

The Sizewell C Project

5.10 Shadow Habitats Regulations Assessment Volume 1: Screening and Appropriate Assessment Part 1 of 5

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1 Introduction

1.1.1. SZC Co.[1] is proposing to build and operate a new nuclear power station comprising two UK European Pressurised Reactors™ (EPRs™) at Sizewell in Suffolk, north of the existing Sizewell B power station: the 'Sizewell C Project', a description of which is provided in section 2 of this report. Given the proximity of the Sizewell C Project to sites of European and international importance for nature conservation, it has been determined that it has the potential to affect one or more such sites. SZC Co. is, therefore, required to provide information to allow a Habitats Regulations Assessment (HRA) to be undertaken by the 'competent authorities' in support of its Development Consent Order (DCO) and Environmental Permit applications[2] (i.e. the Secretary of State for Business, Energy and Industrial Strategy (BEIS) and the Environment Agency respectively) for the Sizewell C Project.

1.1.2. HRA is a requirement under the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (described in section 3 of this report) where a project could affect sites and species designated for their nature conversation importance.

1.1.3. A deemed marine licence will also be sought for the Sizewell C Project through the DCO process, enabled under s149 of the Planning Act 2008. The deemed marine licence is granted by the Secretary of State for carrying out activities associated with the Sizewell C Project for which a licence is required under Part 4 of the Marine and Coastal Access Act 2009. Once 'deemed', the Marine Management Organisation (MMO) will be responsible for enforcing, post-consent monitoring, varying, suspending and revoking any deemed marine licence.

1.1.4. This report – referred to as a 'Shadow HRA'– provides the information required for a HRA to be undertaken in support of the DCO for the Sizewell C Project and considers all elements of the project (including discharges). Separate, stand-alone Shadow HRAs have been provided in support of the Environmental Permit applications for the operational phase and will be provided in due course for the construction phase. It covers 'European site scoping' and 'likely significant effect screening' and presents the outcomes of the screening process with respect to the Sizewell C Project's potential to have a likely significant effect on those European sites that have been scoped in to the process.

[1] NNB Generation Company (SZC) Limited; referred to in this document as 'SZC Co.'.
[2] For the operational phase of Sizewell C, these comprise the 'Radioactive Substances Regulation', 'Combustion Activity' and 'Water Discharge Activity' Environmental Permits. Additional Environmental Permits will be required for certain activities during the construction phase.

1.1.5. For those sites and interest features screened in, it further provides information for Appropriate Assessments to enable the Secretary of State to determine whether the proposed development – both alone or in-combination with other plans or projects – would have an adverse effect on the integrity of these European sites.

1.1.6. It provides the following:

- A summary of the main components of the Sizewell C Project in section 2 of this report.
- A description of the HRA process adopted for this assessment in section 3 of this report.
- The background to and findings of the European site scoping stage and summary information on the European sites taken through into the screening stage as seen in section 4 of this report.
- The findings of the likely significant effect screening stage for the Sizewell C Project alone and in-combination with other plans and projects as seen in section 5 of this report. This chapter identifies the cause and effect pathways relevant to the Sizewell C Project and, more specifically, the qualifying features of the European sites scoped in to the assessment that could be affected.
- A description of baseline conditions for those sites and species screened in to the Appropriate Assessment as provided in section 6 of this report.
- Information for the Appropriate Assessment (for each of the relevant potential effect pathways / screening categories) vis-à-vis designated coastal, freshwater and terrestrial habitats (section 7 of this report), birds (section 8 of this report), marine mammals (section 9 of this report) and migratory fish (section 10 of this report). These chapters provide an assessment of the potential effect of the Sizewell C Project alone and in-combination with other plans and projects.
- The conclusions of the Shadow HRA, including a summary of the European sites and screening categories relevant to each element of the assessment and a summary of the findings of the Appropriate Assessment (alone and in-combination, including within-Sizewell C Project interactive effects) (section 11 of this report).
- References and appendices.

1.1.7. The appendices include figures (**Appendix A** of this report), the likely significant effect screening matrices (**Appendix B** of this report), the

outcomes of scoping/screening other plans and projects for in-combination assessment (**Appendix C** of this report), the Appropriate Assessment European site integrity matrices (**Appendix D** of this report) and evidence to support the recreational disturbance assessment (**Appendix E** of this report).

1.1.8. The relationship between the various documents that comprise SZC Co.'s Stage 3 of the HRA process is as follows:

- Shadow HRA Report, Volume 1: Stages 1 and 2 - Screening and Appropriate Assessment (this document).
- Shadow HRA Report, Volume 2: Stage 3 – Assessment of Alternative Solutions.
- Shadow HRA Report, Volume 3: Stage 4 - Imperative Reasons of Overriding Public Interest (IROPI).
- Shadow HRA Report, Volume 4: Compensatory Measures.

2 Summary of the Project

2.1 Introduction

2.1.1. The proposed Sizewell C nuclear power station is to be located on land immediately to the north of Sizewell B nuclear power station, on the Suffolk coast approximately midway between Lowestoft to the north and Ipswich to the south. It would comprise two UK EPR™ units together with associated infrastructure and facilities. The key components of the Sizewell C Project are shown in **Figure 2.1** and comprise the main development site, offshore works, a temporary construction area and other land, and a series of off-site associated development sites.

2.1.2. The Sizewell C main development site covers an area of 371.7 hectares (ha), of which approximately 35ha would be occupied permanently by the new power station. Most of the rest of the site would only be needed temporarily for construction purposes and would be restored in accordance with the operational masterplan and the **Outline Landscape and Ecological Management Plan (oLEMP)** (Doc Ref. 8.2) once the new power station has been developed. A full description of the Sizewell C Project is provided in **Volume 1**, **Chapter 2** of the **Environmental Statement (ES)** (Doc Ref. 6.2), a summary of which is provided below.

2.1.3. It is proposed to build a new access road to link the Sizewell C site to the B1122. Once in place, this would be the main route to bring workers and road-based freight onto the site during construction and the main access for Sizewell C when the power station is operational. The existing Sizewell access would be used initially and would then provide the secondary access to Sizewell C once the new access road is available.

2.1.4. Under an integrated freight management strategy (see section 2.2b of this report), a direct rail connection would also be constructed to the main development site from the existing Saxmundham to Leiston branch line.

2.1.5. In order to construct Sizewell C nuclear power station, there would also be a need for an associated development, including temporary workers' campus accommodation and park and ride facilities, as well as other improvements to rail and highway infrastructure (see section 2.2b of this report).

2.1.6. The Sizewell C Project proposals include a beach landing facility (BLF) for use during construction and which would be retained for operational purposes.

2.1.7. During the peak year of construction, it has been assumed that a total of 7,900 construction workers would work on the main development site at any one time and 600 construction workers would work on the associated

development sites. The 7,900 construction workers at peak construction are assumed to be made up of:

- 'home based' (2,016 workers); and
- 'non-home based' (5,884 workers) comprising:
  - 2,400 workers on campus.
  - 600 workers in caravans.
  - 2,884 workers living off site.

2.1.8. In addition, all 600 associated development workers are assumed to be 'home based'.

2.1.9. The site-wide surface water drainage philosophy would follow the conventional sustainable drainage techniques, typically moving from each stage to the next only when the current stage is deemed not practicable:

- Store rainwater for later use (e.g. rainwater harvesting).
- Use infiltration techniques (e.g. porous surfaces).
- Attenuate rainwater in ponds or open water features for gradual release.
- Attenuate rainwater by storing in tanks for gradual release through an outlet.
- Discharge rainwater direct into watercourse or sea.

2.1.10. There is a variability of ground water and strata across the main development site and as such the approach taken would vary.

2.2 Description of the development

a) Main development site

i. Introduction

2.2.1. A full description of the main development site is provided in **Volume 1, Chapter 2** of the **ES** (Doc Ref. 6.2), a summary of which is provided below.

2.2.2. The main development site comprises five components, which are illustrated in **Figure 2.2**:

- Main platform - the area that would become the power station itself.

- Sizewell B relocated facilities and National Grid land: the area that certain Sizewell B facilities would be moved to in order to release other land for the proposed development, and land required for the National Grid infrastructure.
- Temporary Construction Area - the area located primarily to the north and west of the proposed Sizewell Marshes Site of Special Scientific Interest (SSSI) crossing, which would support construction activity on the main platform.
- Land East of Eastlands Industrial Estate (LEEIE) - the area to the north of Sizewell Halt and King George's Avenue, which would be used to support construction on the main platform and temporary construction area.
- Offshore works area - the area where offshore cooling water infrastructure and other marine works would be located.

ii. Permanent development

2.2.3. The permanent development within the Sizewell C main development site would include:

Nuclear islands

- Two nuclear islands, including two UK EPR™ reactor buildings and associated annexed buildings and structures containing the safety systems, fuel handing systems and access facilities, together with the adjacent emergency diesel generator buildings.

Conventional islands

- Two conventional islands, each including a turbine hall and associated electrical buildings for the export and distribution of electrical power.

Operational building

- An operational service centre (a multi-purpose building), which allows for access into the nuclear islands, including storage areas, workshops, store rooms, laboratories, data centre, offices and associated support and welfare facilities, including the staff restaurant.

Cooling water pumphouses and associated buildings

- Two cooling water pumphouses with related infrastructure (one for each UK EPR™ reactor).

Ancillary buildings

- Plant, office/access, storage and fuel and waste management.
- National Grid 400 kilovolt (kV) substation, alterations to the existing National Grid substation and associated diversion of overhead lines.
- Relocation of several Sizewell B buildings including the outage store, training centre; administrative buildings; visitor centre; and, office, canteen and welfare facilities.
- Associated buildings, structures and plant outside of the power station perimeter.

Marine works and associated infrastructure

- The cooling water system and combined drainage outfall in the North Sea, including associated dredging and tunnelling works.

Other site structures, infrastructure and works, including highway works and earthworks

- Overhead power lines and pylons connecting the conventional islands to the National Grid substation.
- Replacement of an existing National Grid pylon and power line south of Sizewell C.
- Installation of a cut-off wall and cut-off wall platform and associated deep excavations within the main platform
- A vehicular and pedestrian crossing over the Sizewell Marshes SSSI south of Goose Hill in the form of a culverted embankment.
- A beach landing facility (BLF) proposed for freight and abnormal indivisible loads (AILs) arriving by sea.
- Relocation of certain Sizewell B infrastructure, including: outage laydown area; up to 112 replacement car parking spaces; access roads; up to 576 outage car parking space; and, outage car park access roads.
- Diversion of rights of way, including Bridleway 19.
- The power station access road, linking the SSSI crossing with a new roundabout onto Abbey Road (B1122).

- Up to 770 operational car parking spaces and up to 600 outage car parking spaces.
- Realignment of Lover's Lane and Eastbridge Road.
- Onshore components of the marine infrastructure.
- Replacement vehicular access from Valley Road to adjoining farmland to the north.
- Realignment of the junction of the B1122 Abbey Road and Lover's Lane.
- Flood defences and coastal protection measures.
- Water supply and drainage measures, including realignment of Sizewell Drain.
- Landscape restoration works and planting.
- Fencing, lighting and other security provisions.
- Additional parking spaces at Kenton Hills car park.

Additional facilities associated with the Sizewell C Project

- Off-site sports facilities located on existing playing fields at Alde Valley school in Leiston.
- Permanent fen meadow compensation sites to the south of Benhall and to the east of Halesworth.
- Temporary marsh harrier habitat improvement area to the west of Westleton (if required).

b) Associated development

i. Introduction

2.2.4. To support the construction of the Sizewell C nuclear power station, SZC Co. also needs additional land for off-site associated developments (as defined in Section 115 of the Planning Act 2008) to support the movement of materials and staff to and from the main development site during construction. This includes the following:

- Two temporary park and ride facilities adjacent to the A12 to reduce the amount of traffic generated by the construction workforce on local roads and through local villages. One park and ride site is located to the north

of Sizewell C main development site at Darsham (the 'northern park and ride', see **Volume 3, Chapter 2** of the **ES** (Doc Ref. 6.4) for a full description; **Figure 2.3A**), and one to the south at Wickham Market (the 'southern park and ride', see **Volume 4, Chapter 2** of the **ES** (Doc Ref. 6.5) for a full description; **Figure 2.3B**).

- Permanent road improvements on the A12 and a new road to bypass Stratford St Andrew and Farnham (the 'two village bypass', see **Volume 5, Chapter 2** of the **ES** (Doc Ref. 6.6) for a full description; **Figure 2.4**).
- A road linking the A12 with the B1122 east of Theberton (the 'Sizewell link road', see **Volume 7, Chapter 2** of the **ES** (Doc Ref. 6.8) for a full description; **Figure 2.5**).
- A new roundabout to replace the existing priority junction at the A12/Yoxford junction. The proposed new roundabout would provide a safer and more efficient solution than signalising the existing junction (see **Volume 6, Chapter 2** of the **ES** (Doc Ref. 6.7) for a full description; **Figure 2.6**).
- A temporary 'freight management facility' at Seven Hills on land to the south-east of the A12/A14 junction to provide spaces for approximately 154 heavy goods vehicles (HGVs) (see **Volume 8, Chapter 2** of the **ES** (Doc Ref. 6.9) for a full description; **Figure 2.7**).
- A temporary extension of the existing Saxmundham to Leiston branch line and other permanent rail improvements on the Saxmundham to Leiston branch line in order to transport freight to the main development site and remove large numbers of HGVs from the regional and local road network (the 'green rail route', see **Volume 9, Chapter 2** of the **ES** (Doc Ref. 6.10) for a full description; **Figure 2.8**).

ii. Park and ride facilities

2.2.5. The park and ride facilities would play an important role in reducing the amount of additional traffic generated by the construction workforce on local roads and through local villages. Two park and ride facilities are proposed, one at Darsham for construction workers approaching Sizewell from the north on the A12 and the other at Wickham Market for those approaching from the south on the A12 (see **Figure 2.3A** and **Figure 2.3B**). Both park and ride facilities would also intercept traffic movements from locations west of the A12. The workforce would be transported to and from the Sizewell C main development site by bus.

2.2.6. Each park and ride facility would comprise:

- car parking areas for up to 1,250 car parking spaces (of which up to 40 would be accessible spaces) and up to 12 pick up only spaces;
- up to 10 spaces for minibuses/vans/buses;
- up to 80 motorcycle parking spaces;
- cycle shelters for up to 20 bicycles;
- bus terminus area, including shelters;
- security fencing and lighting;
- an amenity and welfare building comprising toilets and staff room;
- a security building including an administration office;
- a security booth adjacent to an exit loop for errant vehicles;
- two landscape bunds and additional planting;
- other ancillary development, including signage, road markings, CCTV and utilities; and
- external areas including roadways, footways, landscaping, surface water management areas and drainage infrastructure.

iii. Two village bypass

2.2.7. The two village bypass would comprise a new, permanent, 2.4 kilometres (km) single carriageway road, with a design speed of 60 mph, that would depart from the A12 to the south-west of Stratford St. Andrew before re-joining the A12 to the east of Farnham. The two village bypass would effectively create a new route around the south of Stratford St. Andrew and Farnham, thus bypassing the two villages. Once operational, the two village bypass is proposed to be a permanent bypass that would form a new section of the A12 (see **Figure 2.4**).

2.2.8. The two village bypass would include:

- A 2.4km single carriageway road.
- Provision of a four arm roundabout at the western end of the road, east of Parkgate Farm and Stratford Plantation to connect the road to the A12 and Tinker Brook.

- A multi-span overbridge, up to 7.5m in height above ground level to the road surface, and approximately 60m in length, to allow a crossing over the River Alde.
- Eight 5.4m, 3m wide, flood relief culverts are proposed (four on either side of the River Alde overbridge), as well as mammal migration culverts and a culvert to allow an existing watercourse and livestock access track to pass beneath a road.
- Provision of flood compensation areas to the north of the bypass (if required).
- Provision of a staggered junction between Nuttery Belt and Pond Wood to maintain vehicular access on both sides of the route of the proposed two village bypass.
- West of Foxburrow Wood, a non-motorised user bridge, over the two village bypass road, would be provided to maintain connectivity across the route (referred to as the 'Foxburrow Wood footbridge').
- Provision of a four arm roundabout at the eastern end of the road, to replace the existing junction of the A12, with the A1094 (Friday Street).

iv. Sizewell link road

2.2.9. The Sizewell link road would comprise a new, permanent 6.8 km single carriageway road, with a design speed of 60 mph, which begins at the A12 south of Yoxford, and bypasses Middleton Moor and Theberton before joining the B1122 (see **Figure 2.5**). It would be used by SZC Co. during the construction phase of the Sizewell C main development site to transport construction workers arriving by car, buses from both northern and southern park and ride sites, and goods vehicles (both light and heavy) delivering freight to the Sizewell C main development site.

2.2.10. The Sizewell link road would include:

- a 6.8km single carriageway road;
- a new three arm roundabout on the A12, located approximately 180m north of The Red House Farm;
- a single span bridge, approximately 50m in length, to enable the proposed road to cross over the East Suffolk line;
- a ghost island junction and a new link road (referred to as the 'Middleton Moor link'), from the proposed route of the Sizewell link road;

- Fordley Road would be realigned on the south side of the proposed route of the Sizewell link road so northbound traffic could join the new road;
- provision of a staggered crossroads ghost island junction from the proposed route of the Sizewell link road, to the B1122, to the north-west of Yankee Lodge. At the junction with the B1122, a new three arm-roundabout would be provided;
- a new walking and cycling route from the existing Littlemore Road, which will continue along the Middleton Moor link, to allow a crossing point over the proposed Sizewell link road;
- realignment of Hawthorn Road for approximately 150m to meet the proposed route of the Sizewell link road. Hawthorn Road would be stopped up on the north side of the proposed route of the Sizewell link road;
- a new ghost island junction would be formed with an extension of the B1125 and reconfiguration of the existing B1122 to form a suitable new junction. This includes a provision of a new link road between the route of the proposed Sizewell link road and Leiston Road (the 'B1125 link');
- a new priority junction on the west side of the Sizewell link road at Pretty Road;
- a new overbridge, single span, up to 44m long would be provided which would carry non-motorised users only (pedestrians, cyclists, equestrians) over the Sizewell link road and connect to Pretty Road on either side;
- a new junction to Moat Road would be provided to maintain access to the existing properties including Theberton Grange and Moat House; and
- a new junction to provide access to Theberton to the north, where approximately 500m of the B1122 would be realigned, with the route of the Sizewell link road joining the southern section of the B1122.

v. Yoxford and other highway improvements

2.2.11. The proposed off-site highway improvement works (**Figure 2.6**) comprise the following:

- A12 and B1122 east of Yoxford – provision of a new roundabout at the junction (referred to as the 'Yoxford Roundabout').

- A1094/B1069 junction south of Knodishall – improvements of visibility splays and provision of signage and road markings. SZC Co. would also seek to reduce the speed limit from 60mph to 40mph.
- A12/A144 junction south of Bramfield – provision of a central reservation island and waiting area.
- A12/B1119 junction at Saxmundham – improvements of visibility splays, alteration of the B1119 at the junction with the A12, and provision of signage and road markings.

2.2.12. Road safety analysis has also identified potential highway safety issues at two sites (the B1078 and B1079 junction east of Easton and Otley College and the A140 and B1078 junction west of Coddenham). Highway safety measures at these sites will be secured by obligations in a Section 106 Agreement (see draft Section 106 Heads of Terms appended to the **Planning Statement** (Doc. Ref. 8.4).

2.2.13. All of the proposed highways improvement works listed above would be retained following the construction of the main development site.

vi. Freight management facility

2.2.14. The freight management facility (**Figure 2.7**) would assist in allowing a controlled pattern of deliveries of construction material to the Sizewell C main development site with reduced movements during peak or sensitive hours on the network. The facility would provide buildings and external areas where paperwork and goods can be checked prior to delivery to the Sizewell C main development site and be a location where HGVs can be held while they wait to enter the main development site or in the event of an accident on the local road network which prevents access to the main development site.

2.2.15. The freight management facility would comprise:

- space for approximately 154 HGVs;
- up to 12 car parking spaces for staff and visitors, up to one accessible space, up to 10 spaces for minibuses/vans, up to four motorcycle spaces, covered and secure cycle parking for up to 10 bicycles and up to six covered HGV spaces for screen and search activities;
- access and circulation roads;
- a ghost island junction on the access road to the site, which allows right turning traffic from the east to enter the site without blocking westbound traffic using Felixstowe Road;

- security fencing and lighting;
- ancillary buildings and structures including an amenity and welfare building, a security building, a security booth, a bus shelter, a smoking shelter and a shelter for cycle parking;
- other ancillary development, including signage, CCTV and utilities;
- three landscape bunds and additional planting;
- Up to four swales, including adjacent to the highway, and geo-cellular storage structures beneath two of the landscape bunds forming part of the sustainable drainage system (SuDS); and
- external areas including roadways and footways.

vii. Green rail route and other rail improvements

2.2.16. Under the freight management strategy, the green rail route (**Figure 2.8**) has been proposed which would provide a new rail route from Saxmundham Road to a new rail terminal in the Sizewell C main development site, totalling approximately 4.5km in length. This comprises a 1.8km section (approximately) from Saxmundham Road up to and including a temporary level crossing on the B1122 (Abbey Road) and the land required for the temporary construction compound required in association with the construction of this level crossing. The remainder of the green rail route forms part of the Sizewell C main development site.

2.2.17. In addition, proposed rail improvement works are required to the existing track and level crossings on the Saxmundham to Leiston branch in order to accommodate up to three freight trains (six movements) per day once the green rail route is operational.

