).

3 COMPENSATION FOR SANDWICH TERNS AT A SITE OUTSIDE NNC SPA BUT NEARBY

16. The lack of clear options for compensation at NNC SPA led to consideration of the next tier identified in the draft Defra guidance (2021) i.e. compensation for the same species at a site outside NNC SPA but nearby (i.e. as close as possible to NNC SPA). The first step was to assess the conservation status of Sandwich terns at UK SPA sites and non-SPA sites, the existing pressures at these sites and therefore further measures that could be implemented to increase breeding success. The Applicant started this process by using data from the most recent national survey of breeding seabirds to identify the sites around the UK used as breeding colonies by Sandwich terns (Mitchell et al. 2004) and extracted more recent survey counts for these sites from the JNCC SMP database to assess how numbers have been changing at these sites – see **Appendix 1 Annex 1B Sandwich Tern and Kittiwake Ecological Evidence** (document reference 5.5.1.2) for more information.

17. There were no Sandwich tern colonies listed in the Seabird 2000 survey anywhere on the east coast of England north of NNC SPA apart from Coquet Island SPA in Northumberland and Farne Islands SPA in Northumberland (Mitchell et al. 2004). Those sites are both more than 300 km from NNC SPA, so cannot be considered to be nearby. The only nearby site south of NNC SPA listed in Mitchell et al. (2004) is Alde-Ore Estuary SPA in Suffolk, which held 7 pairs in 2000, but that colony was subsequently abandoned by Sandwich terns. The loss of Sandwich terns from Alde-Ore Estuary SPA is thought to have been due to large numbers of lesser black-backed gulls nesting there, as large gulls compete with terns for breeding space, cause disturbance to nesting terns, and prey upon eggs and chicks (Mitchell et al. 2004). Subsequently, lesser black-backed gull numbers have declined at Alde-Ore Estuary SPA, but efforts are now being made to restore the large numbers of lesser black-backed gulls that are a feature of that SPA. It would therefore be inappropriate, as agreed with stakeholders in the January 2022 ETG (see the **Consultation Report Appendices** (document reference: 5.2) and **Appendix 1 Annex 1D Record of HRA Derogation Consultation** (document reference: 5.5.1.4)), to try to re-establish a Sandwich tern colony at a site where the management objective is to greatly increase numbers of large gulls.

18. It is unclear why no Sandwich terns nested anywhere on the east coast of England between north Norfolk and Northumberland in 2000. However, that situation appears to have been the same in earlier and in later decades. According to Brown and Grice (2005) the only historical nesting record of Sandwich tern at any site between north Norfolk and Northumberland was of six pairs that attempted to nest at Friskney, Lincolnshire in 1950, but abandoned that site and never returned. There are no Sandwich tern breeding records in the JNCC SMP database for any site along that coast since 2000. It is possible that the lack of breeding on that coast may relate to lack of suitable nesting habitat, but there are locations with islands in freshwater pools/wetlands where nesting might be possible. Common tern, Arctic tern and roseate tern also do not breed on coastal Lincolnshire, although common terns do nest inland in Lincolnshire (Mitchell et al. 2004, Brown and Grice 2005). This suggests that the lack of Sandwich tern nesting (and lack of common tern, Arctic tern and roseate tern nesting) on this coast might possibly be related to some aspect of foraging ecology rather than to lack of breeding habitat. The Applicant cannot rule out the possibility that coastal Lincolnshire and Humberside are unsuitable for Sandwich tern foraging, perhaps due to opacity of the water, lack of coastal forage fish stocks, or lack of shallow sheltered bays in which Sandwich terns prefer to feed. Baptist and Leopold (2010) showed that Sandwich tern foraging success is very strongly influenced by the transparency of the water, so that this may be a key determinant of where colonies can be located. Recent research by Fijn et al. (2022) also shows that Sandwich terns have strong preferences for foraging habitat that is based mainly on static variables such as sediment type and water transparency, rather than on dynamic environmental conditions.

19. Yorkshire, Lincolnshire and Humberside also have hardly any coastal colonies of black-headed gulls (Mitchell et al. 2004), and it is considered that Sandwich terns often choose to nest adjacent to black-headed gulls to gain protection from the defence against predators shown by black-headed gulls. According to Brown and Grice (2005) "*Sandwich terns often nest in close association with black-headed gulls whose antipredator tactics are thought likely to benefit the terns despite the gulls' propensity to rob returning adults of the catch intended as food for their chicks and to take the terns' eggs and young when the colony is disturbed*". Lack of black-headed gulls to attract Sandwich terns also suggests that establishing novel colonies of Sandwich terns in this area may be very difficult. For these reasons the Applicant considered the coast outside but near to NNC SPA to be unsuitable for compensation actions for Sandwich tern and therefore moved to the next Defra (2021) tier to consider locations further away.

3.1 Additional sites suggested by RSPB

20. Subsequently, in May 2022 RSPB suggested that developing nesting habitat for Sandwich terns in Lincolnshire or Humberside might provide suitable compensation, and they identified five locations where such habitat creation might be possible. These sites were:

- Gibraltar Point (Indicative Grid Ref: TF56255882),
- South of Anderby Creek (Indicative Grid Ref: TF56255882),
- Lincolnshire Coast; North of Anderby Creek (Indicative Grid Ref: TF54337816),
- Lincolnshire Coast; North Lincolnshire Coast (Tetney to Mablethorpe) (Indicative Grid Ref: TF43519968); and
- an area adjacent to Easington lagoons/Kilnsea area (Indicative Grid ref: TA41201611).

21. The Applicant considered these possibilities, undertook an initial appraisal of their potential (which included a consideration of existing designation status and other obvious potential issues such as coastal erosion risk, designations and other proposals/projects) and held a meeting (24th May 2022) with both RSPB and Natural England to review these suggested sites.