2.3 Construction for the main platform area

2.3.1. Construction work for the main platform (the area within which the main construction activity would occur, and where the majority of permanent plant and buildings would be constructed, together with the foreshore works) is anticipated to be undertaken in five main phases, although these phases would overlap as work on different phases would be undertaken simultaneously in different areas across the main development site. The indicative construction timeline for the main development site works, along with the construction timeline for the associated development, is provided in **Plate 2.1**. Full construction details can be found in **Volume 2, Chapter 3** of the **ES** (Doc Ref. 6.3).

2.3.2. It has been assumed that works relating to the relocation of certain Sizewell B facilities would begin approximately two years prior to the start of Phase 1, pursuant to planning permission reference DC/19/1637/FUL issued by East Suffolk Council. These works are referred to later in this chapter as Phase 0.

2.3.3. Construction work for the main platform is expected to fall into five phases, as follows:

a) Phase 1 – Site establishment and preparation for earthworks.

2.3.4. Enabling works would take place prior to formal site establishment, including archaeological and protected species mitigation works (translocation of species such as reptiles and water voles, and related local habitat removal).

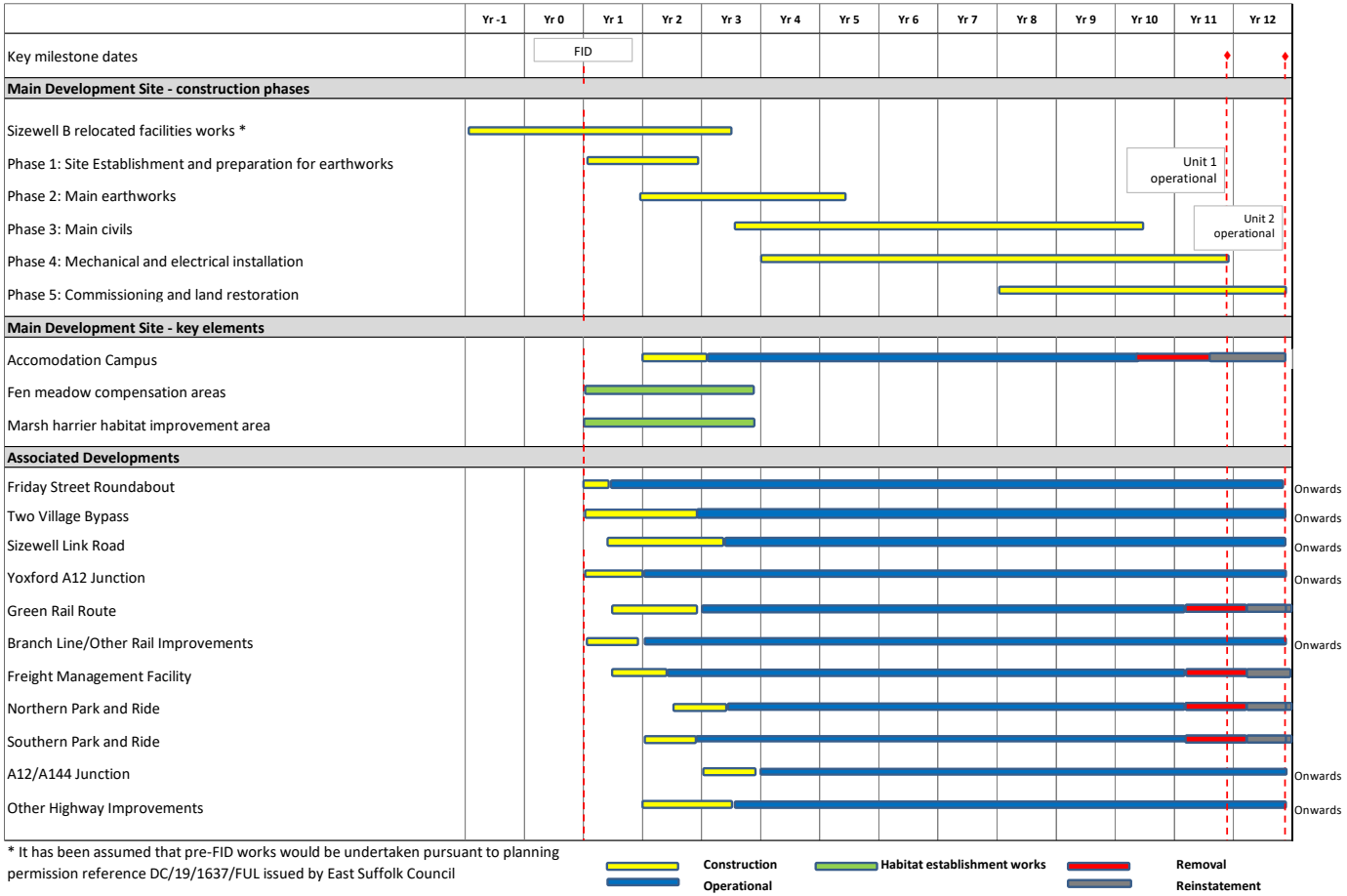
2.3.5. Construction work would then begin by securing the site through installation of fencing and site clearance, demolition of above and below ground structures and buildings and diversion of existing utilities as necessary.

2.3.6. Acoustic fences and earth bunds would be used, where necessary, to attenuate noise levels. Earth bunds would be grassed/seeded. Contractor compounds would be erected including welfare and office accommodation. Storage and handling areas, facilities for and equipment for processing of excavated materials and other temporary facilities, plant, cranes and machinery would also be provided.

2.3.7. The Sizewell Drain would be realigned to pass along the western edge of the main platform and connect to the Leiston Drain to the north. Water control features would be installed in the new drain to enable manipulation of the water levels within Sizewell Marshes SSSI.

2.3.8. The cut-off wall platform would be constructed around the perimeter of the location of the cut-off wall and would include a perimeter access corridor. There would be a retaining slope from the platform to the newly aligned Sizewell Drain.

Plate 2.1: Indicative construction timeline



* It has been assumed that pre-FID works would be undertaken pursuant to planning permission reference DC/19/1637/FUL issued by East Suffolk Council

2.3.9. A crossing would be constructed over Sizewell Marshes SSSI. This would comprise an embankment and culvert, with the culvert of sufficient dimensions to leave the bank and channel of the Leiston Drain intact.

2.3.10. A haul road would provide a dedicated route for heavy earthmoving plant from the main platform to the temporary construction area stockpiles. A segregated route would be provided for general site traffic.

2.3.11. Construction of the coastal defence structures would commence in this phase.

b) Phase 2 – main development site earthworks and completion of temporary infrastructure

2.3.12. Earthworks would commence alongside dewatering of the area within the cut-off wall area. Existing Made Ground and granular materials would be removed and transported to the stockpile areas within the temporary construction area.

2.3.13. Temporary facilities, plant, cranes, machinery and other temporary works would be required.

2.3.14. Work would commence to construct the marine launch chambers and bore the intake and outfall tunnels from within the main platform.

2.3.15. The BLF would be constructed, consisting of a piled platform, fenders (located at the seaward end), a ramp and mooring dolphins. Piling for dolphins would be carried out from a jack leg rig or barge. Localised dredging will be necessary prior to piling.

c) Phase 3 – Main civils.

2.3.16. The nuclear island buildings would be constructed with reinforced concrete. The concrete would be mixed using onsite batching plants in the temporary construction area.

2.3.17. The reactor building incorporates a steel liner which forms the inner shell of the building. Sections of the liner would be pre-fabricated within either the main platform or the temporary construction area and craned into position.

2.3.18. Concrete buildings within the conventional island would be constructed using similar methods to the nuclear island buildings.

2.3.19. Construction of pylons within the main platform would generally follow the same construction methodology as described below for National Grid pylons.

2.3.20. Temporary facilities, plant, cranes, machinery and other temporary works would be required.

d) Phase 4 – Mechanical and electrical installation.

2.3.21. Approximately 180 mechanical and electrical plant items (e.g. the reactor pressure vessels) would be AILs and may be shipped to the BLF during this phase.

2.3.22. The majority of mechanical and electrical activity would take place within the power station buildings.

2.3.23. Temporary facilities, plant, cranes, machinery and other temporary works would be required.

2.3.24. During Phase 4, the western part of the permanent sea defences would be constructed, involving the raising of the construction phase sea defence. This would be followed by the implementation of a landscape scheme to soften the visual appearance through planting and varying the backfilled height.

e) Phase 5 – Commissioning and land restoration.

2.3.25. Following completion of the works described above, temporary facilities on the main platform would be removed and the final surfacing would be undertaken as part of on-site hard landscaping.

2.4 Sizewell B relocated facilities and National Grid land

2.4.1. The Sizewell B relocated facilities and National Grid land is the area that certain Sizewell B facilities would be moved to in order to release other land for the proposed development, and land required for the National Grid transmission network.

2.4.2. A hybrid planning application for the relocation, demolition and replacement of a number of existing Sizewell B facilities (known as the Sizewell B relocated facilities works) was submitted to East Suffolk Council in April 2019 (application ref. DC/19/1637/FUL) and planning permission for these works was granted on 13 November 2019. A Shadow HRA Report was submitted with this application and is provided in **Appendix F** of this document.

2.4.3. As the Sizewell B relocated facilities works are critical elements to facilitate the construction of Sizewell C, the proposals for these facilities are also included in the application for development consent and have been considered to form part of the Sizewell C Project in this HRA. The Sizewell B relocated facilities works included within the DCO are the same as consented by ESC under the Town and Country Planning Act 1990. However, since the preparation of the Sizewell B relocated facilities HRA, two changes to the

design proposals have been made and are included within the DCO, as these formed planning conditions to the permission granted by ESC:

- A footpath between the proposed outage car park at Pillbox Field and Coronation Wood development area has been removed from the design to prevent loss of land within the Sizewell Marshes SSSI, which would have been required for the construction of the footpath.
- An alternative junction arrangement for outage car park access and Sizewell Gap road has been developed to minimise effects on road safety.

2.4.4. A full description of works required for Sizewell B relocated facilities is provided within **Appendix F** of this report. A summary of the works is also included below. For the purposes of this HRA, it has been assumed that the first phase of the Sizewell B relocated facilities works would be carried out in Phase 0 pursuant to the planning permission granted by East Suffolk Council. The second part of the Sizewell B relocated facilities works would be carried out pursuant to the DCO in Phases 1 and 2 in parallel with other DCO works due to take place at that time.

2.4.5. The works associated with Sizewell B relocated facilities include:

- During Phase 0:
  - Coronation Wood development area includes the western access road, training centre, laydown area and replacement car park;
  - Outage store to replace the existing general store within the Sizewell B power station complex;
  - Outage car park and associated access at Pillbox Field; and
  - Temporary relocation of the visitor centre to the existing technical training centre;
- During Phases 1 and 2:
  - Temporary modifications to Sizewell B site access;
  - Facilities in outline development zone (offices, canteen and welfare facilities) within the Sizewell B power station complex;
  - New visitor centre at Coronation Wood development area; and
  - Demolition of existing Sizewell B facilities.

2.4.6. Works within National Grid land would be undertaken during Phase 2 and comprise an extension of the existing National Grid 400kv substation and

overhead line realignment works, including the installation of a new pylon, modification of an existing pylon and the removal of an existing pylon.

2.5 Temporary construction area

2.5.1. The temporary construction area refers to the main area of land that would be required largely on a temporary basis to facilitate the construction of the proposed development. This land would primarily be located to the north of the Sizewell Marshes SSSI between the B1122 and the coast, to the north west of the main platform. The temporary construction area would comprise:

- Earthworks, excavation and site ground preparation works.
- Site hoardings (including perimeter enclosures and security fencing) and provision of construction and traffic signage and notices;
- Construction vehicle access routes and provision of temporary gated site accesses.
- Construction-related buildings, structures, facilities, plant, equipment, cranes and machinery.
- Construction services and utilities, including electricity, telecommunications, water and power supplies (including substations) and construction lighting.
- Landscaping, hard-standing areas and drainage works.
- Construction areas and compounds.
- Temporary crossing over Sizewell Marshes SSSI, prior to construction of a permanent crossing.
- Material management areas, including borrow pits and stockpiles.
- Common user facilities, including approximately six concrete batching plants; access and storage areas; logistical facilities, including waste handling areas; water treatment plants and water pumping stations; fabrication areas; and. pre-cast concrete production areas.
- Railway infrastructure including railway tracks, a terminal facility for offloading goods, railway sidings, a passing loop for locomotives and associated works.
- Temporary water resource storage area for the storage of non-potable water during the construction phase;

- Approximately 1,000 car parking spaces and approximately 75 Heavy Goods Vehicles (HGV) parking spaces at the temporary construction area;
- Accommodation campus, comprising: 3-storey and 4-storey residential buildings providing up to 2,400 bed spaces; non-residential welfare and recreation buildings; approximately 1,360 car parking spaces (including accessible spaces); 120 motorbike spaces, 120 pedal cycle spaces, plus a drop-off and pick-up area; and, associated plant and infrastructure.

2.5.2. The north-western area of the temporary construction site would be used to win aggregate in a series of borrow pits for use as engineering fill in the main development site and for subsequent stockpiling of construction spoil. In addition, the north-western area of the construction site, as well as the south-western area of the site, would similarly be used for stockpiling. The central area would be used for contractor's compounds, offices and welfare facilities, materials laydown and site infrastructure such as site roads and any railhead and sidings. The eastern area would also be used for compounds and may include a concrete batching plant.

2.5.3. A water resource storage area would be constructed, which is expected to provide a volume of less than 25,000m^3 of non-potable water at any one time. Water would be sourced from within the site without adversely affecting groundwater levels.

2.5.4. Construction works for the water resource storage area would take place at the earliest stage in the construction programme and during the winter months in order to minimise disturbance effects on foraging marsh harriers during their breeding season. A temporary construction compound area would be provided to the north. The water resource storage area site would be cleared and then excavated spoil would be transported to the stockpile areas already proposed within the temporary construction area.

2.5.5. Water from within the water resource storage area would be transported directly to the main development site via a trenched water supply pipe.

2.6 Land East of Eastlands Industrial Estate (LEEIE)

2.6.1. LEEIE, which includes land directly to the north of Sizewell Halt, would be used to support construction on the main platform and temporary construction area. This land is bounded to the north by Valley Road, to the east by Lover's Lane, to the south by Grimsey's Lane, and to the west by Eastlands Industrial Estate. The LEEIE would comprise:

- 400-pitch caravan park, including serviced plots and associated facilities for staff welfare and amenity.
- Vehicular accesses onto Lover's Lane, Valley Road and King Georges Avenue.
- Freight management facility, up to 80 HGV parking spaces and associated infrastructure.
- Park and ride facility including up to 500 car parking spaces and an associated bus parking and terminal area.

2.7 Offshore works area

2.7.1. The offshore works area is the area where offshore cooling water infrastructure, and other marine works would be located.

- Cooling water infrastructure

2.7.2. The cooling water tunnels would extend approximately 3km offshore and would be bored using tunnel boring machines at depths of approximately 30m under the seabed. Tunnelling would be a continuous activity requiring 24 hour working and preliminary estimates suggest this would take around 15 months to complete.

2.7.3. Connections between the intake and outfall structures and the bored tunnels would be made via lined vertical shafts bored from the seabed down to the tunnels. The shafts would be bored using a drilling technique and are likely to be undertaken from a jack-up rig.

2.7.4. The intake and outfall headworks would be prefabricated off-site and floated into position over the connecting shafts before being lowered into position.

- Fish recovery and return (FRR) systems

2.7.5. Two fish recovery and return (FRR) systems would be constructed, one for each reactor. The tunnels would be drilled beneath the seabed using a directional drilling technique, with arisings transported landward for disposal. The FRR systems would terminate in a seabed outfall structure approximately 300m offshore.

- Combined drainage outfall (CDO)

2.7.6. The CDO tunnels would be created using a directional drilling technique under the foreshore and seabed, with arisings transported landward for disposal. Two individual tunnels would connect and terminate in a CDO structure approximately 300m offshore.

- Dredging and disposal

2.7.7. To accommodate the safe passage of barges and accompanying tugs to the BLF, a navigational channel, and grounding area would be required in the nearshore zone occupied by the two longshore bars. Dredging would only be needed in periods when the BLF is in use.

2.7.8. Plough dredging would be used to create a planar surface for the barges to come aground. An approximately 62m wide navigational channel and grounding pocket would be profiled within the shallow subtidal zone (less than 6m water depth). Plough dredging agitates the sediment, which is then transported away by the tide.

2.7.9. Dredging would be conducted over an area of approximately 1ha, to a depth greater than 0.5m below the sediment surface.

2.7.10. The frequency of maintenance dredging would depend on the specific tolerance of the barges to the substrate profile and seasonal infilling rates. Maintenance dredging is anticipated at least annually due to infilling during winter periods, but may also be required following storm events.

2.7.11. A cutter suction dredger would be required for the FRR, cooling water system intake and outfall tunnels and CDO.

2.7.12. The anticipated total volume of dredging during construction is approximately 110,000m^3.

2.8 Operation

2.8.1. The expected net electrical output of Sizewell C would be approximately 1,670 megawatts (MW) per UK EPR™ reactor unit, giving a total site capacity of approximately 3,340MW.

2.8.2. Sizewell C is planned to operate for 60 years and it is expected that approximately 900 staff would be employed during normal operations. Sizewell C is designed to operate continuously 24 hours a day, save for routine maintenance outages. Therefore, access would be required to the site and facilities at all times.

2.8.3. On average, 1,000 additional staff would be employed during planned refuelling and maintenance shutdowns (known as 'outages'), which are expected to take place approximately every 18 months for each UK EPR™ unit. The length of these outages would vary according to the maintenance and inspections required, but typically would be up to two months in duration and may require 24-hour working.

2.8.4. Further details on the operation of Sizewell C nuclear power station are included in **Volume 2, Chapter 4** of the **ES** (Doc Ref. 6.3).

2.9 Decommissioning

2.9.1. As set out above, it is planned that Sizewell C would operate for 60 years. At the end of that period, unless any operational extension is consented, the site would be decommissioned. Decommissioning is a process governed by the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (as amended) and the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) and requires consent from the Office for Nuclear Regulation (ONR) before it can take place. This consenting process would include a period of public consultation.

2.9.2. The UK EPR™ has been designed with decommissioning in mind, enabling radioactive waste quantities to be limited when decommissioning takes place. Through decommissioning, most of the site would be cleared and released for other uses. The interim spent fuel store would continue to operate until a UK Geological Disposal Facility is available and the spent fuel is ready for disposal.

2.9.3. SZC Co. has a decommissioning strategy and decommissioning plan in place which make assumptions regarding techniques to be employed during decommissioning.

2.10 Project parameters

2.10.1. As outlined in **Volume 1, Chapter 2** of the **ES** (Doc Ref. 6.2), the approach adopted for the design and construction of Sizewell C Project (both the main development site and associated development sites) is to set parameters, where necessary, for the extent of development and key aspects of that development. The final design and construction methodology would be limited to these parameters and limits of deviation.

2.10.2. Full details of the parameters and plans used for the Sizewell C Project assessments are provided in the **ES** chapter(s) referred to in sections 2.2 to 2.8 of this report above and in **Table 2.1**.

Table 2.1: Detailed plans describing the project

Project Element	Document Reference
Main development site	Doc Ref. 2.5
Northern Park and Ride	Doc Ref. 2.6
Southern Park and Ride	Doc Ref. 2.7

Project Element	Document Reference
Two Village Bypass	Doc Ref. 2.8
Yoxford Roundabout and Other Highway Improvements	Doc Ref. 2.9
Sizewell Link Road	Doc Ref. 2.10
Freight Management Facility	Doc Ref. 2.11
Rail plans	Doc Ref. 2.12

2.11 Scenarios assessed in the Shadow HRA

2.11.1. The Shadow HRA assesses the project as described above and within the ES chapters referenced in sections 2.2 to 2.8 of this report. Further details of the viable worst-case scenarios assessed in sections 7 to 10 of the Shadow HRA (e.g. construction noise and the thermal plume) are presented in **Table 2.2**.

2.11.2. **Table 2.2** is intended to clarify the basis upon which the assessment presented in the Shadow HRA has been undertaken (noting that there are also the assessed scenarios for the Environmental Impact Assessment (EIA)).

Table 2.2: Scenarios assessed in the Shadow HRA

Predicted Effects	Assessed Scenarios
Discharge to the marine environment	
Effect due to treated sewage (construction)	Estimated average discharge rate of 13.3 ls^{-1} and potential maximum of 30 $ls^{-1.}$
Effect due to discharge of concrete wash water (construction)	Daily volumes up to 10 m^3 a day (0.1 ls^{-1}).
Effect due to discharge of metals (construction)	Discharge rate of 124 ls^{-1} or 446 m^3hr^{-1} over a 28-day period.
Effect due to discharge chemical plume (operation)	TRO/bromoform – 132 m^3s^{-1} discharge scenario. Hydrazine – 69 ng discharge scenario.
Effect due to an increase in water temperature (operation)	Excess temperatures would arise from 11.6°C to 23.2°C.
Effects due to discharge of groundwater via the CDO	Estimated discharge rate of 124 ls^{-1} or 446 m^3hr^{-1} over a 28-day period. For the remainder of the construction period, groundwater dewatering is estimated to occur at a rate of 15 ls^{-1} or 54 m^3hr^{-1}.