22. All the suggested sites appear suitable for wetland creation that would provide habitat for a variety of wetland birds. Islands in pools within these wetland sites might be suitable for Sandwich terns to colonize. The Applicant accepts the idea that these sites could considerably enhance bird biodiversity and abundance, but considers that the chances of Sandwich terns colonizing such sites may be low (for example relating to foraging conditions as discussed above). A previous history of Sandwich terns breeding in the area would give greater confidence that creating potential nesting habitat might result in re-colonization. However, with no evidence that Sandwich terns can breed successfully in this region, it would be inappropriate to assume that creating nesting habitat would be likely to lead to successful attraction of Sandwich terns into this area as a new breeding species. Risk of failure of such compensation measures in Lincolnshire or Humberside seems to be likely to be high, although they might be considered as a promising option for non like-for-like compensation if that was deemed necessary. In the May 2022 meeting held to review the sites suggested by RSPB, Natural England was in general agreement with the Applicant's position i.e. did not favour any of these sites over the existing work that was being progressed by the Applicant at this stage, which was focussed on the Loch Ryan area (see Section 5). See Appendix 1 Annex 1D Record of HRA Derogation Consultation (document reference: 5.5.1.4) for specific details related to this feedback.

4 COMPENSATION FOR SANDWICH TERNS AT A MORE DISTANT SITE

23. More distant sites (in this context sites more than 50 km from NNC SPA) include sites where breeding Sandwich tern is a feature of an SPA and sites where Sandwich terns breed in locations that are not SPAs. Because compensation must be additional to normal management to maintain or restore features of SPAs, it may be considered preferable to target compensation at non-SPA populations rather than at SPA populations of Sandwich terns. However, there are very few locations with Sandwich tern colonies that are not designated as SPAs with breeding Sandwich tern as a feature. An alternative is to select an SPA population where management has failed to prevent serious decline in breeding numbers of Sandwich terns. Measures over and above normal management at an SPA site can qualify as compensation where these can be shown to be additional to the management that can be carried out (based on the management plan for that SPA). The Applicant therefore considered two categories of site: sites that are SPAs for breeding Sandwich tern but where management has failed to prevent serious declines in breeding numbers, and sites where Sandwich tern is not an SPA feature.

4.1 Failing SPA sites

24. The most recent published counts in the JNCC SMP database (most of which are from 2020 or 2019) show that the UK Natura 2000 suite (now national site network) for breeding Sandwich terns held about 14,000 birds at the end of the 2010s (2), whereas at designation of these sites the total was around 11,600. Although there have been decreases at several SPA sites, overall the SPA suite held about 21% more breeding Sandwich terns at the end of the 2010s than the numbers on which designation of these sites was founded. However, several SPA sites show large declines that suggest that there may be scope to compensate by developing measures at those sites to recover breeding numbers. Those sites include four SPAs on the west side of the North Sea, so in the same general region as NNC SPA: Forth Islands SPA, Farne Islands SPA, Alde-Ore Estuary SPA, Foulness SPA.

Table 2: Summary of UK Natura 2000 Sandwich tern breeding feature suite

SPA	Years of count data used for designation	Pairs in citation	Most recent published count	Year of most recent count	Percent change
Loch of Strathbeg	1985-1990	280	0	2015	**-100**
Sands of Forvie, Ythan Estuary & Meikle	1989-1991	Up to 1,125	1,000	2020	**ca.0**
Forth Islands	1980s	440	10	2019	**-98**
Farne Islands	2010-2014	862	417	2019	**-52**
Coquet Island	1987-1991	1,500	1,652	2019	**+10**
North Norfolk Coast	1992-1996	3,700	6,585	2020	**+78**
Alde-Ore Estuary	1992-1996	170	0	2018	**-100**
Foulness	1992-1996	320	0	2019	**-100**
Poole Harbour	2010-2014	181	174	2015	**ca.0**
Chichester & Langstone Harbours	1993-1997	31	0	2019	**-100**
Solent & Southampton Water	1993-1997	231	93	2020	**-60**
Anglesey Terns	1993-1997	460	1,972	2020	**+329**
Morecambe Bay & Duddon	1988-1992	804	805	2019	**0**

SPA	Years of count data used for designation	Pairs in citation	Most recent published count	Year of most recent count	Percent change
Carlingford Lough	2000-2004	717	24	2019	-97
Larne Lough	1993-1997	189	1,010	2019	+434
Strangford Lough	1992-1997	593	252	2020	-58
Entire SPA suite		**11,603**	**14,004**		+21

4.2 Forth Islands SPA

25. The Forth Islands SPA has held breeding Sandwich terns on Isle of May, Inchmickery, Fidra, and Long Craig. The terns have moved between these sites and fluctuated considerably in numbers (2).

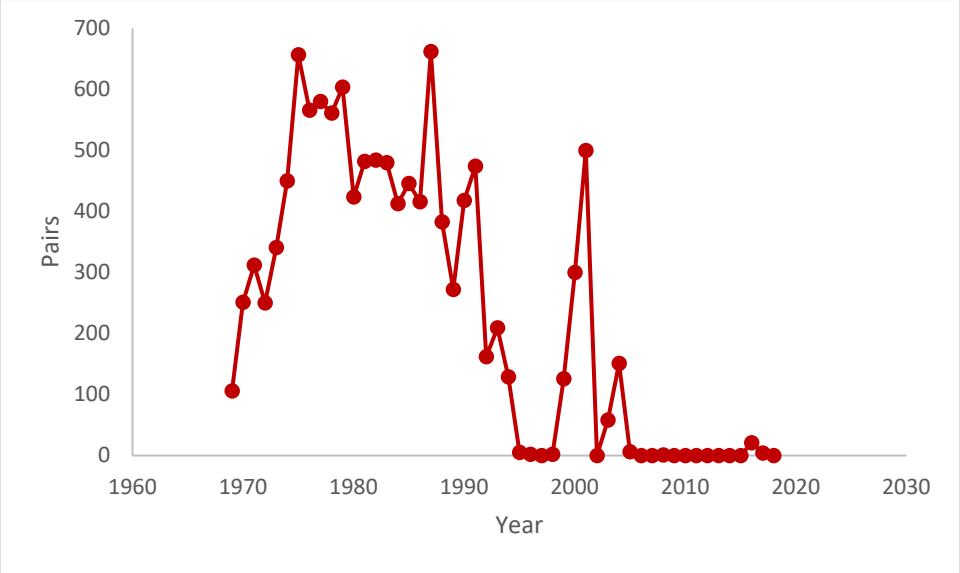

Figure 2: Numbers of pairs of Sandwich terns nesting at Forth Islands SPA 1969-2021 (data from JNCC SCM database).

26. Between 1926 and 1956 up to 1,500 pairs nested on the Isle of May, but these deserted as herring gull numbers grew and rabbit numbers decreased, resulting in development of rank nitrophilous vegetation that made the nesting site unsuitable for Sandwich terns (Forrester et al. 2007). Although at the time the increase in gull numbers was considered a main influence on tern numbers on the Isle of May, with hindsight it may be that changes in vegetation on the island also played an important a role. Since the 1950s, Sandwich terns nested on Inchmickery and Fidra, but declined through the 1990s, and deserted those sites, apparently at least in part in response to increasing herring gull numbers on those islands.

27. Provision of tern nest box terraces where terns can breed without risk of predation of eggs and chicks by gulls has resulted in a (very) small recent increase in numbers, and high breeding success, of Sandwich terns on the Isle of May (Steel and Outram 2020), suggesting that gull predation, in addition to loss of suitable nesting habitat, rather than forage fish availability, has been limiting Sandwich tern breeding numbers in the Forth Islands SPA in recent years. Forth Islands SPA was designated on 25 April 1990, with the citation document noting 440 pairs of Sandwich terns, but the years of count not specified. According to NatureScot Sitelink the conservation status of the Sandwich tern feature at Forth Islands SPA is "*Unfavourable Declining*" as updated on 30 June 2016. The creation of new nesting habitat and nest box protection from predators appears to have much promise as a management measure to recover the Sandwich tern population but is still at a very early stage of development (Steel and Outram 2020). Further funding resource might allow this to be developed further and faster, but management of Forth Islands SPA aims to recover the Sandwich tern population there, so it is not clear that any aim to compensate at Forth Islands SPA would pass the test of additionality (as agreed with stakeholders in the January 2022 ETG (see the **Consultation Report Appendices** (document reference: 5.2) and **Appendix 1 Annex 1D Record of HRA Derogation Consultation** (document reference: 5.5.1.4)).

4.3 Farne Islands SPA

28. The Farne Islands SPA citation document lists an average of 862 pairs of Sandwich terns in 2010-2014. However, that number is far smaller than the numbers that were present in the 1970s to 1990s (**Figure 3**). On the Farnes, a high proportion of surviving Sandwich tern chicks were reported to have been eaten by large gulls in 2001 (Mavor et al. 2002). However, predation has not been reported to be a problem at this site in most years. Nevertheless, the population at Farne Islands SPA has been declining consistently for over 40 years, with no clear sign of any management action halting or reversing that decline (**Figure 3**). The population is now close to local extinction, and if that is allowed to happen, the chances of restoring the population will become much smaller, as re-colonization is likely to be much more difficult to achieve than retaining an existing population.

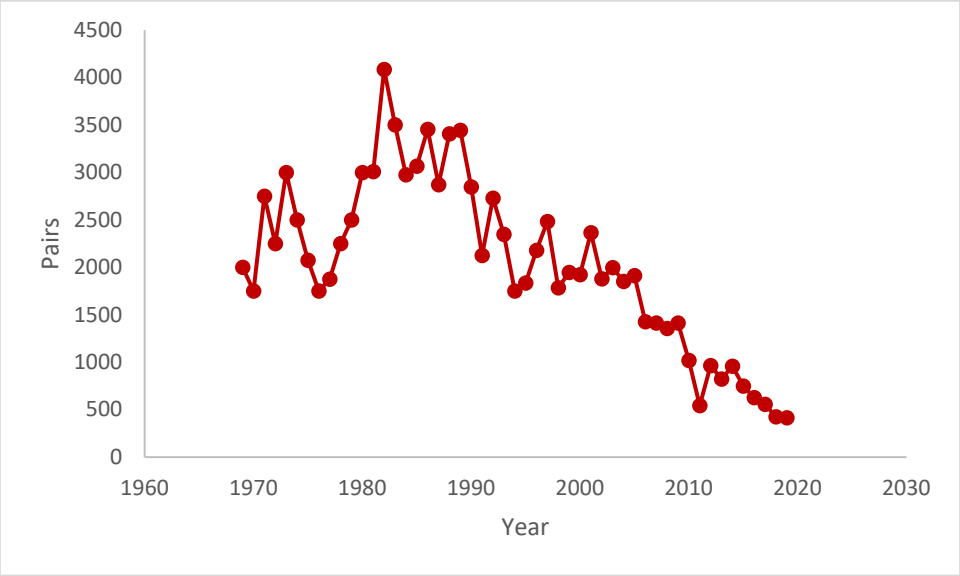

Figure 3: Numbers of pairs of Sandwich terns nesting at Farne Islands SPA 1969-2021 (data from JNCC SMP database).

29. BBC (2021) report huge concern about the failure of National Trust to manage vegetation on Inner Farne in a way that would allow terns to breed there. Emphasis in the published article is on Arctic terns, but the same applies for Sandwich tern. The main breeding area of Sandwich terns on Inner Farne was an area that was closely grazed by the abundant rabbits on the island, which maintained a very short sward on which terns nested. The rabbit population was removed by Ministry of Agriculture, Forestry and Fisheries (MAFF) pest officers in 1968, although "*unauthorised*" reintroductions occurred in 1974 and again in 2013 (Tooth and Blakely 2015). The vegetation in the area has changed over the years from a close-cropped sward of grass to more rank nitrophilous vegetation, less suitable for terns to nest among. According to Tooth and Blakely (2015) who wrote the management plan for the Farnes for 2016 to 2021 "*The current condition is unfavourable declining for Sandwich, Roseate, Common and Arctic Tern and Eider, therefore management policy is not meeting the objectives set. This would suggest the current management needs to be modified.* ***For years the islands have been in a state of decline due to the rapid colonisation and growth of common nettle and hemlock, which has been allowed to spread over Inner Farne virtually uncontrolled, encroaching on the nesting areas of all three tern species that currently breed on the islands. Rapidly growing Yorkshire fog, as well as nettle beds, limited the amount of short turf required by the terns.*** *After consultations with the RSPB, who have similar difficulties on Coquet Island and Natural England, it has been agreed that a combination of strimming, digging and spraying of nettle is required to provide open areas near existing colonies on Inner Farne. The resulting biomass is to then be piled to provide ideal nesting areas of Common Eider. In addition to this due to the multiple number of staff annually getting open sores despite wearing appropriate PPE (thought to be a reaction to hemlock sap with UV) Hemlock on Inner Farne will be dug out where possible and spot sprayed over the next 5 years to eradicate it. It is believed that if the vegetation is strimmed hard down at the beginning of the season this could create areas which birds later choose to colonise and potentially continue to suppress naturally. In addition to this, test plots, where matting will be laid and shingle laid on top in the veg-patch area will be trialled to create a better nesting habitat for the terns. This will be used in areas where nettle growth causes the loss of suitable habitat for nesting terns could create areas which birds later choose to colonise and potentially continue to suppress naturally. In the case of rabbit grazing - although this option may remain open currently the cost and logistics are unfeasible.*"