Predicted Effects	Assessed Scenarios
Operational abstraction	
Impingement/entrainment/entrapment effects from marine water abstraction (operation)	Intakes would abstract water at a rate of ca. 132 m^3s^{-1} (66 m^3s^{-1} per tunnel).
Dredging / drilling	
Alteration of coastal processes / sediment transport due to navigational dredging	Dredging over longshore bars would be required for the approach to the BLF (less than 0.5 m) and the barge grounding pocket (0 – 1.9 m).
Alteration of coastal processes / sediment transport due to dredging for offshore cooling water infrastructure	The spatial extent of the dredge would be 7.4 ha for the two outfalls, and 20 ha for the four intakes.
Alteration of coastal processes / sediment transport due to drilling of connection shafts to headworks for offshore cooling water infrastructure	Drilling seabed area would be 402 m^2 for the two outfalls and 1016 m^2 for the four intakes.
Emissions to air	
Effects on habitats due to emissions to air	Commissioning and operating scenarios for the main development site combustion plant comprise: • Commissioning of EPR™ Unit 1 and Unit 2 (hourly and annual scenarios), including undertaking testing for a loss of off-site power event. • Routine testing during operation (hourly and annual scenarios). • A loss of off-site power event (this represents emergency back-up operation and, therefore, would only generate short-term (hourly) impacts).
Noise	
Effects on marine mammals due to noise generated by piling	• A maximum hammer energy of 90 kJ (however, to allow for engineering flexibility, a worst-case scenario is also considered, with a hammer strike energy assumption of 200 kJ). • Pile strike rate of 46 strikes per minute. • A total of approximately 1,500 strikes per pile. • A total piling time of 33 minutes per pile. • Maximum pile diameter of 1m for the BLF piles and 1.52m for the dolphins. • A maximum of five piles to be installed within any 24-hour period.

Predicted Effects	Assessed Scenarios
Effects on birds due to construction noise	• Construction noise is modelled separately for the five phases of the construction period. Modelling uses the peak noise levels (as defined by L_{Amax}) and so represents the highest levels which might occur for a fraction of a second during the noisiest component of an activity. • For each construction phase, the modelling outputs show the predicted worst-case for the entire duration of that phase, as determined from the activities occurring at some point during the full duration of this phase (but which, in reality, would not necessarily occur simultaneously). Therefore, the noise emissions predicted for each phase are likely to be overestimates (and hence precautionary), whilst the duration of the worst-case scenario would not extend over the entire phase. • The assessments of noise disturbance on Special Protection Areas (SPA) and Ramsar bird populations are based upon the phase of the construction period for which the predicted noise levels are greatest, so (again) represent a worst-case scenario.
Recreational use	
Effect of the construction phase on the recreational use of Sizewell beach and other European sites	At peak construction the Sizewell C Project workforce is anticipated to be approximately 7,900. This figure comprises, 2,016 ‘home based’ workers and 5,884 ‘non-home based’ workers. In addition, all 600 associated development workers are assumed to be ‘home based’.

3 The Habitats Regulations Assessment Process

3.1 Introduction

3.1.1. This section provides details of the principles of the HRA process (**sections 3.2** to **3.5** of this report) and describes the approach adopted by SZC Co. to the Shadow HRA, including the Evidence Plan process (**section 3.6** of this report).

3.2 The HRA Process

a) The Directives and Regulations

3.2.1. European Union (EU) obligations in respect of habitats and species are met through Council Directive 92/43/EEC (the Habitats Directive) on the conservation of natural habitats and of wild fauna and flora, which requires Member States to schedule important wildlife sites through the European Community as Special Areas of Conservation (SACs) and to give protection to habitats and species listed in the Directive as being threatened or of Community Interest.

3.2.2. The EU meets its obligations for birds through Directive 2009/147/EC (the Birds Directive) on the conservation of wild birds. This provides a framework for the conservation and management of wild birds in Europe through the designation of SPAs. Of particular relevance is the requirement to identify and designate SPAs for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species, paying particular attention to the protection of wetlands of international importance. Together with other Sites of Community Importance (SCIs)[3], SACs and SPAs form a network of protected areas known as *Natura 2000*.

3.2.3. Under planning policy in England (Ref. 3.1 – paragraph 118 of the National Planning Policy Framework), internationally designated Ramsar sites[4] are to be treated in the same way as European sites in terms of HRA. For the purposes of this report, 'European sites' is taken to include Ramsar sites along with SACs and SPAs.

3.2.4. The Habitats Directive is transposed into UK law by the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations') and the Conservation of Offshore Marine Habitats and Species Regulations 2017

[3] For example, candidate SACs or proposed SPAs.
[4] Sites listed under '*The Convention on Wetlands of International Importance, especially as Waterfowl Habitat*', (Ramsar, Iran, 1971).

(the 'Offshore Habitats Regulations')[5]. The Habitats Regulations incorporate all SPAs into the definition of European sites and, consequently, the protections afforded to European sites under the Habitats Directive apply to SPAs designated under the Birds Directive.

3.2.5. The HRA process helps meet the requirements of Article 6(3) of the Habitats Directive (replicated in Regulation 63(1) of the Habitats Regulations) which states that any plan or project, which is not directly connected with or necessary to the management of an European site, but would be likely to have a significant effect on such a site, either on its own or in-combination with other plans or projects, will be subject to an Appropriate Assessment of its implications for the European site in view of the site's 'conservation objectives'.

3.2.6. Subject to the provisions of Article 6(4) of the Habitats Directive, the 'competent authority' will agree to the plan or project only having ascertained that it will not adversely affect the integrity of the European site(s) concerned.

b) A four-stage process

3.2.7. The HRA process typically follows a four-staged approach, as detailed in Advice Note 10 (Ref. 3.2):

- Screening: The process of identifying potentially relevant European sites, and whether the proposed project is likely to have a significant effect on the qualifying interest features of the European site, either alone or in-combination with other plans and projects. If it is concluded at this stage that there is no potential for likely significant effects, there is no requirement to carry out subsequent stages of the HRA.
- Appropriate Assessment: Where a likely significant effect for a European site(s) cannot be ruled out, either alone or in-combination with other plans and projects, assessment of the potential effects of the project on the integrity of the European site(s), in view of its qualifying interest features and associated conservation objectives, is required. Where it is concluded that there would be an adverse effect on site integrity (or where such an effect cannot be discounted) an assessment of mitigation options is carried out and mitigation measures (where available) are proposed to address the effects. If, having considered mitigation, the potential for adverse effects on integrity remains, the HRA must progress to Stages 3 and 4.
- Assessment of Alternative Solutions: Identifying and examining alternative ways of achieving the objectives of the project to establish

[5] The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 came into force on 31 January 2020. These Regulations have no material effect on the HRA process as applied to the Sizewell C Project.

whether there are solutions that would avoid, or have a lesser effect, on the European site(s).

- IROPI: Where no alternative solution exists, the next stage of the process is to assess whether the project is necessary for IROPI and, if so, the identification of compensatory measures needed to maintain the overall coherence of the *Natura 2000* network.

3.3 Stage 1 likely significant effect screening

3.3.1. In respect of Stage 1 (screening), a recent ruling (April 2018) by the Court of Justice of the European Union (CJEU) referred to as *People Over Wind and Sweetman v Coillte Teoranta* (C-323/17 – Ref. 3.3) provided *"…it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site".*

3.3.2. In the context of this Shadow HRA Report, the phrase *"…measures intended to avoid or reduce the harmful effects..."* is interpreted as meaning any mitigation measures. This does not mean measures that are an integral part of the Sizewell C Project design (and thereby are not mitigation). As such, no mitigation measures were taken into account when undertaking the likely significant effect screening exercise.

3.3.3. There is no explicit definition of likely significant effect in the legislation and in the context of HRA it is typically taken as any effect that may reasonably be predicted as a consequence of the project that may significantly adversely affect the conservation or management objectives of the features for which a site was designated, excluding trivial or inconsequential effects (Ref. 3.4). That is, the term 'likely' infers the presence of a risk that a significant effect could occur. By definition, this assessment is based on the consideration of a number of factors, for example, the spatial extent and duration of an identified effect, and other considerations such as the availability of appropriate mitigation. When considering such effects, a precautionary approach is adopted.

3.3.4. The conservation status of a natural habitat, as defined in the Habitats Directive, means the *"sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2"*. The conservation objectives for a SAC or SPA are considered when identifying likely significant effects. The conservation status of a natural habitat is taken as 'favourable' when:

- its natural range and the area it covers within that range is stable or increasing;

- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
- the conservation status of its typical species is favourable.

3.3.5. In general, according to the Planning Inspectorate's Advice Note 10 (Ref. 3.2), if a large amount of evidence and data gathering is necessary to determine likely significant effect, it is assumed that a likely significant effect could arise and an Appropriate Assessment is required.

3.3.6. According to the *Waddenzee judgement* (Judgement of 7.9.2004 – Case C -127/02 – Ref. 3.5) (paragraph 45) an Appropriate Assessment will be required if a likely significant effect cannot be excluded on the basis of objective information (paragraph 45) and where the plan or project is likely to undermine the site's conservation objectives, the assessment of that risk must be made in the light inter alia of the characteristics and specific environmental conditions of the site concerned by such a plan or project (paragraph 49). The *Sweetman opinion* (Opinion of Advocate General 22.10.2012 – Case C-258/11 – Ref. 3.6) states that the question of whether an Appropriate Assessment should be carried out is simply whether the plan or project concerned is *capable* of having a significant effect (paragraphs 46-47).

3.3.7. In addition to screening, although not referred to in the Habitats Directive or national legislation, it is becoming common practice for very large developments to undertake a pre-screening site selection exercise in order to identify the European sites and the qualifying interest features to be taken forward into the screening stage; referred to as 'scoping' (see section 4 of this report). This step has been undertaken by SZC Co. during both production of the HRA Evidence Plan (Ref. 3.7) and to incorporate recent developments in practice or updates to the status/number of relevant European sites since the Evidence Plan was published.

3.4 Stage 2 Appropriate Assessment

a) Introduction

3.4.1. In respect of Stage 2 (the Appropriate Assessment), the integrity of a European site is defined as "*the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated*" (Ref. 3.8). An adverse effect on integrity, therefore, is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation.

3.4.2. Furthermore, the *Kilkenny judgement* (Judgement of 7.11.2018 – Case C-461/17 paragraph 40 – Ref. 3.9) states that an Appropriate Assessment must identify and examine the implications of the proposed project for species present in a European site, including species for which the site has been listed and those for which it has not, provided those implications are liable to affect the conservation objectives of the site. It further states that an Appropriate Assessment must identify and examine the implications of the proposed project for species and habitats outside the boundaries of the European site in question, again, provided that those implications are liable to affect the conservation objectives of the site.

b) Alone and in-combination

3.4.3. Regulation 63 of the Habitats Regulations requires the competent authority to make an Appropriate Assessment of any plan or project which is likely to have a significant effect on a European site, either alone or in-combination with other plans or projects. In line with the Habitats Regulations, the term 'in-combination' is used herein to describe the interactions of within-project activities and the potential for the Sizewell C Project (as a whole) to interact with other (non-SZC Co.) plans and projects.

i. Alone assessment

3.4.4. The approach taken to the assessment of the effects of the Sizewell C Project on European sites and mobile species has included:

- Collection of extensive baseline environmental information over a number of years through survey and other research and information gathering work. This work is critical to understanding how cause and effect pathways may link to receptors.
- Liaison with the HRA Working Group (see section 3.6 of this report), including on the methodology to be adopted for the HRA alone and in-combination assessments.
- Technical liaison with the team preparing the EIA to support the DCO to share knowledge in respect of key HRA topic areas, such as the marine environment (benthic ecology, marine mammals and fish), coastal birds and noise.
- Technical workshops relating to coastal process modelling outcomes; marine and fresh (surface and ground) water flows, levels and quality; predicted effects on fish and birds; noise and disturbance; and air quality.
- Production of technical reports, notes and mock assessments on subject matters that are central to the HRA, such as recreational

disturbance, marsh harrier, red-throated diver and the response of prey species to thermal and chemical plumes.

- Scoping of European sites and likely significant effect screening for those European sites and qualifying interest features scoped in to the assessment.

3.4.5. For the alone assessment, the Shadow HRA considers all potential cause and effect pathways between the Sizewell C Project in its entirety (i.e. the main development site, associated development sites and relevant transport routes) and the relevant qualifying interest features of screened in European sites, including potential effects on:

- habitats, vegetation, invertebrates and mobile species – qualifying interest features of SACs and Ramsar sites (not also designated as SPAs);
- birds – qualifying interest features of SPAs and Ramsar sites, including rare and vulnerable birds (as listed on Annex I of the Birds Directive), regularly occurring migratory species and species forming designated assemblages (including those species that are designated as a feature of an SPA or Ramsar site and that may be affected outside of the boundaries of a European site); and
- supporting species and habitats – in those cases where there are potential effects on qualifying interest features through indirect effects (e.g. prey species).

Assessment of effects: construction and operation

3.4.6. The approach taken to the assessment varies based on the nature of the interest feature (habitats, birds, marine mammals and fish) and is detailed in sections 7 to 10 of this report. The shadow Appropriate Assessment has focused primarily on assessing the implications of the construction and operation phases of the Sizewell C Project.

Assessment of effects: decommissioning

3.4.7. It is recognised that the HRA also needs to consider the potential effects of the decommissioning phase.

3.4.8. SZC Co. has a decommissioning strategy and decommissioning plan in place which make assumptions regarding techniques to be employed during decommissioning. However, the detail of the working methods to be adopted and the nature of the baseline environment conditions at the time of decommissioning are currently unknown. The lack of detail available at this stage on the activities to be undertaken during decommissioning means that

the assessment of potential effects can only be undertaken based on a set of assumptions about the extent of the works required and controls (risk management and mitigation measures) that would be in place at the time.

3.4.9. On a precautionary basis, for the purposes of likely significant effect screening and the Appropriate Assessment, it has been assumed that the predicted effects associated with the decommissioning phase would be similar to those of the construction phase. A further (reasonable) assumption is that the potential effects of construction would be 'bounding' (i.e. decommissioning phase effects would be within the envelope of potential effects associated with construction).

3.4.10. Significantly, however, new consents, permits and licences would be required for decommissioning and this phase of the Sizewell C Project would be subject to its own regulatory control (see section 2.9 of this report).

ii. In-combination assessment

3.4.11. For each European site (and combination of potential effects and qualifying interest features) considered, alone assessment is followed by in-combination assessment, before a conclusion is reached regarding the combined implications of the Sizewell C Project for the integrity of the site. The following text sets out at a high level the approach taken to the in-combination assessment of the activities covered by the DCO and the other plans and projects considered within the HRA process; including their identification.

Rationale for identifying other plans and projects

3.4.12. The approach taken to the identification of non-Sizewell C Project plans and projects is based upon the advice provided by the Department for Communities and Local Government (Ref. 3.10), which states:

> *"In most cases, detailed consideration of the combined effects of the development proposed together with other developments will be limited to those others that are already begun or constructed [present and past] or those that have not been commenced but have a valid planning permission [reasonably foreseeable].*
>
> *Often, future developments in the vicinity of a project site will be included in the baseline scenario as 'committed development'. But in the context of EIA the term 'committed development' conventionally refers to development for which consent has been granted."*

3.4.13. Whilst there is no legal definition of what constitutes a plan or project for the purposes of the Habitats Regulations, PINS Advice Note 10 (Ref. 3.2) advises that the following should be taken into account:

- projects that are under construction;
- permitted application(s) not yet implemented;
- submitted application(s) not yet determined;
- all refusals subject to appeal procedures not yet determined;
- projects on the national infrastructure's programme of projects; and
- projects identified in the relevant development plan (and emerging development plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.

Over-lapping and discrete effects

3.4.14. Spatially, in-combination assessment takes account of effects that are over-lapping (i.e. a spatial interaction exists and the effects from two or more plans and projects will coincide) as well as discrete; that is, in the context of the Habitats Regulations in-combination effects can include the effects of different plans and projects on the same habitat/species, at different locations within a European site (e.g. loss the same habitat at disparate locations).

3.4.15. In respect of temporal effects, some of these may be of a short-term nature and would, from an ecological perspective, represent 'pulse' type disturbances that have no long-term effect. However, it is possible that such short-term effects could be significant and, consequently, they have been assessed accordingly. Other effects may be of a long-term nature and, even when the activity causing the identified impact ceases, the ecological response may still be manifest in the system (e.g. recovery of some species communities from disturbance/damage).

3.4.16. With specific regard to air quality, a recent judgement by the High Court 'Wealden v SSCLG [2017] EWHC 351 (Admin)', commonly referred to as the *Wealden judgement'* (Ref. 3.11), means that the potential effects on air quality from a plan or project must be considered in any in-combination assessment, even if the plan or project in question is unlikely to give rise to a likely significant effect in isolation. Where a development is below the screening threshold alone, i.e. less than 1000 annual average daily traffic flow or less than 1%, the threshold must be applied in-combination with emissions from other plans and projects. As such, the air quality modelling and assessment which underpins this Shadow HRA Report has been undertaken with full consideration of the implications of the *Wealden judgement*.

Past projects

3.4.17. With respect to 'past' projects, a useful ground rule in in-combination assessment is that the environmental effects of schemes that have been completed should be included within the environmental baseline (and hence implicitly taken account of in the HRA process). Consequently, completed projects are excluded from the scope of in-combination assessment. However, it is acknowledged that the environmental effects of recently completed projects may not be fully manifested and that these effects need to be taken into account in the assessment. For the purposes of this in-combination assessment, the effects and influences of Sizewell A and Sizewell B have been taken to be included within the environmental baseline.

3.4.18. In the event that 'past' projects refer to past consents not yet implemented (for example), these have been considered as part of the in-combination assessment.

Current projects

3.4.19. Projects that are currently being constructed ('present' projects) or that are in the planning process (where sufficient information is publicly available), as well as ongoing activities that have the potential to influence the same environmental parameters as the Sizewell C Project, are the focus of in-combination assessment. Where such data are available, quantitative assessment of likely effects and their significance has been undertaken. More weight is given to those projects that are at a more advanced stage in the planning process, as more confidence accompanies the assessment of potential combined effects.

Future plans and projects

3.4.20. Future plans or projects for which sufficient information is available (i.e. 'reasonably foreseeable' projects) have been considered as part of the in-combination assessment. Future plans or projects for which sufficient information is not available on which to base a reliable assessment, which are unlikely to be submitted or receive consent until after the proposed development has been completed, cannot reasonably be assessed as part of an in-combination assessment. However, the applicants for such projects will be required to take the effect of the Sizewell C Project into account in their own application.

3.4.21. In the absence of publicly available data, it is not possible to undertake a detailed in-combination assessment, but it is possible to make judgements regarding potential impacts on the basis of the characteristics of the other projects being considered (where these are known) and whether there is the potential for the effects of the various projects to interact spatially and

temporally. It is not appropriate to consider worst-case scenarios in this context, as this would introduce the risk that the assessment would become over precautionary and unrealistic.

3.4.22. In-combination assessment has been undertaken with respect to relevant current and future plans and projects for the construction and operation phases of the Sizewell C Project. In-combination assessment cannot be undertaken with any validity for the decommissioning phase (see above).

3.5 Stages 3 and 4

3.5.1. Following an Appropriate Assessment, where a risk to the integrity of the European site is identified, it must then be considered (at Stage 3) whether any 'alternative solutions' exist that would be capable of delivering the same overall objective as the original proposal in a way that would not adversely affect the integrity of a European site. If such an alternative is identified, then it should be pursued. If such an alternative is not identified, then the competent authority must consider whether the plan or project, in spite of a negative assessment of the implications for the European site, must nevertheless be undertaken for IROPI) (Stage 4).

3.5.2. Furthermore, if IROPI can be demonstrated, for the project to proceed 'compensatory measures' necessary to ensure that the overall coherence of *Natura 2000* is protected will need to be implemented. Therefore, following the demonstration of IROPI in Stage 4, compensatory measures must be demonstrated to be available and deliverable.

3.6 Evidence Plan

3.6.1. When the Sizewell C Project Shadow HRA process was initiated, the Evidence Plan process was a relatively new, voluntary mechanism to establish, upfront, the evidence that an applicant should provide for HRA. This process was adopted by SZC Co. and comprises four stages (Stages 1 and 2 were completed in 2014 and, in conjunction with this, Stage 3 Topic Group meetings were held):

- Evidence Plan Stage 1 - Applicant registers a request with the Major Infrastructure and Environment Unit[6] to prepare an Evidence Plan.
- Evidence Plan Stage 2 - Preparation of the Evidence Plan; including European site scoping.
- Evidence Plan Stage 3 - Topic group meetings and draft likely significant effect screening.

[6] This unit has since been disbanded.

- Evidence Plan Stage 4 - Topic group meetings, focussing on aspects of the draft Appropriate Assessment for which information was available at the time of the meetings.

3.6.2. The EDF Energy Sizewell C Project HRA Evidence Plan (EDF Energy, 2014):

- defined the roles and responsibilities of and working arrangements for EDF Energy and participating technical stakeholders;
- set out the scope of cause-effect pathways to be considered at the likely significant effect screening stage based on best-available project and environmental information;
- helped to ensure that evidence gathering focused on areas of likely significant effect;
- outlined the types of evidence that needed to be provided;
- defined and programmed a series of technical workshops for more detailed consideration of evidence requirements, outputs and impact assessments;
- set out some of the important aspects, considerations and methodologies for the HRA (e.g. determination of likely significant effects, the methodology for in-combination assessment and the process of change management); and
- defined potential impact pathways based on envisaged effects for all European sites scoped into the process (i.e. green – no impact pathway; amber – weak impact pathway; red – moderate or strong impact pathway).

3.6.3. The Evidence Plan was prepared following consultation and agreement with a Working Group that included:

- the Major Infrastructure and Environment Unit – which maintained oversight of the process and acted as a facilitator;
- Natural England - the lead Statutory Nature Conservation Body for agreement of the Evidence Plan and provision of specialist technical advice during its implementation;
- the Environment Agency – which provided advice and input into the Evidence Plan process (as the competent authority for the Environmental Permit applications);
- The Planning Inspectorate – which maintained a watching brief;

- the MMO – which maintained a watching brief regarding effects on the marine environment;
- Suffolk Coastal District Council (SCDC; now known as East Suffolk[7]);
- Suffolk County Council (SCC);
- Suffolk Wildlife Trust (SWT); and
- the Royal Society for the Protection of Birds (RSPB).