30. The management plan for 2016-2021 does not indicate how much vegetation management was carried out in those years. Vegetation cutting cannot be carried out at tern colonies once terns have settled to nest, and the lack of grazing results in the rapid growth of nitrophilous plants fuelled by seabird guano. The gradual decline in breeding numbers of Sandwich terns on Farne Islands SPA appears to be a response to the progressive deterioration of the nesting area, which became particularly obvious in 2021 because no cutting at all was carried out before the tern nesting season. That decline is in stark contrast to the situation on nearby Coquet Island which is managed by RSPB and where Sandwich tern numbers have remained consistently high over the period of decline at the Farnes. Since breeding numbers and breeding success are consistently high at nearby Coquet Island, there seems to be no problem of food shortage limiting Sandwich tern numbers at the Farnes; the problem appears to be one that could be solved with a change in management to restore the nesting area habitat to conditions suitable for nesting terns.

31. Tooth and Blakely (2015) report "*Large gulls (LBB and Herring) eggs are destroyed each year to keep the population at a level agreed with Natural England*" but there is no information in the management plan as to how much predation on tern chicks is caused by large gulls at this site, although that was noted in 2001 (Mavor et al. 2002).

32. If the failure to manage the Farnes over recent years in a way that retains populations of terns is simply a consequence of a lack of resources for that work, then possibly this could be a site where compensation might help to recover the declining Sandwich tern population of this important SPA.

33. The 2016-2021 management plan expired in March 2021. A new management plan for April 2021 onwards has been prepared by National Trust and has been submitted to Natural England (National Trust, in litt.). The new management plan aims to improve vegetation management to recover tern breeding numbers. The new management plan has not yet been published (as of July 2022), but the Applicant has been informed by National Trust's author of the plan that it does not include provision of tern nest boxes and shelters which is a measure that has been shown on the Isle of May to be effective in reducing mortality of Sandwich tern eggs and chicks (Steele and Outram 2020) and has similarly been shown to be effective at a variety of other tern colonies for other species of terns. The new management plan also does not include provision of cameras to monitor predation attempts on tern nests and chicks and does not include the use of canes to reduce predatory attacks by gulls (canes around tern colonies have been shown to reduce such attacks by 50% but not to hamper terns). These measures therefore can be seen as additional to the planned management of tern habitat at Farne Islands SPA over the next five years. In combination they are likely to improve breeding success of terns and to allow more successful adaptive management by providing better understanding of the issue of predation impacts on terns at this site.

34. As such, nest site improvements at the Farne Islands SPA is proposed by the Applicant as part of its package of compensatory measures put forward in relation to the NNC SPA Sandwich tern. Detailed information about this proposal can be found in the main Sandwich tern compensation document (see Appendix 2 Sandwich Tern Compensation Document (document reference: 5.5.2).

4.4 Foulness SPA

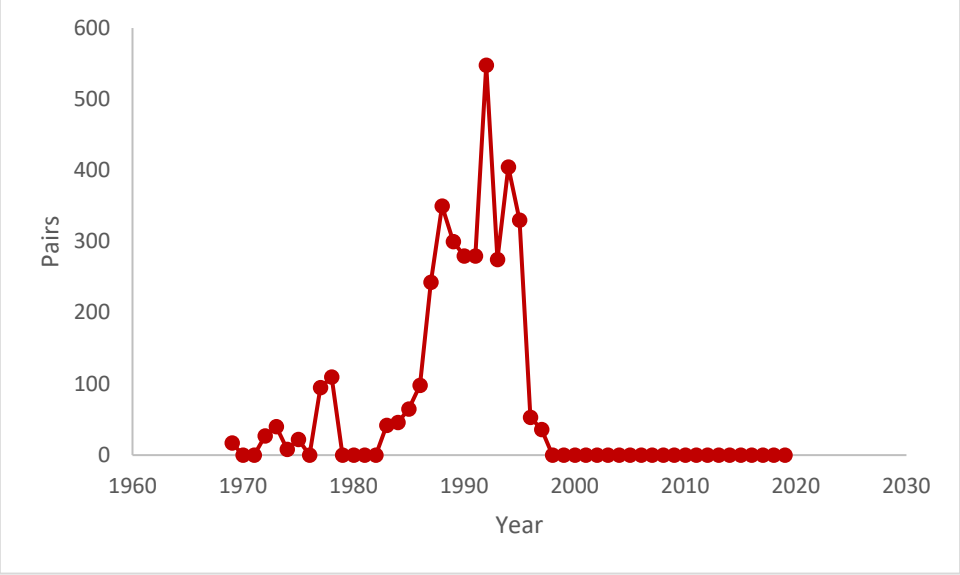

Figure 4: Numbers of pairs of Sandwich terns nesting at Foulness SPA 1969-2021 (data from JNCC SMP database).

35. Ratcliffe et al. (2000) identified predation by foxes as the cause of the desertion of Foulness SPA by Sandwich terns since the late 1990s. No management measures put into effect at this site have yet allowed Sandwich terns to resume breeding at Foulness SPA (4). In discussions, Natural England have stated that they would *"support measures to identify a positive way forward to provide suitable habitat for the terns."* They emphasise the difficulty of working with the Ministry of Defence and QinetiQ at this site and the access restrictions imposed which make compensation measures at Foulness Island more difficult.

36. It seems possible that creation of nesting habitat on an island within a newly created pool at Foulness Island that is protected by fences to exclude foxes might be a suitable conservation measure to deploy at this site, but that would require dedicated resources (not only fence materials, but staff time to erect and remove the fence each year, and to carry out daily checks and maintenance throughout the pre-breeding and breeding season, following best practice (Short 2020)). More importantly, the lack of any Sandwich tern nesting at Foulness for more than 20 years means that restoring the species to this site would be likely to be much more difficult than halting the decline of breeding numbers at Farne Islands SPA. The Applicant therefore considers that efforts should focus on Farne Islands SPA rather than Foulness SPA, but that the possibility of implementing compensatory measures at Foulness should be retained. Local ornithologists and local conservation groups at Foulness Island have expressed enthusiasm for the possibility of restoring Sandwich tern as a breeding species at Foulness Island by creating suitable nesting habitat, but also highlight the difficulty of achieving this with the access restrictions at the site.

4.5 Non-SPA sites

37. The JNCC SMP database holds very few counts of numbers of Sandwich tern pairs at non-SPA sites. Since 2000, only 16 such sites are listed in England, Wales and Scotland, and only 5 of these sites held more than 50 pairs of Sandwich terns in any year between 2000 and 2021 (3).

Table 3: Peak number of pairs/AONs of Sandwich terns in any year 2000 to 2021 listed in JNCC SMP database for sites where Sandwich tern is not a SPA breeding feature.

Site	Area	Year	Peak numbers of pairs/AONs
Medway Estuary and Marshes SPA	Kent	2000	333
St John's Pool	Caithness	2019	115
South Ronaldsay	Orkney	2000	90
Westray	Orkney	2002	75
Scar Point	Wigtownshire	2000	70
Lamb Holm	Orkney	2005	18
Hunterston	Strathclyde	2016	17
Holy Island Sands (Lindisfarne SPA)	Northumberland	2002	14
Papa Westray	Orkney	2012	14
Muckle Skerry	Orkney	2006	13
North Ronaldsay	Orkney	2001	11
Redcar Ore Terminal	Cleveland	2007	2
Egilsay	Orkney	2001	2

Site	Area	Year	Peak numbers of pairs/AONs
Holm of Scockness	Orkney	2007	2
Machrihanish	Argyll	2016	1
Summer Isles	Ross & Cromarty	2000	1

38. Over 1,000 pairs of Sandwich terns nested in the Morrich More firing range (between Tain and Inver, Easter Ross, Dornoch Firth) in 1969, but deserted in 1971, apparently because of increasing human disturbance (Bourne and Smith 1974, Forrester et al. 2007). This site is not included in Table 3 because no Sandwich terns nested there between 2000 and 2021, but it might be possible to attract Sandwich terns back to this site if issues of human disturbance could be resolved. The site may also require deployment of fences to exclude foxes as this is a mainland site where fox predation is likely to be a problem. However, reducing human disturbance at this site may not be practical in view of the Scottish 'right to roam' legislation. Because no Sandwich terns have nested there for over 50 years, but there are large numbers breeding elsewhere within this general region (at Sands of Forvie NNR, Aberdeenshire and at St John's Pool, Caithness) this site has not been included in more detailed consideration of management options.

39. All 40 pairs nesting at Lindisfarne in 1993 were predated by foxes and the colony was deserted that year (Walsh et al. 1994). It has never returned. It seems possible that fences to exclude foxes might be a suitable conservation measure to deploy at this site, but that would require dedicated resources (not only fence materials, but staff time to erect and remove the fence each year, and to carry out daily checks and maintenance throughout the pre-breeding and breeding season, following best practice; Short 2020). It may be difficult to encourage Sandwich terns to recolonize a site such as this where they have not been nesting regularly for many years, but this site would also potentially conflict with the greatly increased use of this area for tourism and recreation. Sandwich terns are very vulnerable to human disturbance, and the levels of human activity along this coast make it improbable that a Sandwich tern colony there could be viable.

40. At Dungeness, Kent, there were between 100 and 250 pairs in most years from 1988 to 1997, but in 1997 all nests failed in late May, with evidence of predation by mink and badgers (Thompson et al. 1998). None nested at Dungeness in 1998, 1999 or 2000, suggesting that predation caused the abandonment of that colony (Mavor et al. 2001). This site is not listed in Table 3 because no Sandwich terns nested there between 2000 and 2021, It seems possible that predator-proof fences to exclude foxes, mink and badgers might be a suitable conservation measure to deploy at this site, but that would require dedicated resources (not only fence materials, but staff time to erect and remove the fence each year, and to carry out daily checks and maintenance throughout the pre-breeding and breeding season). It may be difficult to encourage Sandwich terns to recolonize a site such as this where they have not been nesting regularly for many years, and difficult to find a site where human disturbance could be kept below the level that causes Sandwich terns to desert.

41. Forrester et al. (2007) note 31 sites in Scotland where Sandwich terns bred in the past but had abandoned the site before the 2000s, and only seven sites in Scotland still used by Sandwich tern for breeding in the mid-2000s. At least four of those seven sites have been abandoned since the 2000s (JNCC SMP database), leaving only Sands of Forvie, Forth Islands, and St John's Pool Caithness, as continuing to hold regular Sandwich tern breeding colonies. Similarly, the JNCC SMP database shows that many sites in Scotland, including many of those listed in Table 3, that had been occupied by breeding Sandwich terns were abandoned during the 2000s. There is, therefore, considerable potential to manage sites in Scotland to increase breeding numbers and breeding distribution of Sandwich tern. Sands of Forvie NNR is well managed by NatureScot and the Sandwich tern population there is in favourable conservation status and has high breeding success as a result of careful exclusion of predators and human disturbance (Short 2020). Forth Islands SPA is discussed in Section 4.2. St John's Pool is a well-managed private nature reserve. Other sites in Table 3 that held breeding Sandwich tern mostly held very small numbers and appear not to have potential for restoring significant breeding numbers, and most sites in Table 3 have now lost their Sandwich tern breeding population so no longer represent active colonies of this species.

42. One site from which Sandwich terns have been lost is Scar Point, Loch Ryan, Wigtownshire. That is a site in SW Scotland which, if restored, would significantly improve the geographical coherence of the Sandwich tern breeding range in Britain and Ireland.