3.6.4. The Evidence Plan Steering Group constituted SZC Co, Major Infrastructure and Environment Unit, Natural England, the Environment Agency and the Planning Inspectorate. East Suffolk, SCC, SWT and the RSPB offered expert views on the process and made available local knowledge and expertise in the context of the agreed risk-based approach.

3.6.5. The HRA Working Group was reconvened in January 2019 and consulted on the draft Stage 1 HRA screening assessment (including screening matrices in the format as required by the Planning Inspectorate). Written responses were received from Natural England, the Environment Agency, the RSPB, SWT and the MMO by the end of February 2019 and those relevant to the scoping and screening exercises are summarised in **Table 3.1**. These comments have been taken into account in the Shadow HRA.

Table 3.1: Summary of comments relevant to scoping and screening of European sites

Organisation	Summary Of Comment (Relevant To Scoping And Screening Exercises)
RSPB	Agree with the list of sites scoped in to the assessment, based on the information provided about the project at this stage. Agree with the categories of [screening] effects, based on the information provided about the project at this stage.
SWT	A number of specific comments related to the pathways for likely significant effects identified in the screening matrices for some SACs, but which were relevant to the Appropriate Assessment and taken into account as appropriate.
Natural England	Advised that marine mammal qualifying interest features of The Wash and North Norfolk Coast SAC and The Humber SAC should be screened in. The Stour and Orwell Estuaries SPA and Ramsar site should therefore be scoped in and assessed further within the screening matrices with respect to the potential effects of the freight management facility.

[7] On 1 April 2019, East Suffolk was created, covering the former districts of Suffolk Coastal District Council and Waveney District Council.

Organisation	Summary Of Comment (Relevant To Scoping And Screening Exercises)
	Potential effect of the two village bypass on the Alde-Ore Estuary SAC, SPA and Ramsar site should be considered. Potential effect of the northern park and ride on Dew's Pond SAC to be considered. A number of comments on pathways identified in the screening matrices and the evidence supporting the screening conclusions.
Environment Agency	Requested clarity and evidence regarding whether the Deben SPA and Stour and Orwell SPA sites should be scoped in or out for HRA with respect to associated development sites. With regard to marine mammals, ensure mobile species that could have functionally linked are considered within the assessment. A number of comments on pathways identified in the screening matrices and the evidence supporting the screening conclusions.
MMO	Further sites should be scoped into the HRA due to the potential impacts on their mobile species (such as marine mammals or sea birds). The Wash and North Norfolk Coast SAC and The Humber Estuary SAC in particular should both be scoped in to consider potential impacts on harbour seals and grey seals respectively A number of comments on pathways identified in the screening matrices and the evidence supporting the screening conclusions.

3.6.6. A meeting of the HRA Working Group was also held on 4th March 2019 in Leiston and attended by representatives of the following Working Group members[8]:

- Natural England;
- the Environment Agency;
- East Suffolk;
- SCC;
- SWT; and
- the RSPB.

3.6.7. All written and verbal comments were collated into a tracking spreadsheet and circulated to the Working Group members as a record of how their comments have been addressed within the HRA process for the Sizewell C Project.

[8] A separate consultation meeting was held with the MMO in Newcastle-upon-Tyne on 26th February 2019.

Following this consultation exercise, the likely significant effect screening matrices were updated. The HRA scoping and screening processes are discussed in greater detail in sections 4 and 5 of this report.

4 Scoping of European Sites

4.1 Background to European site scoping

a) The Nuclear National Policy Statement European site scoping

4.1.1. Sizewell C was nominated by EDF Energy as part of the Government's site selection process for new nuclear build in 2009 and was identified as a site for new development in the original Nuclear National Policy Statement (NPS) (Ref. 4.1), ratified by the Government on the 19th July 2011.

4.1.2. Nominated sites were assessed for their potential to affect European sites and, where applicable (including for Sizewell C), strategic site-based HRAs were undertaken (Ref. 4.2). The approach taken in the strategic HRAs to 'scoping' was to start by considering all European sites within a 20km range of the envisaged location of the development sites (i.e. for Sizewell C, those European sites listed in **Table 4.1**). This area of search was chosen as it reflected guidance recommendations at the time (Ref. 4.3), but distance is (in itself) not a definitive guide to the likelihood or potential cause-effect impact pathways.

Table 4.1: European sites present within 20km of the proposed Sizewell C new nuclear development (Ref. 4.2)

Site Name	Designation	Proximity To The Sizewell Site
Alde-Ore and Butley Estuaries	SAC	5km
Alde-Ore Estuary	SPA	5km
Alde-Ore Estuary	Ramsar	5km
Benacre to Easton Bavents Lagoons	SAC	15.5km
Benacre to Easton Bavents	SPA	15km
Dew's Ponds	SAC	9km
Minsmere to Walberswick Heaths and Marshes	SAC	Adjacent
Minsmere-Walberswick	SPA	Adjacent
Minsmere-Walberswick	Ramsar	Adjacent
Orfordness-Shingle Street	SAC	8km
Outer Thames Estuary	SPA	Main development site and adjacent

Site Name	Designation	Proximity To The Sizewell Site
Staverton Park and the Thicks, Wantisden	SAC	15.5km
Sandlings	SPA	0.7km

4.1.3. Some of these sites were subsequently included in the NPS HRA for Sizewell C (see **Table 4.2**), while other sites were screened out of the strategic HRA process (see **Table 4.3**) because, at that time, there were no identified significant potential cause-effect impact pathways (Ref. 4.2).

Table 4.2: European sites present within 20km of the proposed Sizewell C new nuclear development screened into the NPS HRA (Ref. 4.2)

Site Name	Designation	Proximity To The Sizewell Site
Alde-Ore and Butley Estuaries	SAC	5km
Alde-Ore Estuary	SPA	5km
Alde-Ore Estuary	Ramsar	5km
Minsmere to Walberswick Heaths and Marshes	SAC	Adjacent
Minsmere-Walberswick	SPA	Adjacent
Minsmere-Walberswick	Ramsar	Adjacent
Orfordness-Shingle Street	SAC	8km
Outer Thames Estuary	SPA	Main development site and adjacent
Sandlings	SPA	0.7km

Table 4.3: European sites present within 20km of the proposed Sizewell C new nuclear development screened out of the NPS HRA (Ref. 4.2)

Site Name	Designation	Proximity To The Sizewell Site
Benacre to Easton Bavents Lagoons	SAC	15.5km
Benacre to Easton Bavents	SPA	15km
Dew's Ponds	SAC	9km
Staverton Park and the Thicks, Wantisden	SAC	15.5km

4.2 EDF Energy's European site scoping

a) Identification of cause-effect pathways and European site scoping: 2012-2014

4.2.1. EDF Energy first undertook its own scoping exercise in 2012 and, although the NPS HRA for Sizewell C (Ref. 4.2) screened out some European sites (**Table 4.3**), on the advice of the Evidence Plan Working Group these European sites were included in EDF Energy's scoping process. This exercise benefited from more project information than was available for the strategic NPS HRA, although (in 2012) this information was still at a relatively high level.

4.2.2. The scoping exercise evolved as further detail on the Sizewell C Project became available and, in 2014, the assessment included a number of new cause and effect pathways not considered in the NPS HRA and deselected some of the more tenuous cause and effect relationships discussed in the NPS HRA (based on further project information). For example, potential cooling water effects on the Sandlings SPA and physical effects associated with algal blooms affecting vegetated shingle.

4.2.3. In addition, the 2014 scoping exercise identified a number of additional European sites where activities associated with proposed associated development potentially could have affected European site qualifying interest features (e.g. a possible park and ride scheme at Woodbridge and the possibility that construction materials and AILs could be transported via vessels using port facilities at Ipswich and/or Lowestoft). Given this, the Deben Estuary SPA and Ramsar site and the Stour and Orwell Estuaries SPA and Ramsar site were scoped into the Shadow HRA process.

4.2.4. This work culminated in the development of a set of agreed European site scoping tables for the construction and operation phases of the Sizewell C Project (alone[9]); agreed with the Evidence Plan Working Group (Ref. 3.7). The European sites included in these tables were those where a cause and effect pathway had the potential to exist between any one effect of the Sizewell C Project and any one qualifying interest feature of the site.

4.2.5. Moreover, for each of the qualifying interest features of each selected European site the potential 'effect strength' was categorised in order to help define the evidence requirements for the screening stage (i.e. green = no impact pathway / no effect - no further evidence required; amber = weak impact pathway / trivial or inconsequential effect - evidence required to demonstrate whether a likely significant effect could arise or be excluded;

[9] This did not take account of other plans and projects at this stage.

and red = moderate or strong impact pathway / likely significant effect - evidence required for consideration of adverse effect on site integrity).

b) European site scoping: 2018 -2019

4.2.6. Since the production of the Evidence Plan, a further 17 sites have been scoped in to the Shadow HRA:

- The Southern North Sea was adopted by the European Commission as a site of community importance in 2017 and has since been formally designated as a SAC for harbour porpoise.
- Consultation with the HRA Working Group in 2019 identified that the Humber Estuary SAC and The Wash and North Norfolk Coast SAC should be scoped in for the mobile interest features grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina* respectively.
- Twaite shad *Alosa fallax* has been identified as having the potential to be impinged by the intake tunnel, based on the monitoring carried out on Sizewell B. Therefore, a number of mainland European sites with shad as an interest feature have also been scoped in to the assessment.
- The Stour and Orwell Estuaries SPA and Ramsar site and Deben Estuary SPA and Ramsar site due to their proximity to the Freight Management Facility.

i. Southern North Sea SAC

4.2.7. Following its recognition by the UK Government as an area with predicted persistent high densities of harbour porpoise *Phocoena phocoena* year-round, the Southern North Sea was adopted by the European Commission as a site of community importance on 12 December 2017. In February 2019, the site of community importance was formally designated as a SAC.

4.2.8. The majority of this SAC lies offshore, but it does extend into the coastal areas of Norfolk and Suffolk and so is adjacent to the Sizewell C Project area, meaning that a cause and effect pathway between the Sizewell C Project and the SAC could exist.

ii. Humber Estuary and The Wash and North Norfolk Coast SACs

4.2.9. For both grey and harbour seals, there is evidence of connectivity between Greater Sizewell Bay and the European sites along the east coast of England. This includes the Humber Estuary SAC (designated for grey seal) and The Wash and North Norfolk Coast SAC (designated for harbour seal). That is, grey seals from the Donna Nook haul-out site within the Humber

Estuary SAC were telemetry tagged (21 in total) in May 2015 (Ref. 4.4). The results of this study showed that grey seals travel from the Donna Nook haul-out site along the east coast of England and down to the Kent and Essex coastlines, including travelling through the Greater Sizewell Bay area (see section 6 of this report, **Plate 6.14** and **Plate 6.15**; Ref. 4.4).

4.2.10. While there is evidence of connectivity between the Donna Nook haul-out site and the northern France and Netherlands coastlines, there is no evidence that individuals from the designated sites for grey seal in these areas travel to the Greater Sizewell Bay area. Tagged grey seals were shown to travel directly between Donna Nook and the north coasts of France and the Netherlands only, and do not pass along the Suffolk or Kent coastline (**Plate 6.15**; Ref. 4.4). In addition, the Russel *et al*. (2017) study (Ref. 4.5) seal density maps show that there were very few seals within the vicinity of the Sizewell C Project; supporting the assumption that there is no evidence of seals foraging within or near the Greater Sizewell Bay area. Therefore, all other grey seal designated sites were scoped out of further assessment.

4.2.11. The Sea Mammal Research Unit deployed 344 telemetry tags on harbour seals around the UK coastline between 2001 and 2012 (**Plate 6.16**; Ref. 4.6). The results of this tagging survey indicated that harbour seal travel from The Wash haul-out site (within The Wash and North Norfolk Coast SAC), along the Suffolk and Kent coastlines, including passing through the Greater Sizewell Bay area. A further tagging study of harbour seals in the outer Thames Estuary also demonstrated connectivity between harbour seals that haul-out along the Kent and Essex coastlines with The Wash and North Norfolk Coast SAC population, with harbour seals passing through the Greater Sizewell Bay area (**Plate 6.19**; Ref. 4.7).

iii. Mainland European sites

4.2.12. The following European designated sites have been included in this HRA (after consultation with Cefas) because they are designated for twaite shad (*Alosa fallax*) with a current spawning population and twaite shad is a species of concern relating to the impingement assessment for the Sizewell C Project's water intake pipeline:

- Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent SCI.
- Unterweser SCI.
- Weser bei Bremerhaven SCI.
- Nebenarme der Weser mit Strohauser Plate und Juliusplate SCI.
- Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI.

- Unterelbe SCI.
- Mühlenberger Loch/Neßsand SCI.
- Rapfenschutzgebiet Hamburger Stromelbe SCI.
- Hamburger Unterelbe SCI.
- Elbe zwischen Geesthacht und Hamburg SCI.

iv. Stour and Orwell Estuaries SPA and Ramsar sites and Deben Estuary SPA and Ramsar site

4.2.13. During the 2018-2019 scoping exercise, the Stour and Orwell Estuaries SPA and Ramsar were proposed to be scoped out of the Shadow HRA process as there are no longer plans for construction materials to be transported via vessels using port facilities at Ipswich. In addition, as the park and ride scheme at Woodbridge is no longer proposed, the Deben Estuary SPA and Ramsar site were proposed to be scoped out of the Shadow HRA.

4.2.14. However, following consultation with the HRA Working Group in 2019, it was determined that these European Sites may be affected by the Freight Management Facility which is within close proximity to the Stour and Orwell Estuaries and Deben Estuary SPAs and Ramsar sites. Hence, these sites have been scoped in to the HRA process.

v. Distant breeding seabird SPAs

4.2.15. There is potential for breeding seabird SPAs/Ramsar sites that are distant from the Sizewell C Project (i.e. beyond 20 km) to have connectivity with the Sizewell C Project's Zone of Influence (ZOI). This is because the qualifying interest features may have large breeding season foraging ranges or they may occur within the waters around the Sizewell C Project during passage or at other times in the non-breeding period.

4.2.16. However, the waters adjacent to the Sizewell C Project are beyond the likely foraging range of breeding seabirds from any such SPAs/Ramsar sites (Ref. 4.8, Ref. 4.9, Ref. 4.10), so there is no potential for such effects to arise during the breeding season.

4.2.17. In contrast to breeding seabird populations, access to offshore waters for wintering or passage seabirds is not constrained by colony location. Given the relatively small area of offshore habitat within which potential effects from the Sizewell C Project could arise (relative to the overall availability of such habitat to these populations), it is also the case that there is no potential for effects on such SPA/Ramsar site populations during the non-breeding periods.

4.2.18. Consequently, no distant breeding seabird SPAs/Ramsar sites have been scoped in to this assessment.

c) Cause and effect pathways: 2018-2019

4.2.19. As part of the 2018-2019 scoping refresh exercise, the potential pathways identified through which the Sizewell C Project could affect European sites where also expanded to include:

- the water quality implications of the discharge from the operational FRR system, following consultation with the Environment Agency; and
- physical interaction between species and Sizewell C Project infrastructure, i.e. potential direct effects on qualifying features arising due to interactions (e.g. collisions) with the infrastructure or machinery associated with the Sizewell C Project or indirect effects on prey species (e.g. impingement and entrainment of small fish and their larvae and eggs).

4.3 European sites 'scoped in'

4.3.1. Based on the scoping approach outlined above, a total of 30 European sites were included in the likely significant effects screening assessment. These European sites are listed in **Table 4.4** below and included on **Figure 4.1**. **Table 4.5** sets out the qualifying interest features for each of these European sites.

Table 4.4: List of European sites scoped in to the Shadow HRA and distance from the main development site and closest associated development site

No.	Site Name	Designation	Distance To Sizewell C Main Development Site	Distance To Closest Associated Development Site (If Less Than Distance To Main Development Site)
1	Alde-Ore and Butley Estuaries	SAC	6.5km	1.3km (A1094/B1069 south of Knodishall)
2	Alde-Ore Estuary	SPA	6.5km	1.3km (A1094/B1069 south of Knodishall)
3	Alde-Ore Estuary	Ramsar site	6.5km	1.3km (A1094/B1069 south of Knodishall)
4	Benacre to Easton Bavents Lagoons	SAC	14.6km	12.1km (A12/A144 south of Bramfield)
5	Benacre to Easton Bavents	SPA	14.2km	10.5km (A12/A144 south of Bramfield)

No.	Site Name	Designation	Distance To Sizewell C Main Development Site	Distance To Closest Associated Development Site (If Less Than Distance To Main Development Site)
6	Deben Estuary	SPA	22.2km	5km (freight management facility)
7	Deben Estuary	Ramsar site	22.2km	5km (freight management facility)
8	Dew's Ponds	SAC	11.2km	1.7km (northern park and ride)
9	Humber Estuary	SAC	162.9km	153km (A12/A144 south of Bramfield)
10	Minsmere to Walberswick Heaths and Marshes	SAC	Adjacent	Not applicable
11	Minsmere-Walberswick	SPA	Adjacent	Not applicable
12	Minsmere-Walberswick	Ramsar site	Adjacent	Not applicable
13	Orfordness-Shingle Street	SAC	8.9km	5.9km (A1094/B1069 south of Knodishall)
14	Outer Thames Estuary	SPA	Within and adjacent	Not applicable
15	Sandlings	SPA	1.6km	Not applicable
16	Staverton Park and the Thicks, Wantisden	SAC	17km	6.5km (southern park and ride)
17	Southern North Sea	SAC	Within and adjacent	Not applicable
18	Stour and Orwell Estuaries	SPA	33.7km	1.6km (freight management facility)
19	Stour and Orwell Estuaries	Ramsar site	33.7km	1.6km (freight management facility)
20	The Wash and North Norfolk Coast	SAC	88.2km	79.4km (A12/A144 south of Bramfield)
21	Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent	SCI	197 km	Not applicable
22	Unterweser	SCI	479 km	Not applicable
23	Weser bei Bremerhaven	SCI	483 km	Not applicable
24	Nebenarme der Weser mit Strohauser Plate und Juliusplate	SCI	475 km	Not applicable

No.	Site Name	Designation	Distance To Sizewell C Main Development Site	Distance To Closest Associated Development Site (If Less Than Distance To Main Development Site)
25	Schleswig-Holsteinisches Elbästuar und angrenzende Flächen	SCI	509 km	Not applicable
26	Unterelbe	SCI	508 km	Not applicable
27	Mühlenberger Loch/Neßsand	SCI	563 km	Not applicable
28	Rapfenschutzgebiet Hamburger Stromelbe	SCI	565 km	Not applicable
29	Hamburger Unterelbe	SCI	582 km	Not applicable
30	Elbe zwischen Geesthacht und Hamburg	SCI	584 km	Not applicable

Table 4.5: Description of European sites scoped in to the Shadow HRA and their qualifying interest features

No.	Site Name	Description	Qualifying Interest Features
1	Alde-Ore and Butley Estuaries SAC	The SAC covers an area of 1,633 ha and is made up of three rivers. It is the only bar-built estuary in the UK with a shingle bar. This bar has been extending rapidly along the coast since 1530, pushing the mouth of the estuary progressively south-westwards. The eastwards-running Alde River originally entered the sea at Aldeburgh, but now turns south along the inner side of the Orfordness shingle spit. It is relatively wide and shallow, with extensive intertidal mudflats on both sides of the channel in its upper reaches and saltmarsh accreting along its fringes. The Alde subsequently becomes the south-west flowing River Ore, which is narrower and deeper with stronger currents. The smaller Butley River has extensive areas of saltmarsh and a reed bed community that borders intertidal mudflats. It flows into the Ore shortly after the latter divides around Havergate Island. The mouth of the River Ore is still moving south as the Orfordness shingle spit continues to grow through longshore drift from the north. There is a range of littoral sediment and rock biotopes (the latter on sea defences) that are of high diversity and species richness for estuaries in eastern England. Water quality is excellent throughout. The area is relatively natural, being largely undeveloped by man and with very limited industrial activity. The estuary contains large areas of shallow water over subtidal sediments, and extensive mudflats and saltmarshes exposed at low water. Its diverse and species-rich intertidal sand and mudflat biotopes grade naturally along many lengths of the shore into vegetated or dynamic shingle habitat, saltmarsh, grassland and reed bed.	Annex 1 habitats that are a primary reason for selection of the site: • Estuaries. Annex 1 habitats present as a qualifying feature, but not a primary reason for selection of this site: • Mudflats and sandflats not covered by seawater at low tide. • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).