43. The JNCC SMP database records that there were no Sandwich terns nesting at Scar Point, Loch Ryan (54.968°N, 5.061°W), in 2021, and that there was "*low vegetation on spit above high tide, area of shingle above high tide significantly reduced compared to map*". No data are recorded for 2007 to 2020. However, there were 120 pairs in 1998, 24 pairs in 2006, 20 pairs in 2005, 45 pairs in 2004 (JNCC SMP database). Restoring Sandwich terns to nesting in Loch Ryan would not only appear to be potential compensation by increasing breeding numbers but would also have the very strong qualitative merit of restoring former breeding range of this species which has been lost. Although Sandwich terns nested at several sites in west Scotland in the past, all of those colonies have been lost. Restoring one of the sites in west Scotland would therefore be strategically valuable as restoration of lost breeding range rather than just increasing breeding numbers. Restoring lost breeding range would increase the resilience of the Sandwich tern population.

44. Loch Ryan has the merits of being an historical breeding site for Sandwich tern over many decades and therefore is known to have been suitable habitat to support a breeding colony, it has areas that are away from most human disturbance, close to shore, not above cliffs, away from ferry routes and local oyster fishing activity, and there are no protected area designations in Loch Ryan that might be problematic in terms of habitat management to restore suitable habitat for Sandwich tern nesting.

45. Actions at a distance from NNC SPA recognise that the Sandwich tern population of the British Isles is a meta-population with extensive movement of birds to breed at colonies far from their place of birth (MacArthur Green 2021), so that improving conditions for this species at a site in south-west Scotland will help not only to increase population resilience but will help all colonies through movements of birds among sites, as well as providing an important restoration of former breeding range.

46. Loch Ryan therefore emerged from the Sandwich Tern nesting habitat improvements site selection process as a preferred location following feedback during the ETG meeting in January 2022. Between then and the point of application, the Applicant has undertaken a more detailed desk-based constraints review and targeted consultation with key local stakeholders (e.g. Crown Estate Scotland, NatureScot and Marine Scotland) to determine whether any barriers or conflicts might exist that could preclude delivery of compensation at this location. The outcome of this work is described below. For information relation to consultation see **Appendix 1 Annex 1D Record of HRA Derogation Consultation** (document reference: 5.5.1.4).

5 SELECTION OF A SITE WITHIN THE LOCH RYAN AREA

47. Although the Applicant's and stakeholders (namely Natural England and RSPB) preference is to create an inland pool on land immediately adjacent to Loch Ryan, with islands that can be colonized by Sandwich terns, the Applicant has not at this stage ruled out an alternative possibility of creating a pontoon within Loch Ryan that might provide suitable nesting habitat. Common terns readily take to nesting on small pontoons. Until now no pontoon has been deployed at a site where Sandwich terns are likely to nest, so it is uncertain whether Sandwich terns would use a pontoon. That makes a pontoon the less preferred option, but it does have certain advantages, including greater protection from human disturbance and from terrestrial predators.

48. In the case of both the inland pool and the pontoon, the initial site selection focussed on the general area close to where the Sandwich tern colony in Loch Ryan used to be located, which was on an island off the tip of Scar Point (**Figure 5**), which evidence indicates was destroyed by gravel extraction and coastal erosion.

5.1 Site selection for a pontoon in Loch Ryan

49. As described above, the preferred area to locate a pontoon would be close to the historical colony location at Scar Point. However it should also be far enough offshore to avoid human disturbance from the shore and to reduce risk of mammal predators swimming to the structure from the shore, be in suitable water depth for a seabed anchorage (i.e. floating at all stages of the tidal cycle) and away from the local native oyster fishery on the east side of the loch and distant from ferry routes.

50. A potential location that would meet these criteria is shown on **Figure 5**, although the exact position will be determined at the detailed design stage, accounting for water depth and suitability for a permanent sea bed anchorage, and any other relevant considerations at the time.

51. Subsequently, in July 2022, RSPB advised the Applicant that it had received funding for a pontoon for common tern at Loch Ryan. The RSPB site is to the west and inshore of the potential location identified by the Applicant, just offshore of the area known as Wig Sands, immediately to the west of Scar Point. The Applicant is continuing to engage with RSPB on this point, and specifically in relation to ongoing site selection work to avoid potential conflict between the two proposals.

5.2 Site selection for an inland pool adjacent to Loch Ryan

52. The Applicant has identified an area of search defining the preferred area within which a pool could be located, as shown on **Figure 5**, which encompasses the area of land immediately to the west of Loch Ryan to the north of Scar Point. As well as being close to the historical colony location, this area would enable a site to be selected that would give an inland pool protection from human disturbance while potentially still allowing public viewing of the pool from a hide. The Applicant is progressing discussions with landowners in order to further narrow this area of search down. One important reason for preferring that area is that Sandwich terns show strong preference for foraging close to their colony but in sheltered shallow water of defined water transparency. Since Sandwich terns nested at Scar Point in the past this area must provide suitable foraging conditions. Sites further away within Loch Ryan may be less suitable because birds might have to commute further to get to good foraging grounds.

53. In addition, the Applicant has also carried out a further desktop review of other potential locations for an inland pool around Loch Ryan, with the potential constraints that have been identified shown on **Figure 6**. The Applicant undertook further site visits in August 2022, to further appraise other potential locations around Loch Ryan and to confirm any further constraints that might influence site selection and the eventual implementation of the works (including access requirements, for example). This exercise is being run in parallel to the work to narrow down the area of search in the vicinity of Scar Point to ensure that all potential options have been considered. As a result of this fieldwork, five sites around Loch Ryan have been identified that may be suitable for developing breeding habitat for Sandwich tern by creating a pool and islands. The two sites considered most suitable lie within the preferred area of search.