No.	Site Name	Description	Qualifying Interest Features
2	Alde-Ore Estuary SPA	The SPA is located on the Suffolk coast between Aldeburgh to the North and Bawdsey to the South. The site includes Havergate Island and Orford Ness, as well as the estuaries of the rivers Alde, Butley and Ore. The SPA is composed of Atlantic salt meadows (Glauco-Puccinellietalia maritimae), intertidal mudflats, shingle, coastal lagoons and estuarine fish communities. Bird usage of habitats within the SPA varies seasonally, with different areas being utilised for nesting and feeding at different times of the year.	This site qualifies under Article 4.1 of the Birds Directive (2009/147/EC) by supporting populations of European importance listed on Annex I of the Directive. During the breeding season: • Avocet *Recurvirostra avosetta* • Little tern *Sternula albifrons* • Marsh harrier *Circus aeruginosus* • Sandwich tern *Thalasseus sandvicensis* Over winter: • Avocet *Recurvirostra avosetta* The site also qualifies under Article 4.2 of the Birds Directive (2009/147/EC) by supporting populations of European importance of migratory species. During the breeding season: • Lesser black-backed gull *Larus fuscus* Over winter: • Redshank *Tringa tetanus* • Ruff *Philomachus pugnax*

No.	Site Name	Description	Qualifying Interest Features
3	Alde-Ore Estuary Ramsar site[10]	The site comprises the estuary complex of the rivers Alde, Butley and Ore, including Havergate Island and Orfordness. There are a variety of habitats including, intertidal mudflats, saltmarsh, vegetated shingle (including the second-largest and best-preserved area in Britain at Orfordness), saline lagoons and grazing marsh. The Orfordness/Shingle Street landform is unique within Britain in combining a shingle spit with a cuspate foreland. The site supports nationally-scarce plants, British Red Data Book invertebrates, and notable assemblages of breeding and wintering wetland birds.	The site qualifies as a Ramsar for the following reasons: • Ramsar criterion 2 - the site supports a number of nationally-scarce plant species and British Red Data Book invertebrates. • Ramsar criterion 3 - the site supports a notable assemblage of breeding and wintering wetland birds. • Ramsar criterion 6 - species/populations occurring at levels of international importance. Species regularly supported during the breeding season: • Lesser black-backed gull, *Larus fuscus graellsii*, West Europe/Mediterranean/West Africa Species with peak counts in winter: • Avocet, *Recurvirostra avosetta*, Europe/Northwest Africa • Common redshank, *Tringa totanus tetanus*.
4	Benacre to Easton Bavents Lagoons SAC	This SAC is a series of percolation lagoons on the east coast of England. The lagoons (the Denes, Benacre Broad, Covehithe Broad and Easton Broad) have formed behind shingle barriers and are a feature of a geomorphologically dynamic system. Sea water enters the lagoons by percolation through the barriers, or by overtopping them during storms and high spring tides. The lagoons show a wide range of salinities, from nearly fully saline in South Pool, the Denes, to extremely low salinity at Easton Broad. This range of salinity has resulted in a series of lagoonal vegetation types, including beds of narrow leaved eelgrass	Annex 1 habitats that are a primary reason for selection of the site: • Coastal lagoons.

[10] For all Ramsar sites, the qualifying interest features listed are those which are identified as qualifying 'Ramsar criteria' in the *Information Sheet on Ramsar Wetlands* for each Ramsar site. Other 'noteworthy flora and fauna' are not included as qualifying interest features of the Ramsar site. This approach aligns with that of other recent HRAs for DCO applications (e.g. Wylfa Newydd Nuclear Power Station and East Anglia ONE North Offshore Windfarm).

No.	Site Name	Description	Qualifying Interest Features
		Zostera angustifolia in fully saline or hypersaline conditions, beds of spiral tasselweed *Ruppia cirrhosa* in brackish water, and dense beds of common reed *Phragmites australis* in freshwater. The site supports a number of specialist lagoonal species.	
5	Benacre to Easton Bavents SPA	The SPA is located on the North Sea coast of East Suffolk, between the coastal towns of Kessingland (to the north) and Southwold (to the south). The coast here is low-lying and consists of shingle beach in the northern part and low cliffs around Easton Bavents and Covehithe. Benacre Broad is a natural brackish lagoon separated from the sea by a shingle bar, reed-fringed on the landward side and then grading into deciduous woodland on the rising ground behind. The smaller Covehithe and Easton Broads have developed similarly, with fringing reedbeds. Elsewhere, grazing marsh fields include unimproved meadows, which are separated by ditches rich in water plants and invertebrates. The area supports important populations of breeding birds, which are particularly associated with reedbed and shingle beach habitats. The reedbeds also support important numbers of bittern *Botaurus stellaris* in winter. Little terns *Sternula albifrons* feed substantially outside the SPA in adjacent marine waters.	This site qualifies under Article 4.1 of the Birds Directive (2009/147/EC) by supporting populations of European importance of the following species listed on Annex I of the Directive. During the breeding season: • Bittern *Botaurus stellaris* • Little tern *Sternula albifrons* • Marsh harrier *Circus aeruginosus*
6	Deben Estuary SPA	The Deben Estuary is located on the coast of Suffolk in eastern England. It extends south-eastwards for over 12 km from the town of Woodbridge to the sea just north of Felixstowe. It is relatively narrow and sheltered, and has limited amounts of freshwater input. The estuary mouth is the narrowest section and is protected by the presence of shifting sandbanks. The intertidal areas are constrained by sea walls. The saltmarsh and intertidal mud-flats that occupy the majority of the site, however,	The site qualifies under Article 4.1 of the Birds Directive as it is used regularly by nationally important populations of species listed in Annex I in any one season. Qualifying features under Article 4.1: • (wintering) avocet *Recurvirostra avosetta*

No.	Site Name	Description	Qualifying Interest Features
		display the most complete range of saltmarsh community types in Suffolk. The estuary holds a range of swamp communities that fringe the estuary, and occasionally form larger stands. In general, these are dominated by Common Reed *Phragmites australis*. The estuary is of importance for its wintering waterbirds, especially Avocet *Recurvirostra avosetta*.	The site also qualifies under Article 4.2 of the Birds Directive as it is used regularly by 1% or more of the biogeographical populations of regularly occurring migratory species (other than those listed in Annex I). Qualifying features under Article 4.2: • (wintering) dark-bellied Brent goose *Branta bernicla bernicla*
7	Deben Estuary Ramsar site	The Deben Estuary extends south-eastwards for over 12km from the town of Woodbridge to the sea just north of Felixstowe. It is relatively narrow and sheltered, and has limited amounts of freshwater input. The estuary mouth is the narrowest section and is protected by the presence of shifting sandbanks. The intertidal areas are constrained by sea-walls. The saltmarsh and intertidal mudflats that occupy the majority of the site, however, display the most complete range of saltmarsh community types in Suffolk.	The site qualifies as a Ramsar for the following reasons: • Ramsar criterion 2 - supports a population of the mollusc *Vertigo angustior* (Habitats Directive Annex II (S1014); British Red Data Book Endangered). • Ramsar criterion 6 - species / populations occurring at levels of international importance: Dark bellied brent goose *Branta bernicla bernicla*.
8	Dew's Ponds SAC	This site comprises a series of 12 ponds set in an area of formerly predominantly arable land. The ponds range from old field ponds created for agricultural purposes to some constructed in recent years specifically for wildlife. Some of the land has been converted from arable to grassland, with a variety of grassland types present; other habitats include hedges and ditches. Great crested newts, *Triturus cristatus*, have been found in all ponds on site, though the presence of fish seems to have affected newt numbers in recent years in two ponds.	The site qualifies as a SAC due to the presence of the following Annex II species that are a primary reason for selection of the site: • Great crested newt, *Triturus cristatus.*
9	Humber Estuary SAC	The Humber is the second largest coastal plain Estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion on the tidal	Annex 1 habitats that are a primary reason for selection of the site: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide.

No.	Site Name	Description	Qualifying Interest Features
		rivers of the Ouse and Trent. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them; these include a breeding bird assemblage, winter and passage waterfowl, river and sea lamprey, grey seals, vascular plants and invertebrates. The Humber is a muddy, macro-tidal estuary, fed by a number of rivers including the Rivers Ouse, Trent and Hull. Suspended sediment concentrations (SSC) are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast. This is the northernmost of the English east coast estuaries whose structure and function is intimately linked with soft eroding shorelines. The extensive mud and sand flats support a range of benthic communities, which in turn are an important feeding resource for birds and fish. Wave exposed sandy shores are found in the outer/open coast areas of the estuary. These change to the more moderately exposed sandy shores and then to sheltered muddy shores within the main body of the estuary and up into the tidal rivers.	Annex 1 habitats present as a qualifying feature, but not a primary reason for selection of this site: • Sandbanks which are slightly covered by sea water all the time. • Coastal lagoons. • Salicornia and other annuals colonizing mud and sand. • Atlantic salt meadows (*Glauco-Puccineolietalia maritimae*). • Embryonic shifting dunes. • Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"). • Fixed coastal dunes with herbaceous vegetation ("grey dunes"). • Dunes with *Hippopha rhamnoides.* Annex II species present as a qualifying feature, but not a primary selection: • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis.* • Grey seal *Halichoerus grypus.*
10	Minsmere to Walberswick Heaths and Marshes SAC	This site is one of two representatives of annual vegetation of drift lines on the east coast of England. It occurs on a well-developed beach strandline of mixed sand and shingle and is the best and most extensive example of this restricted geographical type. Species include those typical of sandy shores, such as sea sandwort *Honckenya peploides* and shingle plants such as sea beet *Beta vulgaris* ssp. *maritima*. Lowland European dry heaths occupy an extensive area of the site, which is at the extreme easterly range of heath development in the UK. The heathland is predominantly national vegetation	• Annex 1 habitats that are a primary reason for selection of this site: • Annual vegetation of drift lines. • European dry heaths. • Annex 1 habitat present as a qualifying feature, but not a primary reason for selection of this site: • Perennial vegetation of stony banks.

No.	Site Name	Description	Qualifying Interest Features
		classification (NVC) type H8 *Calluna vulgaris – Ulex gallii* heath, usually more characteristic of western parts of the UK. This type is dominated by heather *Calluna vulgaris*, western gorse *Ulex gallii* and bell heather *Erica cinerea*.	
11	Minsmere-Walberswick SPA	The site comprises two large marshes, the tidal Blyth estuary and associated habitats. This composite coastal site contains a complex mosaic of habitats, notably areas of marsh with dykes, extensive reedbeds, mud-flats, lagoons, shingle, woodland and areas of lowland heath. It supports the largest continuous stand of common reed *Phragmites australis* in England and Wales and demonstrates the nationally rare transition in grazing marsh ditch plants from brackish to fresh water. There are nationally important numbers of breeding and wintering birds. In particular, the reedbeds are of major importance for breeding bittern *Botaurus stellaris* and marsh harrier *Circus aeruginosus*. A range of breeding waders (e.g. avocets *Recurvirostra avosetta*) and heathland birds occur in other areas of the SPA. The shingle beaches support important numbers of breeding little tern *Sternula albifrons*, which feed substantially outside the SPA in adjacent marine waters. The site is also important for wintering bitterns and raptors.	The site qualifies under Article 4.1 of the Birds Directive (2009/147/EC) by supporting populations of European importance of the following species listed on Annex 1 of the Directive. During the breeding season: • Avocet *Recurvirostra avosetta* • Bittern *Botaurus stellaris* • Little tern *Sternula albifrons* • Marsh harrier *Circus aeruginosus* • Nightjar *Caprimulgus europaeus* Over winter: • Hen harrier *Circus cyaneus* This site also qualifies under Article 4.2 of the Birds Directive (2009/147/EC) by supporting populations of European importance of the following migratory species. During the breeding season: • Shoveler *Anas clypeata* • Teal *Anas crecca* • Gadwall *Anas Strepera* Over winter: • Gadwall *Anas strepera*

No.	Site Name	Description	Qualifying Interest Features
			• Shoveler *Anas clypeata* • White fronted goose *Anser albifrons*
12	Minsmere-Walberswick Ramsar site	This Suffolk coastal site contains a complex mosaic of habitats, notably, areas of marsh with dykes, extensive reedbeds, mudflats, lagoons, shingle and driftline, woodland and areas of lowland heath. The site supports the largest continuous stand of reed in England and Wales and demonstrates the nationally rare transition in grazing marsh ditch plants from brackish to fresh water. The combination of habitats creates an exceptional area of scientific interest supporting nationally scarce plants, British Red Data Book invertebrates and nationally important numbers of breeding and wintering birds.	• The site qualifies as a Ramsar under the following criteria: • Ramsar criterion 1 - the site contains a mosaic of marine, freshwater, marshland and associated habitats complete with transition areas in between. It also contains the largest continuous stand of reedbed in England and Wales, and rare transition in grazing marsh ditch plants from brackish to fresh water. • Ramsar criterion 2 - this site supports nine nationally scarce plants and at least 26 red data book invertebrates. It supports a population of the mollusc narrow-mouthed whorl snail Vertigo angustior (Habitats Directive Annex II; British Red Data Book Endangered), recently discovered on the Blyth estuary river walls. • Ramsar criterion 2 – the sites also supports an important assemblage of rare breeding birds associated with marshland and reedbeds including: bittern *Botaurus stellaris*, gadwall *Anas strepera*, teal *Anas crecca*, shoveler *Anas clypeata*, marsh harrier *Circus aeruginosus*, avocet *Recurvirostra avosetta* and bearded tit *Panurus biarmicus*.
13	Orfordness-Shingle Street SAC	Orfordness is an extensive shingle structure and consists of a foreland, a 15 km-long spit and a series of recurves running from north to south on the Suffolk coast. This spit has been selected as it supports some of the largest and most natural sequences in the UK of shingle vegetation affected by salt spray. The southern end of the spit has a particularly fine series of undisturbed ridges, with zonation of communities determined by	Annex 1 habitats which are a primary reason for site selection: • Coastal Lagoons. • Annual vegetation of drift lines. • Perennial vegetation of stony banks.

No.	Site Name	Description	Qualifying Interest Features
		the ridge pattern. Pioneer communities with sea pea *Lathyrus japonicus* and false oat-grass *Arrhenatherum elatius* grassland occur. Locally these are nutrient-enriched by the presence of a gull colony, elsewhere they support rich lichen communities. Orfordness is one of two sites representing annual vegetation of drift lines on the east coast of England. In contrast to Minsmere to Walberswick Heaths and Marshes, drift-line vegetation occurs on the sheltered, western side of the spit, at the transition from shingle to saltmarsh, as well as on the exposed eastern coast. The driftline community is widespread on the site and comprises sea beet *Beta vulgaris* ssp. *maritima* and orache *Atriplex* spp. in a strip 2-5m wide. A series of percolation lagoons have developed in the shingle bank adjacent to the shore at the mouth of the Ore estuary. The salinity of the lagoons is maintained by percolation through the shingle, although at high tides sea water can overtop the shingle bank. The fauna of these lagoons includes typical lagoon species, such as the cockle *Cerastoderma glaucum*, the ostracod *Cyprideis torosa* and the gastropods *Littorina saxatilis tenebrosa* and *Hydrobia ventrosa*. The nationally rare starlet sea anemone *Nematostella vectensis* is also found at the site.	
14	Outer Thames Estuary SPA	The Outer Thames Estuary SPA consists of areas of shallow and deeper water, high tidal current streams and a range of mobile sediments. Large areas of mud, silt and gravelly sediments form the deeper water channels, the main ones of which form the approach route to the ports of London and as such are continually disturbed by shipping and maintenance dredging. Sand in the form of sandbanks separated by troughs predominates in the remaining areas and the crests of some of	The site qualifies under Article 4.1 of the Birds Directive (2009/147/EC) as it is used regularly by 1% or more of the Great Britain population of the following species listed in Annex I in any season. During the breeding season: • Little tern *Sternula albifrons* • Common tern *Sterna hirundo*

No.	Site Name	Description	Qualifying Interest Features
		the banks are exposed at mean low water. In the northern part of the site the main sandbanks are (north to south) Middle Cross Sand, Scroby Sands, Helm Sand, Newcombe Sand, Aldeburgh Napes, Aldeburgh Ridge, North Ship Head and Bawdsey Bank. In the southern part of the site the main sandbanks are Red Sand, Kentish Flats, West and East Barrow, Sunk Sand, Shingles, Long Sand, Margate Sand and Kentish Knock. The seabed along the coast of Norfolk and Suffolk coast is of a similar composition to that in the main estuary with large shallow areas of mud, sand, silt and gravely sediments but, in the absence of main port areas within this area, there is less disturbance through shipping or dredging. The main sandbanks in this area are (from north to south) Dunwich Bank, Sizewell Bank, Aldeburgh Napes, Aldeburgh Ridge and Whiting Ridge. The seabed and waters of the site provide an important habitat in the non-breeding season for red-throated divers *Gavia stellata* which visit the area to feed on the fish populations.	Over winter: • Red-throated diver *Gavia stellata*
15	Sandlings SPA	The Sandlings SPA lies between the Deben Estuary and Leiston. In the 19th century, the area was dominated by heathland developed on glacial sandy soils. During the 20th century, large areas of heath were planted with blocks of commercial conifer forest and others were converted to arable agriculture. Lack of traditional management has resulted in the remnant areas of heath which have survived successional changes and the consequent spread of bracken *Pteridium aquilinum*, shrubs and trees. The recent conservation management work, however, is resulting in their restoration. The heaths support both acid grassland and heather-dominated plant communities with dependent invertebrate and bird communities of conservation	The site qualifies under Article 4.1 of the Birds Directive (2009/147/EC) by supporting populations of European importance of the following species listed on Annex I of the Directive. During the breeding season: • Nightjar *Caprimulgus europaeus* • Woodlark *Lullula arborea*

No.	Site Name	Description	Qualifying Interest Features
		value. Woodlark *Lullula arborea* and nightjar *Caprimulgus europaeus* have also adapted to breeding in the large blocks of conifer forest, using areas that have recently been felled and recent plantation, as well as areas managed as open ground.	
16	Staverton Park and the Thicks, Wantisden SAC	This site is representative of old acidophilous oak woods in the eastern part of its range, and its ancient oaks *Quercus* spp. have rich invertebrate and epiphytic lichen assemblages. Despite being in the most 'continental' part of southern Britain, the epiphytic lichen flora of this site includes rare and Atlantic species, such as *Haemotomma elatinum*, *Lecidea cinnabarina*, *Thelotrema lepadinum*, *Graphis elegans* and *Stenocybe septata*. Part of the site includes an area of old holly *Ilex aquifolium* trees that are probably the largest in Britain. The site has a very well documented history and good conservation of woodland structure and function.	Annex 1 habitats that are a primary reason for selection of this site: • Old acidophilous oak woods with *Quercus robur* on sandy plains.
17	Southern North Sea SAC	The Southern North Sea SAC lies along the east coast of England, predominantly in the offshore waters of the central and southern North Sea, from north of Dogger Bank to the Straits of Dover in the south. It covers an area of 3,695,054 ha, designated for the protection of harbour porpoise *Phocoena phocoena*. This area supports an estimated 17.5% of the UK North Sea Management Unit population. Approximately two thirds of the site, the northern part, is recognised as important for porpoises during the summer season, whilst the southern part support persistently higher densities during the winter. The SAC ranges in depth from mean low water down to 75 m, with the majority of the site shallower than 40 m, and is characterised by its sandy, coarse sediments which cover much	The qualifying feature of the site is the Annex II species: • harbour porpoise *Phocoena phocoena*

No.	Site Name	Description	Qualifying Interest Features
		of the site. These physical characteristics are thought to be preferred by harbour porpoise, likely due to availability of prey.	
18	Stour and Orwell Estuaries SPA	The Stour and Orwell estuaries straddle the eastern part of the Essex/Suffolk border in eastern England. The estuaries include extensive mud-flats, low cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. The mudflats hold *Enteromorpha*, *Zostera* and *Salicornia* spp. The site also includes an area of low-lying grazing marsh at Shotley Marshes on the south side of the Orwell. In summer, the site supports important numbers of breeding avocet *Recurvirostra avosetta*, while in winter they hold major concentrations of waterbirds, especially geese, ducks and waders. The geese also feed, and waders roost, in surrounding areas of agricultural land outside the SPA.	The site qualifies under Article 4.1 of the EC Wild Birds Directive (2009/147/EC) as it is used regularly by nationally important populations of species listed in Annex I in any one season. Qualifying features under Article 4.1 (5-year peak mean 1996-2000) during the breeding season: • Avocet *Recurvirostra avosetta* The site qualifies under Article 4.2 of the Birds Directive as it is used regularly by 1% or more of the biogeographical populations of regularly occurring migratory species (other than those listed in Annex I). Qualifying features under Article 4.2 (5-year mean peak 1995/96 – 1999/00) over winter: • Pintail *Anas acuta* • Dark-bellied Brent goose *Branta bernicla* • Dunlin *Calidris alpina* • Knot *Calidris canutus* • Black-tailed godwit *Limosa islandica* • Grey plover *Pluvialis squatarola* • Redshank *Tringa totanus* The site also qualifies under Article 4.2 as it is used regularly by over 20,000 waterbirds in any season. Over winter, the area regularly supports 63,017 (5-year peak mean to 2005) individual waterbirds.