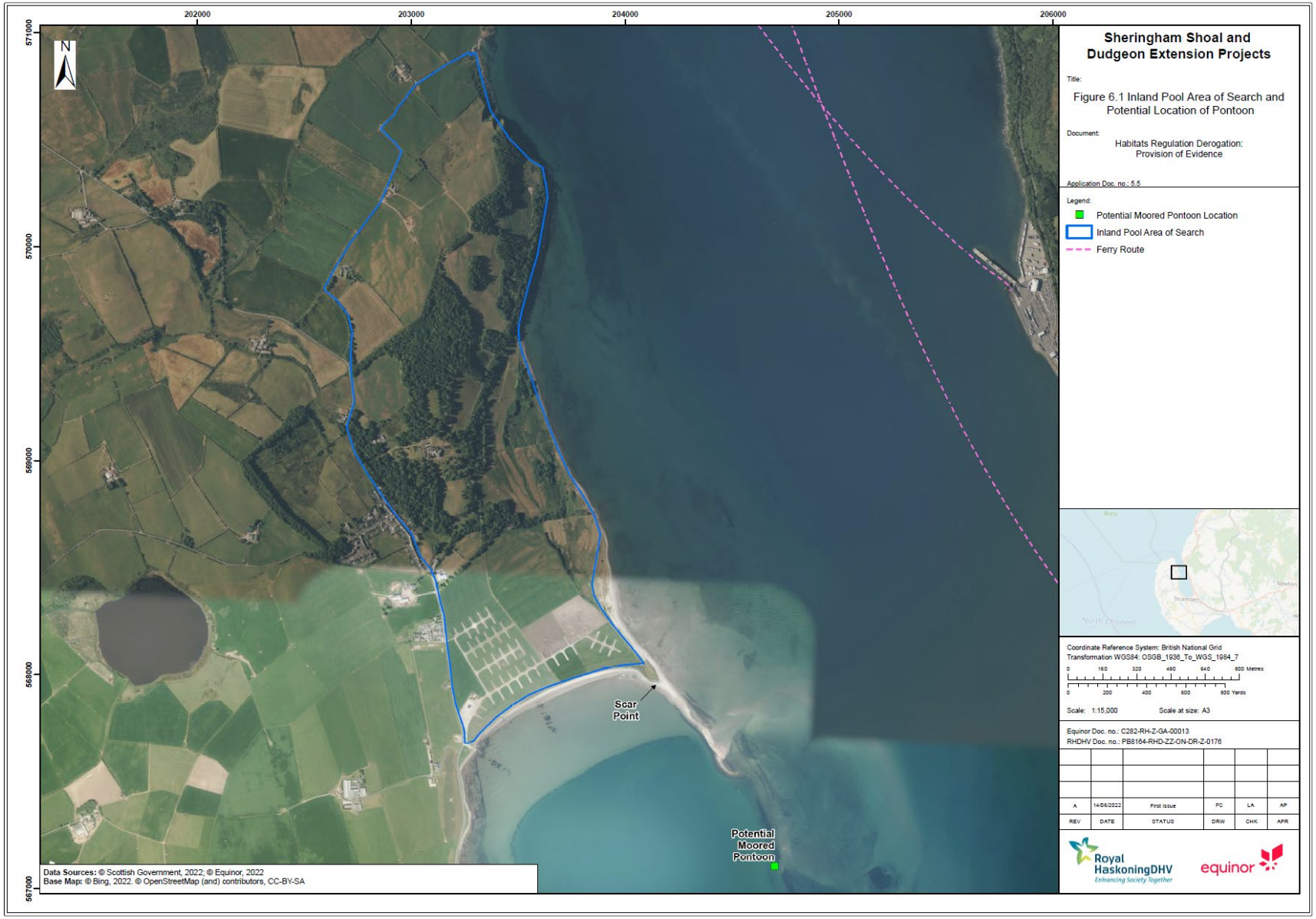

Figure 5: Inland pool area of search (defining the preferred area for a pool) and potential location of pontoon adjacent to Loch Ryan.

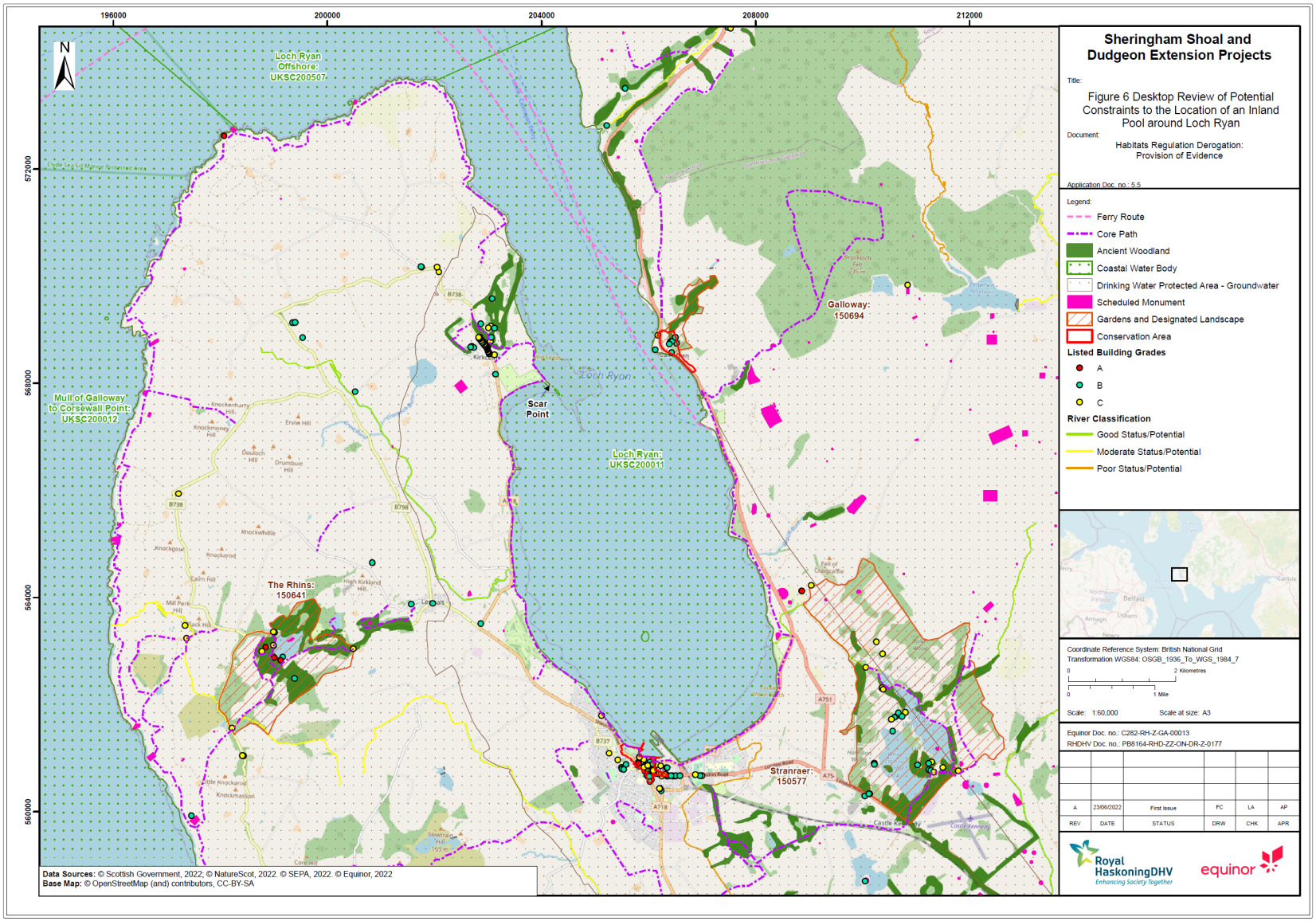

Figure 6: Desktop review of potential constraints to the location of an inland pool around Loch Ryan.

6 REFERENCES

Bayes, J. and Kharadi, N. 2022. Marine natural capital accounting: impacts of the sandeel fishery in the North Sea. UKNEE Webinar. [redacted]

Baptist, M.J. and Leopold, M.F. 2010. Prey capture success of Sandwich terns *Sterna sandvicensis* varies non-linearly with water transparency: optimum water transparency for Sandwich tern. Ibis 152: 815-825.

BBC 2021. Overgrown Farne Island plants spark Arctic tern nesting fears - BBC News

Bourne, W.R.P. and Smith, A.J.M. 1974. Threats to Scottish Sandwich terns. Biological Conservation 6: 222-224.

Brown, A. and Grice, P. 2005. Birds in England. T & AD Poyser, London.

Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J-P., Shannon, L. and Sydeman, W.J. 2011. Global seabird response to forage fish depletion – one-third for the birds. Science 334: 1703-1706.

Defra 2021. Best practice guidance for developing compensatory measures in relation to Marine Protected Areas. Date: 22 July 2021. Version: For consultation.

Fijn, R.C., de Jong, J., Courtens, W., Verstraete, H., Stienen, E.W.M. and Poot, M.J.M. 2017. GPS-tracking and colony observations reveal variation in offshore habitat use and foraging ecology of breeding Sandwich terns. Journal of Sea Research 127: 203–211.

Fijn, R.C., Thaxter, C.B., Aarts, G., Adema, J., Middelveld, R.P. and van Bemmelen, R.S.A. 2022. Relative effects of static and dynamic abiotic conditions on foraging behaviour in breeding Sandwich terns. Marine Ecology Progress Series 692: 137-150.

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. and Grundy, D.S. 2007. The Birds of Scotland. Scottish Ornithologists' Club, Aberlady.

Frederiksen, M. and Wanless, S. 2006. Assessment of the effects of the Firth of Forth sandeel fishery closure on breeding seabirds. PROTECT Work Package 5/Case Study 2.

Furness, R.W., MacArthur, D., Trinder, M. and MacArthur, K. 2013. Evidence review to support the identification of potential conservation measures for selected species of seabirds. Report to Defra.

Furness, R.W. 2021. Report to Crown Estate Scotland and SOWEC: HRA Derogation Scope B – Review of seabird strategic compensation options.

Hill, S.L., Hinke, J., Bertrand, S., Fritz, L., Furness, R.W., Ianelli, J.N., Murphy, M., Oliveros-Ramos, R., Pichegru, L., Sharp, R., Stillman, R.A., Wright, P.J. and Ratcliffe, N. 2020. Reference points for predators will progress ecosystem-based management of fisheries. Fish and Fisheries 21: 368-378.

Lindegren, M., van Deurs, M., MacKenzie, B.R., Clausen, L.W., Christensen, A. and Rindorf, A. 2018. Productivity and recovery of forage fish under climate change and fishing: North Sea sandeel as a case study. Fisheries Oceanography 27: 212-221.

MacArthur Green 2021. Report to Royal Haskoning: Considerations of compensation options for Sandwich terns and kittiwakes.

Mavor, R.A., Pickerell. G., Heubeck, H. and Thompson, K.R. 2001. Seabird numbers and breeding success in Britain and Ireland, 2000. UK Nature Conservation No. 25. JNCC, Peterborough.

Mavor, R.A., Pickerell. G., Heubeck, H. and Mitchell, P.I. 2002. Seabird numbers and breeding success in Britain and Ireland, 2001. UK Nature Conservation No. 26. JNCC, Peterborough.

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird Populations of Britain and Ireland. T & AD Poyser, London.

Perrow, M.R., Harwood, A., Berridge, R. and Skeate, E. 2017. The foraging ecology of Sandwich terns in north Norfolk. British Birds 110: 257-277.

Ratcliffe, N., Pickerell, G. and Brindley, E. 2000. Population trends of little and Sandwich terns *Sterna albifrons* and *S. sandvicensis* in Britain and Ireland from 1969 to 1998. Atlantic Seabirds 2: 211-226.

Short, D. 2020. Breeding of four species of tern and black-headed gull at Forvie National Nature Reserve, 2020. Report to NatureScot.

Steel, D. and Outram, B. 2020. Terns – restoring biodiversity to the Isle of May's breeding seabirds. Scottish Birds 40: 206-211.

Stienen, E.W.M., Brenninkmeijer, A. and Courtens, W. 2015. Intra-specific plasticity in parental investment in a long-lived single-prey loader. Journal of Ornithology 156: 699-710.

Thompson, K.R., Brindley, E. and Heubeck, M. 1998. Seabird numbers and breeding success in Britain and Ireland, 1997. UK Nature Conservation No. 22. JNCC, Peterborough.

Tooth, E. and Blakely, L. 2015. Farne Islands National Nature Reserve Management Plan April 2016-March 2021. National Trust, Newcastle.

Walsh, P.M., Brindley, E. and Heubeck, M. 1994. Seabird numbers and breeding success in Britain and Ireland, 1993. UK Nature Conservation No. 17. JNCC, Peterborough.