No.	Site Name	Description	Qualifying Interest Features
			• The main components of the assemblage include all wintering qualifying features listed above, plus cormorant *Phalacrocorax carbo*; ringed plover *Charadrius hiaticula*; shelduck *Tadorna*; great crested grebe *Podiceps cristatus*; curlew *Numenius arquata*; wigeon *Anas penelope*; goldeneye *Bucephala clangula*; lapwing *Vanellus*; turnstone *Arenaria interpres*; and gadwall *Anas strepera*.
19	Stour and Orwell Estuaries Ramsar site	The Stour and Orwell Estuaries is a wetland of international importance, comprising extensive mudflats, low cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. It provides habitats for an important assemblage of wetland birds in the non-breeding season and supports internationally important numbers of wintering and passage wildfowl and waders. The site also holds several nationally scarce plants and British Red Data Book invertebrates.	The site qualifies as a Ramsar under the following criteria: • Ramsar criterion 2 - contains seven nationally scarce plants: stiff saltmarsh-grass *Puccinellia rupestris*; small cord-grass *Spartina maritima*; perennial glasswort *Sarcocornia perennis*; lax-flowered sea lavender *Limonium humile*; and the eelgrasses *Zostera angustifolia*, *Z. marina* and *Z. noltei*. Also contains five British Red Data Book invertebrates: the muscid fly *Phaonia fusca*; the horsefly *Haematopota grandis*; two spiders, *Arctosa fulvolineata* and *Baryphema duffeyi*; and the Endangered swollen spire snail *Mercuria confusa*. • Ramsar criterion 5 - assemblages of international importance: Species with peak counts in winter: 63,017 waterfowl (5-year peak mean 1998 / 99 to 2002 / 2003). • Ramsar criterion 6 - species/populations occurring at levels of international importance: With peak counts in spring / autumn: common redshank, *Tringa totanus tetanus.* With peak counts in winter: dark-bellied brent goose, *Branta bernicla*, northern pintail, *Anas acuta*; grey plover, *Pluvialis squatarola;* red knot, *Calidris canutus islandica;* dunlin, *Calidris alpina alpine;* black-tailed godwit, *Limosa islandica.*

No.	Site Name	Description	Qualifying Interest Features
20	The Wash and Norfolk Coast SAC	The Wash is the largest embayment in the UK. It is connected via sediment transfer systems to the north Norfolk coast. Together, the Wash and North Norfolk Coast form one of the most important marine areas in the UK and European North Sea coast, and include extensive areas of varying, but predominantly sandy, sediments subject to a range of conditions. Communities in the intertidal include those characterised by large numbers of polychaetes, bivalve and crustaceans. Subtidal communities cover a diverse range from the shallow to the deeper parts of the embayments and include dense brittlestar beds and areas of an abundant reef-building worm ('ross worm') *Sabellaria spinulosa*. The embayment supports a variety of mobile species, including a range of fish, otter *Lutra* and common seal *Phoca vitulina*. The extensive intertidal flats provide ideal conditions for common seal breeding and hauling-out.	Annex 1 habitats that are a primary reason for selection of the site: • Sandbanks which are slightly covered by sea water all the time. • Mudflats and sandflats not covered by seawater at low tide. • Large shallow inlets and bays. • Reefs. • Salicornia and other annuals colonizing mud and sand. • Atlantic salt meadows (*Glauco-Puccineolietalia maritimae*). • Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticose*). Annex 1 habitats present as a qualifying feature, but not a primary reason for selection of this site: • Coastal lagoons. Annex II species that are a primary reason for selection of this site: • Harbour seal *Phoca vitulina.* Annex II species present as a qualifying feature, but not a primary selection: • Otter *Lutra.*
21	Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent Site of Community Importance	The most important and largest estuarine ecosystem in Flanders. The Scheldt estuary with the river the Scheldt and the tributaries the Durme and the Rupel. Including a gradient from brackish, with typical salt marshes and reed-beds, to fresh-water with forbs and willow scrubs. On the landside of the dikes there are important wetlands.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Salicornia and other annuals colonizing mud and sand. • Spartina swards (*Spartinion maritimae*). • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*). • Dry sand heaths with *Calluna* and *Genista.* • Inland dunes with open *Corynephorus* and *Agrostis* grasslands.

No.	Site Name	Description	Qualifying Interest Features
			• Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. • Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation. • Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation. • European dry heaths. • Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe). • *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae). • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Transition mires and quaking bogs. • Atlantic acidophilous beech forests with *Ilex* and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*). • Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Large white-faced darter *Leucorrhinia pectoralis*. • River lamprey *Lampetra fluviatilis.*

No.	Site Name	Description	Qualifying Interest Features
			• Twaite shad *Alosa fallax*. • European bitterling *Rhodeus sericeus amarus*. • Spined loach *Cobitis taenia*. • Northern crested newt *Triturus cristatus*. • Pond bat *Myotis dasycneme*. • Eurasian beaver *Castor fiber*.
22	Unterweser SCI	Weser estuary with shallow water areas, an artificially-deepened fairway, brackish water wadding, brackish reed beds and slightly salt-affected grassland. Use as a shipping route. Representative of an estuary area, significant as a partial habitat of sea lamprey, river lamprey and twaite shad. Within the radius of an important pond bat population (potential hunting area).	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis.* • Twaite shad *Alosa fallax*. • Atlantic salmon *Salmo salar*. • Harbour propoise *Phocoena phocoena* • Harbour seal *Phoca vitulina*.
23	Weser bei Bremerhaven SCI	Estuary of the Weser in the Bremerhaven urban stretch with tide and salt influence, strongly anthropogenically shaped. Tidal flats in front of the former New Lunesiel. Quays and port-related facilities excluded.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide. • Sea lamprey *Petromyzon marinus.*

No.	Site Name	Description	Qualifying Interest Features
		Functional connection with the areas reported below and above Bremerhaven in Lower Saxony. Migratory route and adaptation area of diadromous migratory fish.	• River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax*.
24	Nebenarme der Weser mit Strohauser Plate und Juliusplate SCI	Near-natural, tide-influenced branches of the Lower Weser with brackish and freshwater mudflats, reed beds, pasture forest, lowland mowing meadows, etc., as well as parts of the expanded Weser. Used as a shipping route. Relatively natural parts of the predominantly anthropogenic Unterweser, 'stepping stone' and potential spawning area for twaite shad, 'stepping stone' for migratory fish species such as river and sea lamprey, potential pond bat hunting area.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide. • Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Old acidophilous oak woods with Quercus robur on sandy plains. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Pond bat *Myotis dasycneme*. • Harbour propoise *Phocoena phocoena*.

No.	Site Name	Description	Qualifying Interest Features
			• Harbour seal *Phoca vitulina*.
25	Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI	Entire Schleswig-Holstein Elbe estuary with tributaries consisting of the actual Elbe river course with adjacent flooding areas. The Lower Elbe, together with the tidal underflows of its tributaries, is the largest and best-preserved estuary in Germany. The protected monument 'Hatzburg' is located in the area.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide. • Large shallow inlets and bays. • Salicornia and other annuals colonizing mud and sand. • Atlantic acidophilous beech forests with *Ilex* and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*). • Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation. • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Transition mires and quaking bogs. • Bog woodland. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.*

No.	Site Name	Description	Qualifying Interest Features
			• Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius.* • Loach *Misgurnus fossilis.* • Spined loach *Cobitis taenia.* • Eurasian otter *Lutra.* • Harbour seal *Phoca vitulina*. • Elbe water dropwort *Oenanthe conioides.*
26	Unterelbe SCI	Limnese estuary bordered by flood protection systems with typical zoning in some areas, wider foreland only partially available, partly strongly anthropogenic. Dynamics of the Limnese Elbe estuary with deep and shallow water areas, fresh water mudflats, tidal reed beds and tidal riparian forests, migratory fish species and locations of the hemlock-water fennel shipping route.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Mudflats and sandflats not covered by seawater at low tide. • Atlantic salt meadows (Glauco-Puccinellietalia maritimae). • Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation. • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). • Sea lamprey *Petromyzon marinus.*

No.	Site Name	Description	Qualifying Interest Features
			• River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius aspius.* • Harbour propoise *Phocoena phocoena*. • Harbour seal *Phoca vitulina*. • Elbe water dropwort *Oenanthe conioides*
27	Mühlenberger Loch/Neßsand SCI	Tide-dependent freshwater mud flats and sands of the Elbe with shallow water areas. On the banks of the Elbe island of Neßsand tider ear, riparian forests and artificial grasslands. A landscape characterized by the dynamics of the tidal Elbe with fresh water mud flats, shallow water areas, Elbe islands, tidal reeds, willow bushes and riparian forests, fish farming area (twaite shad), locations of the hemlock water fennel in the shallow water bay of the Mühlenberger Loch resulted from the insulation of the Old Süderelbe in 1962, most of which was artificial reconnaissance the 80s.	Annex 1 habitats which are a primary reason for site selection: • Estuaries. • Inland dunes with open Corynephorus and Agrostis grasslands. • Xeric sand calcareous grasslands. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius aspius.* • Harbour propoise *Phocoena phocoena*. • Harbour seal *Phoca vitulina*. • Elbe water dropwort *Oenanthe conioides.*

No.	Site Name	Description	Qualifying Interest Features
28	Rapfenschutzgebiet Hamburger Stromelbe SCI	Anthropogenically over-formed fairway of the river Elbe (constant entertainment) with adjacent side areas with the exception of the north bank in a water width of approximately 100 m.	Annex 1 habitats which are a primary reason for site selection: • Sea lamprey Petromyzon marinus. • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius aspius.* • Harbour propoise *Phocoena phocoena*.
29	Hamburger Unterelbe SCI	Limnese estuary bordered by flood protection systems with typical zoning in some areas, wider foreland only partially available, partly anthropogenic. Dynamics of the Limnese Elbe estuary with deep and shallow water areas, fresh water mudflats, tidal reed beds and tidal riparian forests, migratory fish species and locations of the hemlock-water fennel shipping route.	Annex 1 habitats which are a primary reason for site selection: • Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation. • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius aspius.* • European bitterling *Rhodeus sericeus amarus* • Loach *Misgurnus fossilis.*

No.	Site Name	Description	Qualifying Interest Features
			• Spined loach *Cobitis taenia.* • Elbe water dropwort *Oenanthe conioides*
30	Elbe zwischen Geesthacht und Hamburg SCI	Freshwater tidal area of the Lower Elbe with mudflats, reed beds, grassland from moist to dry locations, small-scale pasture riparian forests and high-rise meadows. Primarily important as a hiking route and habitat for various fish species (sea lamprey, river lamprey, asp). Significant occurrences of hemlock water fennel of high meadows, lowland meadows, and pasture meadows.	Annex 1 habitats which are a primary reason for site selection: • Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation. • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). • Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). • Sea lamprey *Petromyzon marinus.* • River lamprey *Lampetra fluviatilis*. • Twaite shad *Alosa fallax.* • Atlantic salmon *Salmo salar*. • Houting *Coregonus oxyrinchus.* • Asp *Aspius aspius.* • Elbe water dropwort *Oenanthe conioides*

5 Screening of Potential Effects

5.1 Determination of likely significant effect

a) The 'likely significant effect test'

5.1.1. This section sets out the background to the determination of likely significant effect in respect of the test set out in the Habitats Regulations and the proposed approach to this aspect of the HRA process for the Sizewell C Project.

5.1.2. The section provides information on the likely significant effect test, including definitions of what constitutes likely significant effect as determined through case law. It then highlights how the Shadow HRA has approached the determination of likely significant effect, taking into account the various requirements set out in guidance and previous practice.

5.1.3. The 'likely significant effect test' is the process of identifying potentially relevant European sites (addressed in this case through 'scoping'; see section 4 of this report) and the likely effects of a project on the qualifying interest features of a European site, either alone or in-combination with other plans and projects, and considering whether the effects are likely to be significant.

5.1.4. The HRA screening process uses the threshold of likely significant effect to determine whether effects on European sites should be the subject of further assessment. The Habitats Regulations do not define the term likely significant effect but Natural England's predecessor defined it as *"any effect that may reasonably be predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects"* (Ref. 3.4). In the *Waddenzee* case (Case C-127/02 – Ref. 3.5) the European Court of Justice found that a likely significant effect exists if it cannot be excluded on the basis of objective information that the plan or project will have significant effects on the conservation objectives of the site concerned, whether alone or in-combination with any other project. The Advocate General's opinion of the Sweetman case (Case C-258/11 – Ref. 3.6) further clarifies the position by noting that for a conclusion of a likely significant effect to be made "*there is no need to establish such an effect, ... it is merely necessary to determine that there may be such an effect*" (original emphasis).

5.1.5. Similarly, clarification has been provided through case law on the meaning of 'a likely significant effect' (*Bagmoor Wind Ltd v The Scottish Ministers*, 2012 – Ref. 5.1). In this case, it was ruled that the word 'likely' in the Habitats Regulations should not be interpreted as referring to the probability of a significant effect but rather as a description of the existence of a risk of a

significant effect (i.e. the possibility). Consequently, if the possibility of a significant effect cannot be excluded on the basis of objective information, an Appropriate Assessment will be required.

5.1.6. In the *Bagmoor Wind* case it was also suggested that, where the absence of a risk of a likely significant effect can only be established after detailed investigation or expert opinion, it is an indicator that there is an existence of a risk and the competent authority must move from screening to an Appropriate Assessment.

5.1.7. Although not the topic of this section, it is important to note that the existence of a risk to achieving the conservation objectives of a site as a result of project-related effects does not automatically equate to an adverse effect on the integrity of the site. The risk needs to be examined in detail to the point that no reasonable scientific doubt remains as to the absence of an adverse effect.

b) Mitigation

5.1.8. Where the potential for a likely significant effect is highlighted, it is possible that the effect could be completely avoided by the application of one or more avoidance (mitigation) measures. However, in line with the *People Over Wind and Sweetman v Coillte Teoranta* (C-323/17 – Ref. 3.3) ruling referred to in section 3 of this report, with the exception of mitigation measures that form an integral part of the Sizewell C Project's design, no additional measures intended to avoid or reduce an effect have been taken into account as part of the likely significant effect screening exercise set out herein (i.e. mitigation measures have not been used as a basis for screening effects out).

c) In-combination

5.1.9. The in-combination component of the likely significant effect test needs to focus only on those plans or projects that could potentially interact with the project under consideration. In this respect, the in-combination check must consider whether:

- the effects of the plans and projects, in combination, would make the effects of the project more likely to occur, or more likely to occur at significant levels, that alone would be unlikely to either occur or be significant;
- the effects of the plans and projects, in combination, would make insignificant effects significant; and
- the effects of the plans and projects, in combination, would generate new or different effects that would not occur if the plans and projects proceeded alone.

5.1.10. The approach taken to the in-combination assessment for the Sizewell C Project, including the selection of appropriate plans and projects for consideration in the assessment process, is set out in section 5.6 of this report.

5.2 Effect pathways

5.2.1. The test for likely significant effect requires that consideration is given to potential causes and effects (i.e. any likely effect pathways). Information on the project is needed to identify the potential causes of effects and information on the European site(s) is needed to identify any potential implications related to these effects. In the absence of a potential effect pathway, it can be concluded that no likely significant effect would arise. In respect of this aspect, it is also important to ensure that the potential for a risk is credible rather than hypothetical.

5.2.2. Within this assessment, each potential effect is considered using information from surveys undertaken to inform the HRA process, published literature (where available), other available baseline data, modelling outputs and professional judgement (informed by Ref. 5.2). Where a potential effect has been identified but no likely significant effect is predicted, the evidence and reason for reaching this conclusion are provided.

5.2.3. **Table 5.1** outlines the environmental 'effect' categories adopted for the likely significant effect screening exercise and their definitions for the construction, decommissioning and operational phases.

5.2.4. The judgement as to whether a significant effect is likely has been based on the best readily available information. The information required for determining whether a likely significant effect could arise varies from project to project, but it is the subsequent Appropriate Assessment (would an adverse effect on site integrity arise) stage that forms the more in-depth assessment (in most cases).

Table 5.1: Screening categories

Screening Category	Definition	
	Construction / Decommissioning	**Operation**
Alteration of coastal processes / sediment transport	This includes the potential for erosion, accretion and sedimentation (short and long term). The focus is largely on indirect effects (rather than direct effects which are covered under 'direct habitat loss and fragmentation'). This distinction has been made to avoid the double counting of effects.	As for construction.
Water quality effects – marine environment	This covers potential thermal and chemical (non-radiological and radiological) effects on water quality and indirect effects on habitats and species (including prey species), as well as water quality effects due to change in SSC (it does not include sedimentation, which is covered as part of 'alteration of coastal processes / sediment transport').	As for construction, but also: • chlorination effects associated with the management of organisms in the cooling water intake; and • the implications of the discharge from the FRR system.
Water quality effects – terrestrial environment	This covers potential supporting parameters and chemical effects on freshwater (surface and groundwater) – such as SSC and nutrient concentrations in addition to chemical status – as well as any potential indirect effects on habitats and species. Any foul water flows would be treated to ensure water quality effects are controlled.	This covers potential changes in supporting parameters (e.g. long-term flow changes associated with the cut-off wall and realignment of ditches), as well as any consequential indirect effects on habitats and species. No chemical effects are predicted during the operational phase in this context (as all discharge would be via the cooling water system).
Alteration of local hydrology and hydrogeology	This covers potential physical effects on freshwater (including surface and groundwater resources), i.e. effects on flows and water levels, as well as any consequential indirect effects on habitats and species.	As for construction.
Changes in air quality	This covers changes in air quality through radioactive and non-radioactive emissions to air and any consequential direct or indirect effects on habitats and species (e.g. lichens). Potential non-radiological air quality effects have been considered where the site is within 10km of the main development site	As for construction.

Screening Category	Definition	
	Construction / Decommissioning	**Operation**
	(and not considered beyond this distance). The ZOI for particulate (dust) emissions is generally much smaller than this (less than 500 m from the source).	
Radiological effects	This relates to the direct and indirect effects of any radiological emissions to soils, water and/or air. Commissioning impacts are covered under 'operation', since fuelling of the nuclear power station marks the start of the operational phase.	This relates to the direct and indirect effects of radiological emissions to air, land and the marine environment.
Direct habitat loss and fragmentation	This effect is limited to direct effects on habitats (not species). Indirect effects are covered in elsewhere, as noted above.	As for construction.
Disturbance effects on species populations	This effect is limited to potential disturbance effects on target species (not habitats), e.g. noise, light and human activity, and includes species displacement. Potential recreational disturbance effects are covered separately below.	As for construction.
Disturbance due to increased recreational pressure	Potential effects due to increased recreational pressure have been considered where the European site in question is within the ZOI of potential recreational effects. That is: • Zone of physical change – a 2km area around main development site. • Displacement zone – an 8km area around main development site. • Buffer zone – an 8km area around settlements within the displacement zone. Potential effects include trampling of supporting habitat, as well as disturbance effects to species and populations.	The potential for disturbance due to increased recreational pressure is considered to be of a lesser magnitude during the operational phase due to the large reduction in the number of workers required for this phase.
Physical interaction between species and Project infrastructure	Relates to the potential direct effects on qualifying features arising due to interactions (e.g. collisions) with the infrastructure or machinery associated with the Sizewell C Project.	Indirect effects could arise via effects on prey species (e.g. impingement and entrainment of small fish and their larvae and eggs).

5.2.5. The effects of the project have been considered with respect to all qualifying interest features of the scoped in European sites in order to determine whether a likely significant effect may arise. In line with the precautionary principle, where there is uncertainty or information is lacking in relation to the capacity of an effect to undermine a site's conservation objectives, it has been assumed that there could be an effect and a likely significant effect has not been ruled out.

5.3 Screening for likely significant effect

5.3.1. For an effect on a receptor (in this case a 'qualifying interest feature') to occur, the receptor needs to be sensitive to the change that would occur as a result of the activity and vulnerable to the effect (i.e. within the impact zone). This zone can be determined based on a number of methods, including modelling, to predict the direct and indirect area of effect, or ZOI, of the activity. Based on existing knowledge, it is possible to screen out the potential for some effects to occur on certain qualifying features either because they would not be vulnerable to any changes occurring as a result of the Sizewell C Project and/or they would not be sensitive to any changes that could occur.

5.3.2. The potential changes/effects identified in **Table 5.1** have been investigated to determine their likely ZOI and, together with existing knowledge of the sensitivity of the qualifying features of the European sites scoped in to the assessment, it has been possible to conclude that some qualifying features in some European sites can be 'screened out' for the purposes of further assessment. However, in line with the *Bagmoor Wind* case, if the possibility of a significant effect cannot be excluded on the basis of objective information, a potential change/effect has been screened into the Appropriate Assessment.

5.3.3. The outcome of the Sizewell C Project likely significant effect screening exercise is reported in **Appendix B1** (for SACs), **Appendix B2** (for SPAs) and **Appendix B3** (for Ramsar sites) of this report. The supporting evidence for the conclusions of the likely significant screening exercise is presented in **Table 5.2** (for habitat qualifying interest features of SACs and Ramsar sites), **Table 5.3** (for bird qualifying interest features of SPAs and Ramsar sites), **Table 5.4** (for marine mammal qualifying interest features of SACs) and **Table 5.5** (for migratory fish qualifying interest features of SACs).

Table 5.2: Supporting evidence to likely significant effect screening exercise for habitat qualifying interest features of SACs and Ramsar sites

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
1	Alteration of coastal processes / sediment transport	Construction and decommissioning
		1a) Justification for decision that likely significant effect cannot be excluded. Potential interruption to/alteration of coastal hydrodynamics and sediment transport processes as a result of the influence of marine infrastructure (outfall, intake and coastal defences) is likely to be confined to the vicinity of the works. The construction of a jetty is not proposed; rather either a rail-led or road-led freight management strategy is to be adopted, alongside a BLF for AILs. While that far-field effect on hydrodynamic and sediment transport processes are unlikely, this cannot be confirmed without undertaking further assessment, including hydrodynamic and sediment transport modelling. Therefore, it is not possible to exclude likely significant effect from alteration of coastal processes/sediment transport on the qualifying features of the SAC during construction and decommissioning.
		Operation
		1b) Justification for decision that likely significant effect cannot be excluded The presence of new structures in the marine environment in the operational phase is likely to only have a very localised effect on coastal processes and sediment transport. However, this can only be further assessment, including hydrodynamic and sediment transport modelling. Likely significant effect cannot, therefore, be excluded at this stage.
2	Water quality effects – marine environment	Construction and decommissioning
		2a) Justification for decision that likely significant effect cannot be excluded Any uncontrolled discharges to the marine environment in the vicinity of Sizewell (including sediment plumes from dredging) could affect water quality, leading to indirect effects on designated habitats along the Minsmere-Walberswick frontage. Therefore, likely significant effects cannot be excluded at this stage. 2b) Justification for decision that no likely significant effect would arise Any uncontrolled discharges to the marine environment in the vicinity of Sizewell (including sediment plumes from dredging) could affect water quality, leading to indirect effects on qualifying features. There is a weak southerly net drift of coastal sediments. As such there is the potential for this weak net movement to provide a pathway through which discharges (including spillages from pollution events) could impact upon water quality within European sites to the south of Sizewell. However, the amounts of sediment removal and release as a result of the construction activities would be small, whilst discharges to the marine environment are unlikely to result in any significant changes in water quality. Furthermore, dilution of any suspended sediments or potential

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
		pollutants would be substantial and resultant concentrations would be unlikely to be significant. Therefore, any effects on marine water quality are highly unlikely to affect the qualifying features of the European site, and no likely significant effect is predicted.
		Operation
		2c) Justification for decision that likely significant effects cannot be excluded The cooling water discharge would raise ambient water temperature and introduce potential pollutants into the water column. Given the tidal excursion, the plume associated with the discharge potentially could affect coastal waters and the coastline at some distance from the point of discharge. This is more likely to arise for locations in the immediate vicinity of the frontage or to the south, as there is a weak southerly net drift of coastal sediments. This weak net movement could provide a potential pathway through which discharges (including spillages from pollution events) could impact upon water quality within designated sites to the south of Sizewell. However, dilution of any potential pollutants or suspended sediments would be substantial and resultant concentrations would be unlikely to be significant. Nevertheless, discharges to the marine environment could affect water quality leading to indirect effects on designated habitats. Therefore, likely significant effects cannot be excluded at this stage.
3	Water quality effects – terrestrial environment	Construction and decommissioning
		3a) Justification for decision that likely significant effects cannot be excluded The construction of the two village bypass, which will be constructed over the River Alde, upstream of the SAC, has the potential to affect water quality, which may cause secondary effects on the qualifying habitat features of the SAC. Therefore, likely significant effects cannot be excluded at this stage. The two village bypass will not be decommissioned and will become part of the highway network. 3b) Justification for decision that likely significant effects cannot be excluded There are direct hydrological connections between the Sizewell C development area and Minsmere-Walberswick (south of the Minsmere New Cut) through the Minsmere Sluice. A number of factors mean that the potential for measurable hydrological impact as a result of construction (or decommissioning) activities on either side of the sluice is minimal but any increase in water levels at the Minsmere Sluice could potentially affect surface water levels to the north. As such, discharges into watercourses within the development area, or changes in water levels, flow, ditch alignment or sedimentation rates within the watercourses, could have a direct effect on water quality in the Minsmere South or Minsmere North Levels.

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
		Any construction activity that interrupts or alters the baseline groundwater regime (e.g. the presence of the proposed cut-off wall around the main site excavations, or reduced rainfall infiltration rates into the soil within the construction area due to the development) could potentially change the hydrological or hydrogeological properties of the site and adjacent land and, in turn, the conditions that support wetland habitat. The potential for direct effects on water quality in the Minsmere South or Minsmere North Levels means that likely significant effects cannot be excluded for those qualifying features dependent on wetland habitats.
		Operation
		3c) Justification for decision that cannot be excluded There are direct hydrological connections between the Sizewell development area and Minsmere–Walberswick (south of the Minsmere New Cut) through the Minsmere Sluice. The refurbished sluice prevents the ingress of water from the Leiston Drain system into the Minsmere New Cut and Scott's Hall Drain and vice versa. Although it is possible that water could move upstream through the syphon into Scott's Hall Drain if the penstock was open, this could only occur if the seaward end of the culverts was to become blocked and the penstock on Scott's Hall Drain was opened. This means that although there is a potential mechanism for water that enters the sluice chamber to pass upstream into the Scott's Hall Drain, this mechanism is reliant on head differences that are unlikely to occur under normal flow conditions. Even under such extreme conditions, which would occur rarely, if at all, there would be no passage of water from Leiston Drain to Scott's Hall Drain unless the penstock to Scott's Hall Drain is open. If it were to be open, it could be closed to prevent this occurring. This means that the potential for measurable hydrological impact on either side of the sluice is minimal. Although the form and operation of the sluice make changes unlikely, any increase in water levels at Minsmere Sluice could potentially affect surface water levels to the north. As such, discharges into watercourses within the development area, or changes in water levels/flow/ditch alignment/sedimentation rates within the watercourses, could have a direct effect upon water quality in Minsmere South or Minsmere North levels. Therefore, likely significant effects cannot be excluded at this stage. 3d) Justification for decision that no likely significant effects would arise The operation of the two village bypass is not expected to affect the water quality of the River Alde. In addition, the two village bypass is not expected to be decommissioned and will become part of the highway network. Therefore, likely significant effects can be excluded for this pathway of effect during operation and decommissioning.

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
4	Alteration of local hydrology and hydrogeology	Construction and decommissioning
		4a) Justification for decision that likely significant effects cannot be excluded The construction of the two village bypass, which will be constructed over the River Alde upstream of the Alde-Ore and Butley Estuaries SAC and Alde-Ore Estuary Ramsar site, has the potential to alter the local hydrology and hydrogeology which may cause secondary effects on the qualifying habitat features of the SAC and Ramsar site. Therefore, likely significant effects cannot be excluded at this stage. 4b) Justification for decision that likely significant effects cannot be excluded The northern park and ride proposal at Darsham may potentially alter the local hydrology and hydrogeology on which Dew's Pond SAC is dependent. Therefore, likely significant effects cannot be excluded at this stage. 4c) Justification for decision that likely significant effects cannot be excluded Any permanent development that interrupts or alters the baseline hydrological or hydrogeological regime (e.g. the presence of the proposed cut-off wall around the nuclear and conventional islands) potentially could change the hydrological or hydrogeological properties of the Minsmere to Walberswick Ramsar site and adjacent land and, in turn, the conditions that support wetland habitat. Although, the groundwater conceptualisation study, which has been carried out on a precautionary, 'without mitigation' basis, indicates that there is only localised and limited potential for effects on groundwater levels in the vicinity of the Ramsar site, likely significant effects cannot be excluded at this stage.
		Operation
		4d). Justification for decision that likely significant effects cannot be excluded The evidence reported in item 4a) is also relevant to the operational phase for the Alde-Ore and Butley Estuaries SAC and Alde-Ore Estuary Ramsar site. 4e) Justification for decision that likely significant effects cannot be excluded The evidence reported in item 4b) is also relevant to the operational phase for the Dew's Pond SAC. 4f) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 4c) is also relevant to the operational phase for the Minsmere to Walberswick Ramsar site.

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
5	Changes in air quality	Construction and decommissioning
		5a) Justification for decision that likely significant effects cannot be excluded Localised nutrient loading on vegetation communities (e.g. coastal, heathland) may arise as a result of construction activities. Some species/vegetation types are sensitive to relatively small changes in air quality (e.g. lichens). During the construction phase, the main potential emissions would be from road traffic and dust from construction activities
		Operation
		5b) Justification for decision that likely significant effect cannot be excluded During the operational phase, the main potential emissions may arise as a result of increased traffic flows and use of diesel generators for testing or as required. Any significant change in air quality is likely to be confined to the immediate vicinity of the nuclear power station as concentrations of potential pollutants would rapidly diminish away from the source. Far-field effects are therefore considered very unlikely to arise. However, on a precautionary basis, potential changes in air quality from combustion sources have been considered for sites within 10km of Sizewell C. Therefore, likely significant effects cannot be excluded at this stage. 5c) Justification for the decision that no likely significant effects would arise This qualifying interest feature is not considered to be sensitive to changes in air quality. No likely significant effect is therefore predicted.
6	Radiological effects	Construction and decommissioning
		6a) Justification for decision that no likely significant effect would arise Potential radiological effects resulting from construction and decommissioning activities relate to the disturbance of any existing (baseline) radiological contamination associated with soils, sediment and water. Detailed radiological analysis has confirmed that background levels around the Sizewell C main development site are negligible and consistent with the results of long-term operator monitoring which is subject to Environment Agency surveillance. The results are also consistent with other monitoring programmes such as the annual Radiation in Food and the Environment (RIFE) surveys compiled from monitoring undertaken around all nuclear sites in the UK by the Food Standards Agency and national environmental agencies. In addition, there is no evidence

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
		from desk studies to suggest that associated development sites are contaminated. Therefore, any disturbance associated with construction or decommissioning would not give rise to likely significant effects.
		Operation
		6b) Justification for decision that no likely significant effect would arise. The assessment of radiological effects on non-human biota considered a terrestrial, marine, coastal and freshwater habitat and considered predicted discharges from Sizewell C (and also these discharges in combination with discharges at permitted limits from Sizewell B power station). For all of the organisms evaluated, dose rates remained lower than the screening value of 10 µGy per hour that is considered protective of populations of non-human biota across all ecosystems. As such, based on the international recognised models used in EDF's assessment, the outputs from which are below the screening value, it can be concluded that there would be no likely significant effect on European sites.
7	Direct habitat loss and fragmentation	Construction and decommissioning
		7a) Justification for the decision that likely significant effects cannot be excluded Loss of habitats within the footprint of the Sizewell C main development site may affect the overall habitat resource available to mobile populations. While there would not be any direct impact on habitat extent within designated sites, the loss and fragmentation of supporting habitats off-site may adversely affect designated populations. Therefore, likely significant effects cannot be excluded at this stage. 7b) Justification for the decision that no likely significant effect would arise There is no direct habitat loss during construction.
8	Disturbance effects on species populations	The qualifying habitat features of SACs and Ramsar sites are not sensitive to disturbance from noise and visual sources and, therefore, no impact pathway exists.
9	Disturbance due to increased recreational pressure	Construction and decommissioning
		9a) Justification for the decision that likely significant effects cannot be excluded Minsmere to Walberswick Heaths and Marshes SAC is a well-used and managed site for recreational activities. The coastal frontage/beach at Dunwich and Walberswick is already subject to intense visitor use. The site improvement plan for the Minsmere-Walberswick SAC recognises that there is

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
		existing damage to the shingle vegetation at locations where visitor access is greatest, notably the car parks at Walberswick village and Dunwich village. Additional visitors to these locations resulting from the Sizewell C Project would be expected to follow similar behaviours to existing visitors and use the defined path network/beach. Further incursion by people into areas supporting sensitive vegetated shingle habitat would not be expected and additional loss of vegetation as a result of trampling is therefore considered unlikely to arise. However, because mitigation measures cannot be taken into account at the likely significant effect screening stage, it is concluded that likely significant effects cannot be excluded. 9b) Justification for the decision that likely significant effects cannot be excluded Subsequent to the production of the HRA Evidence Plan, the Sizewell C Visitor Surveys revealed that very few people indicated that they would potentially undertake recreational activity on Orfordness. In total, four people (0.78% of the survey sample) stated that they would consider Orford as an alternative location should they be displaced. Access to Orfordness is via boat / ferry from Orford and is managed by the National Trust. The numbers of people that can visit Orfordness is therefore effectively controlled. Once on the ness, visitors are restricted by the National Trust to specific areas in order to minimise disturbance to both shingle habitats and breeding / wintering bird populations. Potentially, access to Orfordness can be gained via the beach at the southern end of Aldeburgh (Slaughden) where there is a large car park. This would entail a long walk along the shingle bank / beach and access is dissuaded by the presence of a barrier to vehicles and signs stating that there is strictly no access (apart from sea anglers, who should keep to the beach) in order to prevent damage to the shingle vegetation. Public pedestrian access to Orfordness is also available from Slaughden, where there is free parking available within 200m of the site at the Martello Tower. Given these factors, the potential for the Sizewell C Project to generate additional disturbance to habitat features of the Orfordness to Shingle Street SAC is considered to be negligible. However, because this conclusion relies on elements that could be classed as mitigation, at this stage likely significant effects cannot be excluded. 9c) Justification for the decision that likely significant effects cannot be excluded Aldeburgh is a popular and well-established visitor destination. It is considered that the majority of additional visits undertaken by people displaced from Sizewell, or potentially the RSPB Minsmere Reserve, to Aldeburgh would involve activities on the immediate beach frontage around the town, rather than

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
		the estuarine habitats and landscape of the Alde-Ore Estuary Ramsar site. However, it is considered that there could be an increase in the number of visits to some locations around the Alde-Ore Estuary and further studies need to be carried out to assess this pathway of effect. Therefore, a likely significant effect cannot be excluded at this stage. 9d) Justification for decision that no likely significant effect would arise. Aldeburgh is a popular and well-established visitor destination. It is considered that the majority of additional visits undertaken by people displaced from Sizewell, or potentially the RSPB Minsmere Reserve, to Aldeburgh would involve activities on the immediate beach frontage around the town, rather than the estuarine habitats and landscape of the Alde-Ore and Butley Estuaries SAC. It is also considered unlikely that people using the car park to the south of the town would be inclined to attempt to walk down the shingle spit towards Orfordness. Overall, it is considered that while there could an increase in the number of visits to some locations around the Alde-Ore Estuary, the limited accessibility to qualifying habitats of the SAC indicates that the potential for an increase in disturbance is unlikely. No likely significant effect is therefore predicted.
		Operation
		9e) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 9a) is also relevant to the operational phase for the Minsmere to Walberswick Heaths and Marshes SAC. 9f) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 9b) is also relevant to the operational phase for the Orfordness to Shingle Street SAC. 9g) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 9c) is also relevant to the operational phase for the Alde-Ore Estuary Ramsar site. 9h) Justification for the decision that no likely significant effects would arise. The evidence reported in item 9d) is also relevant to the operational phase for the Alde-Ore and Butley Estuaries SAC.
10	Physical interaction	The qualifying habitat features of SACs and Ramsar sites are not sensitive to this effect and, therefore, no impact pathway exists.

Item	Screening Category	Rationale For Screening Decisions (Habitat Qualifying Interest Features of SACs and Ramsar Sites)
	between species and Sizewell C Project infrastructure	

Table 5.3: Supporting evidence to likely significant effect screening exercise for bird qualifying interest features of SPAs and Ramsar sites

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
1	Alteration of coastal processes / sediment transport	Construction and decommissioning
		1a) Justification for the decision that likely significant effects cannot be excluded Potential interruption to/alteration of coastal hydrodynamics and sediment transport processes as a result of the influence of marine infrastructure (outfall, intake and coastal defences) is likely to be confined to the vicinity of the works. This could affect nesting, foraging and roosting habitats of the qualifying bird features of the European site which use near-shore and intertidal habitats. While far-field effects on hydrodynamic and sediment transport processes are unlikely, this cannot be confirmed without undertaking further assessment, including hydrodynamic and sediment transport modelling. Therefore, it is not possible to exclude likely significant effects from alteration of coastal processes/sediment transport on the qualifying features of the European site during construction and decommissioning.
		Operation
		1b) Justification for the decision that likely significant effects cannot be excluded The presence of new structures in the marine environment in the operational phase is likely to only have a very localised effect on coastal processes and sediment transport. However, this can only be further assessment, including hydrodynamic and sediment transport modelling. Likely significant effects cannot, therefore, be excluded at this stage.
2	Water quality effects – marine environment	Construction and decommissioning
		2a) Justification for the decision that likely significant effects cannot be excluded Any uncontrolled discharges to the marine environment in the vicinity of Sizewell (including sediment plumes from dredging) could affect water quality, leading to indirect effects on habitats within designated sites along the Minsmere-Walberswick frontage (and any bird qualifying interest features

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		supported by these habitats). Therefore, likely significant effects cannot be excluded. 2b) Justification for the decision that no likely significant effects would arise Any uncontrolled discharges to the marine environment in the vicinity of Sizewell (including sediment plumes from dredging) could affect water quality, leading to indirect effects on qualifying features. There is a weak southerly net drift of coastal sediments. As such there is the potential for this weak net movement to provide a pathway through which discharges (including spillages from pollution events) could impact upon water quality within European sites to the south of Sizewell. However, the amounts of sediment removal and release as a result of the construction activities would be small, whilst discharges to the marine environment are unlikely to result in any significant changes in water quality. Furthermore, dilution of any suspended sediments or potential pollutants would be substantial and resultant concentrations would be unlikely to be significant. Therefore, any effects on marine water quality are highly unlikely to affect the qualifying features of the European site, and no likely significant effect is predicted.
		Operation
		2c) Justification for the decision that likely significant effects cannot be excluded The cooling water discharge would raise ambient water temperature and introduce potential pollutants into the water column. Given the tidal excursion, the plume associated with the discharge potentially could affect coastal waters and the coastline at some distance from the point of discharge. This is more likely to arise for locations in the immediate vicinity of the frontage or to the south, as there is a weak southerly net drift of coastal sediments. This weak net movement could provide a potential pathway through which discharges (including spillages from pollution events) could impact upon water quality within designated sites to the south of Sizewell. However, dilution of any potential pollutants or suspended sediments would be substantial and resultant concentrations would be unlikely to be significant. Nevertheless, discharges to the marine environment could affect water quality leading to indirect effects on designated habitats. Therefore, likely significant effects cannot be excluded. 2d) Justification for the decision that likely significant effects cannot be excluded Discharges during the operational phase would lead to a number of effects on the surrounding marine habitats, including increased water temperatures and increased total residual oxidants. Current modelling indicates that some of these effects may extend over a sufficiently large area as to have the potential to affect the marine foraging areas of some species that are qualifying features of the European site. This could affect the prey resource available to such species. Therefore, likely significant effects cannot be excluded.

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		2e) Justification for the decision that no likely significant effect would arise Discharges during the operational phase would lead to a number of effects on the surrounding marine habitats, including increased water temperatures and increased total residual oxidants. However, it is considered highly unlikely that this would lead to effects on those qualifying features of the European site that may use the associated coastal and estuarine habitats within the site, but do not depend upon marine habitats for foraging. Therefore, no likely significant effect is predicted.
3	Water quality effects – terrestrial environment	Construction and decommissioning
		3a) Justification for the decision that likely significant effects cannot be excluded The construction of the two village bypass, which will be constructed over the River Alde, upstream of the SPA and Ramsar site, has the potential to affect water quality, which may cause secondary effects on the qualifying interest features of the European sites. Therefore, likely significant effects cannot be excluded. The two village bypass will not be decommissioned and will become part of the highway network. 3b) Justification for the decision that likely significant effects cannot be excluded There are direct hydrological connections between the Sizewell C development area and Minsmere-Walberswick (south of the Minsmere New Cut) through the Minsmere Sluice. A number of factors mean that the potential for measurable hydrological impact as a result of construction (or decommissioning) activities on either side of the sluice is minimal but any increase in water levels at the Minsmere Sluice could potentially affect surface water levels to the north. As such, discharges into watercourses within the development area, or changes in water levels, flow, ditch alignment or sedimentation rates within the watercourses, could have a direct effect on water quality in the Minsmere South or Minsmere North Levels. The potential for direct effects on water quality in the Minsmere South or Minsmere North Levels means that likely significant effects cannot be excluded for those qualifying features dependent on wetland habitats. This includes breeding little tern because in recent years they have nested on the shingle islands in the main scrape in the RSPB Minsmere Reserve (as opposed to the shingle beach).
		Operation
		3c) Justification for decision that LSE cannot be excluded

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		There are direct hydrological connections between the Sizewell development area and Minsmere–Walberswick (south of the Minsmere New Cut) through the Minsmere Sluice. The refurbished sluice prevents the ingress of water from the Leiston Drain system into the Minsmere New Cut and Scott's Hall Drain and vice versa. Although it is possible that water could move upstream through the syphon into Scott's Hall Drain if the penstock was open, this could only occur if the seaward end of the culverts was to become blocked and the penstock on Scott's Hall Drain was opened. This means that although there is a potential mechanism for water that enters the sluice chamber to pass upstream into the Scott's Hall Drain, this mechanism is reliant on head differences that are unlikely to occur under normal flow conditions. Even under such extreme conditions, which would occur rarely, if at all, there would be no passage of water from Leiston Drain to Scott's Hall Drain unless the penstock to Scott's Hall Drain is open. If it were to be open, it could be closed to prevent this occurring. This means that the potential for measurable hydrological impact on either side of the sluice is minimal. Although the form and operation of the sluice make changes unlikely, any increase in water levels at Minsmere sluice could potentially affect surface water levels to the north. As such, discharges into watercourses within the development area, or changes in water levels/flow/ditch alignment/sedimentation rates within the watercourses, could have a direct effect upon water quality in Minsmere South or Minsmere North levels. Therefore, LSE cannot be excluded. 3d) Justification for decision that no LSE would arise The operation of the Two Village Bypass is not expected to affect the water quality of the River Alde. In addition, the Two Village Bypass is not expected to be decommissioned and will become part of the highway network. Therefore, LSE can be excluded for this pathway of effect during operation and decommissioning.
4	Alteration of local hydrology and hydrogeology	Construction and decommissioning
		4a) Justification for the decision that likely significant effects cannot be excluded The construction of the two village bypass, which will be constructed over the River Alde upstream of the Alde-Ore Estuary SPA and Ramsar site, has the potential to alter the local hydrology and hydrogeology which may cause secondary effects on the qualifying bird features of the SPA and Ramsar site. Therefore, likely significant effects cannot be excluded. 4b) Justification for decision that likely significant effect cannot be excluded Any permanent development that interrupts or alters the baseline hydrological or hydrogeological regime (e.g. the presence of the proposed cut-off wall around the nuclear and conventional islands) potentially could change the hydrological or hydrogeological properties of the Minsmere to Walberswick SPA and Ramsar site and adjacent land and, in turn, the conditions that support

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		wetland habitat. The potentially affected qualifying features of the SPA include breeding little tern because in recent years they have nested on the shingle islands in the main scrape within the RSPB Minsmere Reserve (as opposed to using the shingle beach). Although, the groundwater conceptualisation study, which has been carried out on a precautionary, 'without mitigation' basis, indicates that there is only localised and limited potential for effects on groundwater levels in the vicinity of the SPA and Ramsar site, likely significant effects cannot be excluded. 4c) Justification for the decision that no likely significant effects would arise The two village bypass is not expected to be decommissioned and will become part of the highway network. Therefore, likely significant effects can be excluded for this pathway of effect during decommissioning.
		Operation
		4d) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 4a) is also relevant to the operational phase for the Alde-Ore Estuary SPA and Ramsar site. 4e) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 4b) is also relevant to the operational phase for the Minsmere to Walberswick SPA and Ramsar site.
5	Changes in air quality	Construction and decommissioning
		5a) Justification for decision that likely significant effects cannot be excluded During the construction phase, the main potential emissions would be from road traffic and dust from construction activities. Changes in air quality would not have a direct effect upon SPA or Ramsar qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.
		Operation
		5b) Justification for the decision that likely significant effects cannot be excluded. During the operational phase, the main potential emissions may arise as a result of increased traffic flows and use of diesel generators for testing or as required.

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		Any significant change in air quality is likely to be confined to the immediate vicinity of the nuclear power station as concentrations of potential pollutants would rapidly diminish away from the source. Far-field effects are therefore considered very unlikely to arise. Changes in air quality would not have a direct effect upon SPA or Ramsar qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend. On a precautionary basis, potential changes in air quality from combustion sources have been considered for sites within 10km of Sizewell C. Therefore, likely significant effects cannot be excluded.
6	Radiological effects	Construction and decommissioning
		6a) Justification for the decision that no likely significant effects would arise Potential radiological effects resulting from construction and decommissioning activities relate to the disturbance of any existing (baseline) radiological contamination associated with soils, sediment and water. Detailed radiological analysis has confirmed that background levels around the Sizewell C main development site are negligible and consistent with the results of long-term operator monitoring which is subject to Environment Agency surveillance. The results are also consistent with other monitoring programmes such as the annual Radiation in Food and the Environment (RIFE) surveys compiled from monitoring undertaken around all nuclear sites in the UK by the Food Standards Agency and national environmental agencies. In addition, there is no evidence from desk studies to suggest that associated development sites are contaminated. Therefore, any disturbance associated with construction or decommissioning would not give rise to likely significant effects.
		Operation
		6b) Justification for decision that no likely significant effects would arise The assessment of radiological effects on non-human biota considered a terrestrial, marine, coastal and freshwater habitat and considered predicted discharges from Sizewell C (and also these discharges in combination with discharges at permitted limits from Sizewell B power station). For all of the organisms evaluated, dose rates remained lower than the screening value of 10 µGy per hour that is considered protective of populations of non-human biota across all ecosystems. As such, based on the international recognised models used in EDF's assessment, the outputs from which are below the screening value, it can be concluded that there would be no likely significant effects on European sites.
7	Direct habitat loss and fragmentation	Construction and decommissioning
		7a) Justification for the decision that likely significant effects cannot be excluded

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		Loss of habitats within the footprint of the Sizewell C main development site may affect the overall habitat resource available to mobile populations. While there would not be any direct impact on habitat extent within designated sites, the loss and fragmentation of supporting habitats off-site has the potential to affect designated populations. Therefore, likely significant effects cannot be excluded. 7b) Justification for the decision that no likely significant effects would arise There is no direct habitat loss during construction. 7c) Justification for the decision that no likely significant effects would arise The qualifying feature is considered to make, at most, limited use of the affected habitats and/or not to be dependent upon supporting habitats outside the SPA, so that effects of habitat loss and habitat fragmentation as a result of construction (and decommissioning) activities are considered unlikely. Therefore, no likely significant effect is predicted. 7d) Justification for the decision that no likely significant effect would arise The habitat loss due to the combined area covered by the outfall, intake, FRR, BLF and CDO structures equates to 0.000128 % of the SPA extent. On that basis, it is concluded that the loss is insignificant.
		Operation
		7e) Justification for the decision that likely significant effects cannot be excluded The loss of habitat within the footprint of the Sizewell C development during operation may affect those qualifying features that rely upon supporting habitats outside the SPA and Ramsar site. 7f) Justification for the decision that no likely significant effects would arise The loss of habitat within the footprint of the Sizewell C development during operation may affect those qualifying features that rely upon supporting habitats outside the European site. Therefore, likely significant effects cannot be excluded for those qualifying features that may use the affected habitats and which may rely upon supporting habitats outside the European site. 7g) Justification for the decision that no likely significant effects would arise

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		The qualifying feature is considered to make, at most, limited use of the affected habitats and/or not to be dependent upon supporting habitats outside the SPA, so that effects of habitat loss and habitat fragmentation as a result of operation are considered unlikely. Therefore, no likely significant effect is predicted.
8	Disturbance effects on species populations	Construction and decommissioning
		8a) Justification for the decision that likely significant effects cannot be excluded Construction (and decommissioning) activities within the terrestrial environment may have direct and indirect disturbance effects (from both noise and visual stimuli) on the SPA and Ramsar site qualifying features. Disturbance could have a number of detrimental effects on qualifying features, including displacement from habitats and barrier effects (which could lead indirectly to habitat fragmentation). The likelihood of such disturbance effects would diminish with distance, so that the qualifying features which use habitats in relatively close proximity to the construction site are most likely to be affected. Therefore, likely significant effects cannot be excluded. Within the marine environment, disturbance may arise from increased vessel traffic associated with construction and from activities such as piling. Potentially, this could affect the foraging behaviour and available prey resource of the breeding and non-breeding bird populations.
		Operation
		8b) Justification for the decision that likely significant effects cannot be excluded Noise and visual stimuli during operation (e.g. from increased traffic and artificial lighting) may have direct and indirect disturbance effects on the SPA and Ramsar site qualifying features. Disturbance could have a number of detrimental effects on qualifying features, including displacement from habitats and barrier effects (which could lead indirectly to habitat fragmentation). The likelihood of such disturbance effects would diminish with distance, so that the qualifying features which use habitats in relatively close proximity are most likely to be affected. Therefore, likely significant effects cannot be excluded.
9	Disturbance due to increased recreational pressure	Construction and decommissioning
		9a) Justification for the decision that likely significant effects cannot be excluded The Minsmere-Walberswick SPA and Ramsar site includes many well-used and managed sites for recreational activities, such as Minsmere RSPB Reserve, Dunwich Heath (owned and managed by the National Trust) and Westleton Heath, to the south of Dunwich Forest (not itself part of the European site), and Walberswick National Nature Reserve (NNR) (incorporating Westwood Marshes and Walberswick Common), to the north. Many of these areas, in particular the coastal frontage/beach at Dunwich and Walberswick,

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		are already subject to intense visitor use. Additional visitors to these locations resulting from the Sizewell C Project would be expected to follow similar behaviours to existing visitors and use the defined path networks/accessible beaches. Measures would be put in place to help manage any potential increase in visitor numbers and, as such, significant adverse effects are not predicted. However, because mitigation measures cannot be taken into account at the screening stage, likely significant effects cannot be excluded. 9b) Justification for the decision that likely significant effects cannot be excluded Aldeburgh is a popular and well-established visitor destination. It is considered that the majority of additional visits undertaken by people displaced from Sizewell, or potentially the RSPB Minsmere Reserve, to Aldeburgh would involve activities on the immediate beach frontage around the town, rather than the estuarine habitats and landscape of the Alde-Ore Estuary Ramsar site. However, it is considered that there could be an increase in the number of visits to some locations around the Alde-Ore Estuary and further studies need to be carried out to assess this pathway of effect. Therefore, likely significant effects cannot be excluded. 9c) Justification for the decision that likely significant effects cannot be excluded The influx of workers to Sizewell during the construction (and potentially decommissioning) phase for the Sizewell C development potentially could lead to an increase in the number of people partaking in recreational activities in the surrounding countryside, whilst existing recreational users in the vicinity of the development (e.g. dog walkers on Sizewell beach) could also be displaced to other areas. A ZOI of 16km around Sizewell has been assumed for such potential effects, which encompasses the Alde-Ore SPA and Ramsar site. Such increased recreational pressure is likely to involve activities on the immediate beach frontage at Aldeborough, rather than on the estuarine habitats of the Alde-Ore Estuary SPA. Furthermore, there are relatively few access points to this SPA, with access to a large part of the site (Orfordness and Havergate Island) being restricted and controlled by the National Trust and the RSPB. It is also considered unlikely that people using the car park to the south of the town would be inclined to walk down the shingle spit towards Orfordness, and the key intertidal habitats supporting SPA qualifying features tend to be relatively inaccessible. However, despite all this, the potential for an increase in the number of visits to some locations around the Alde-Ore Estuary cannot be discounted and further studies need to be carried out to remove this pathway of effect. Therefore, likely significant effects cannot be excluded. 9d) Justification for the decision that likely significant effects cannot be excluded The influx of workers to Sizewell during the construction (and potentially decommissioning) phase for the Sizewell C development potentially could lead

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		to an increase in the number of people partaking in recreational activities in the surrounding countryside, whilst existing recreational users in the vicinity of the development (e.g. dog walkers on Sizewell beach) could also be displaced to other areas. The Benacre to Easton Bavents SPA is also covered by the Suffolk Recreational Avoidance and Mitigation Strategy (RAMS). Further studies need to be carried out to determine whether there is the potential for an adverse effect on the qualifying species of the SPA; therefore, likely significant effects cannot be excluded. 9e) Justification for the decision that likely significant effects cannot be excluded Sandlings SPA includes a number of discrete areas of heathland, acid grassland and coniferous plantations. Within the 8km displacement buffer zone the SPA component area comprises Aldringham Walks, to the south of Sizewell, and North Warren Nature Reserve located to the west of Thorpeness and north of Aldeburgh. Both of these sites are located away from the immediate coast and are more discrete than the sites at Minsmere and Dunwich. As a result, they have fewer visitor facilities and are accessed via a series of smaller and informal car parks. Given the extensive and spatially disparate nature of the habitat comprising the SPA is that an adverse effect from Sizewell C at the level of designated SPA populations is considered to be unlikely. Measures would be put in place to help manage any potential increase in visitor numbers and, as such, significant adverse effects are not predicted. However, because mitigation measures cannot be taken into account at the likely significant effect screening stage, likely significant effects cannot be excluded.
		Operation
		9f) Justification for decision that likely significant effects cannot be excluded The evidence reported in item 9a) is also relevant to the operational phase for the Minsmere-Walberswick SPA and Ramsar site. 9g) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 9b) is also relevant to the operational phase for the Alde-Ore Estuary SPA Ramsar site. 9h) Justification for the decision that likely significant effects cannot be excluded During the operational phase, staffing levels at Sizewell C would be considerably lower than during construction and any Public Rights of Ways (PRoWs) affected by the construction activities would be re-opened, so that the potential for any increase in recreational disturbance to affect the qualifying

Item	Screening Category	Rationale For Screening Decisions (Bird Qualifying Interest Features Of SPAs and Ramsar Sites)
		features of the Alde-Ore SPA would be less than during the construction phase. However, further studies would need to be carried out to determine this; therefore, likely significant effects cannot be excluded. 9i) Justification for the decision that likely significant effects cannot be excluded The evidence reported in item 9e) is also relevant to the operational phase for the Sandlings SPA.
10	Physical interaction between species and Sizewell C Project infrastructure	Operation
		10a) Justification for the decision that likely significant effects cannot be excluded Impingement and entrainment of the small fish, larvae, eggs and marine invertebrates will occur as a result of the operation of the cooling water system, which may lead to a reduction in the availability of prey for foraging seabirds. Although any such effects are likely to be localised, the scale of these losses will need to be quantified in order to assess the likelihood of any effects on the species from these qualifying features of the European site. Therefore, likely significant effects cannot be excluded.

Table 5.4: Supporting evidence to likely significant effect screening exercise for marine mammal qualifying interest features of SACs

Item	Screening Category	Rationale For Screening Decisions (Marine Mammal Qualifying Interest Features Of SACs)
1	Alteration of coastal processes / sediment transport	The marine mammal qualifying interest features of SACs are not sensitive to this effect and, therefore, no impact pathway exists.
2	Water quality effects – marine environment	Construction and decommissioning
		2a) Justification for the decision that likely significant effects cannot be excluded. Any uncontrolled discharges to the marine environment in the vicinity of Sizewell (including sediment plumes from dredging) could affect water quality, leading to indirect effects on designated habitats along the Minsmere-Walberswick frontage and direct effects on marine mammals qualifying interest features and/or indirect effects on prey species in the SAC. Therefore, likely significant effects cannot be excluded. 2b) Justification for the decision that likely significant effects cannot be excluded

Item	Screening Category	Rationale For Screening Decisions (Marine Mammal Qualifying Interest Features Of SACs)
		Any uncontrolled discharges to the marine environment (including sediment plumes from dredging) could affect water quality, leading to indirect effects on prey species of foraging grey seal.
		Operation
		2c) Justification for the decision that likely significant effects cannot be excluded. The cooling water discharge would raise ambient water temperature and introduce potential pollutants into the water column. Given the tidal excursion, the plume associated with the discharge potentially could affect coastal waters and the coastline at some distance from the point of discharge. This is more likely to arise for locations in the immediate vicinity of the frontage or to the south, as there is a weak southerly net drift of coastal sediments. This weak net movement could provide a potential pathway through which discharges (including spillages from pollution events) could impact upon water quality within designated sites to the south of Sizewell. However, dilution of any potential pollutants or suspended sediments would be substantial and resultant concentrations would be unlikely to be significant. Nevertheless, discharges to the marine environment could affect water quality leading to indirect effects on designated habitats along the Minsmere-Walberswick frontage and, potentially, direct effects on harbour porpoise from the Southern North Sea SAC and / or indirect effects on prey species for harbour porpoise of the Southern North Sea SAC, harbour seal of The Wash and North Norfolk Coast SAC and grey seal of The Humber Estuary SAC. The thermal and chemical plumes associated with the discharge may alter water quality properties such that small-scale behavioural effects on local fish communities may occur, altering the spatial distribution of the fish assemblage; including changes to the availability of potential prey species for marine mammals. The water quality assessment will consider chlorination of the intake tunnels in accordance with the proposed chlorination strategy for Sizewell C. This will cause the discharge from the FRR system to contain chlorination products (total residual oxidants and chlorination by-products). This discharge would be at a different location than the cooling water outfall but the discharge rate would be small in comparison with the cooling water plume (approximately 1 cumec compared to 125 cumecs) and it is expected that the effects of this discharge would be only discernible over a very short range. The FRR discharge would also return fish that have been exposed to chlorination products in the cooling water system. Some of these fish will be prey species for marine mammals. The fish would only be exposed to chlorination for a short period as they transit through the system and are not expected to accumulate detectable levels of chlorination products before discharge to sea. The discharge and any potential environmental effects (including any potential effects on seabirds) will be subject to a separate assessment. Likely significant effects cannot be excluded.
3	Water quality effects –	The marine mammal qualifying interest features of SACs are not sensitive to this effect and, therefore, no impact pathway exists.

Item	Screening Category	Rationale For Screening Decisions (Marine Mammal Qualifying Interest Features Of SACs)
	terrestrial environment	
4	Alteration of local hydrology and hydrogeology	The marine mammal qualifying interest features of SACs are not sensitive to this effect and, therefore, no impact pathway exists.
5	Changes in air quality	The marine mammal qualifying interest features of SACs are not sensitive to this effect and, therefore, no impact pathway exists.
6	Radiological effects	Construction and decommissioning
		6a) Justification for the decision that no likely significant effects would arise. Potential radiological effects resulting from construction and decommissioning activities relate to the disturbance of any existing (baseline) radiological contamination associated with soils, sediment and water. Detailed radiological analysis has confirmed that background levels around the Sizewell C main development site are negligible and consistent with the results of long-term operator monitoring which is subject to Environment Agency surveillance. The results are also consistent with other monitoring programmes such as the annual Radiation in Food and the Environment (RIFE) surveys compiled from monitoring undertaken around all nuclear sites in the UK by the Food Standards Agency and national environmental agencies. In addition, there is no evidence from desk studies to suggest that associated development sites are contaminated. Therefore, any disturbance associated with construction or decommissioning would not give rise to likely significant effects.
		Operation
		6b) Justification for the decision that no likely significant effects would arise. The assessment of radiological effects on non-human biota considered a terrestrial, marine, coastal and freshwater habitat and considered predicted discharges from Sizewell C (and also these discharges in combination with discharges at permitted limits from Sizewell B power station). For all of the organisms evaluated, dose rates remained lower than the screening value of 10 µGy per hour that is considered protective of populations of non-human biota across all ecosystems. As such, based on the international recognised models used in EDF's assessment, the outputs from which are below the screening value, it can be concluded that there would be no likely significant effects on European sites.
7	Direct habitat loss and fragmentation	Construction and decommissioning
		7a) Justification for the decision that likely significant effects cannot be excluded.

Item	Screening Category	Rationale For Screening Decisions (Marine Mammal Qualifying Interest Features Of SACs)
		Construction activities including the construction of the intakes and outfalls, FRR and dredging can cause habitat loss and fragmentation, even if temporary. Therefore, it is not possible to exclude likely significant effects.
		Operation
		7b) Justification for the decision that likely significant effects cannot be excluded. During operation, the discharge of the thermal and chemical plumes and presence of infrastructure will cause the direct and indirect loss and fragmentation of habitats. Therefore, it is not possible to exclude likely significant effects.
8	Disturbance effects on species populations	Construction and decommissioning
		8a) Justification for the decision that likely significant effects cannot be excluded. Construction activities (e.g. piling and vessel traffic) in the marine environment may lead to disturbance and displacement of harbour porpoise as well as their key prey species, such as small fish, from near shore waters that are utilised as a foraging area by marine mammal species. Likely significant effects cannot be excluded.
9	Disturbance due to increased recreational pressure	The marine mammal qualifying interest features of SACs are not sensitive to this effect and, therefore, no impact pathway exists.
10	Physical interaction between species and Sizewell C Project infrastructure	Construction and decommissioning
		10a) Justification for the decision that likely significant effects cannot be excluded. There is the potential for direct physical interaction between marine mammal qualifying interest features and vessels required for construction. There is also the potential for indirect effects through the interaction of prey and project infrastructure including construction of the dredge area, intakes and outfalls and the FRR system. Likely significant effects cannot be excluded.
		Operation
		10b) Justification for the decision that likely significant effects cannot be excluded. Operation of the cooling water system could lead, via impingement and entrainment, to a localised loss in small fish species (and their prey) that are the prey of marine mammals. The impingement assessment will also consider the potential effects of chlorination of the intake tunnels on fish survival from the FRR discharge. Likely significant effects cannot be excluded.

Table 5.5: Supporting evidence to likely significant effect screening exercise for migratory fish qualifying interest features of SACs

Item	Screening Category	Rationale For Screening Decisions (Migratory Fish Qualifying Interest Features Of SACs)
1	Alteration of coastal processes / sediment transport	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
2	Water quality effects – marine environment	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
3	Water quality effects – terrestrial environment	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
4	Alteration of local hydrology and hydrogeology	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
5	Changes in air quality	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
6	Radiological effects	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
7	Direct habitat loss and fragmentation	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
8	Disturbance effects on species populations	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
9	Disturbance due to increased recreational pressure	No discernible impact pathway is evident due to the distance between the European site and the Sizewell C Project.
10	Physical interaction between species and Sizewell C Project infrastructure	Operation
		10b) Justification for the decision that likely significant effects cannot be excluded. Operation of the cooling water system could lead, via impingement and entrainment, to a localised loss in migratory fish species that are a qualifying interest feature of a European site. Likely significant effects cannot be excluded.

5.4 Radiological effects

a) Impact of radioactive discharges on non-human biota

5.4.1. Radioactivity is a natural phenomenon with natural sources of radiation being found all around in the environment. Activities such as the operation of Sizewell C have the potential to add to the natural and pre-existing radioactivity in the environment and as such the risks to the public and the environment that may arise must be assessed and, if necessary, controlled.

5.4.2. As part of the planned operation of Sizewell C, discharges of low levels of radioactivity will be made to both the atmosphere and marine environment. In order to undertake this activity, SZC Co. must first apply for an Environment Permit under Schedule 23 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (EPR16) or as they are also known, Radioactive Substances Regulations. This application process involves an in-depth Radiological Impact Assessment of the effects of the proposed discharges on the members of the public and non-human biota.

5.4.3. It is via the permitting process that the Environment Agency demonstrates it has met it obligations under the EU Wild Birds and Natural Habitats Directives to ensure that no Environment Agency permitted activity results in an adverse effect, either directly or indirectly, on the integrity of *Natura 2000* sites (Ref. 5.3).

b) Criteria for assessing LSE

5.4.4. The assessment undertaken by the Environment Agency for the UK EPR™ technology (Ref. 5.4) adopted the default screening value included in the internationally accepted ERICA (Environment Risks from Ionising Contaminants: Assessments and management; Ref. 5.5) Integrated Approach of 10µGy/h. This is the proposed generic screening value that below which 95% of all species should be protected from ionising radiation. The Environment Agency (Ref. 5.4) states that the 10µGy/h criterion is a screening value which should be used to screen out sites (meaning power stations or other sources of radioactive discharge) of low concern, with no further requirement for assessment (noting that this value is not intended for use as a dose rate limit).

5.4.5. In addition, ERICA includes the conservative screening dose rate of 10 µGy per hour. This value has, therefore, been applied in the screening assessment.

c) Likely significant effect screening for radiological effects

5.4.6. The full assessment for non-human biota can be found within the 'Sizewell C Non-Human Biota Radiological Impact Assessment'. A summary is provided below.

5.4.7. The assessment was undertaken using the European Commission's ERICA tool, with the exception of noble gas releases which were modelled using the Environment Agency's Research and Development Report (R&D) 128 Methodology (Ref. 5.6).

5.4.8. Assessment of non-human biota is demonstrated using established methodologies against a number of reference organisms which are considered to be representative of the Sizewell C ecosystem. The selection of reference organisms is based on habitat and feeding habits, bio-accumulation.

5.4.9. The terrestrial, marine, coastal and freshwater habitats were considered and the assessment considered predicted discharges from Sizewell C and also these discharges in combination with discharges at permitted limits from Sizewell B power station.

5.4.10. For all of the organisms evaluated, dose rates remained lower than the screening value of 10 µGy per hour that is considered protective of populations of non-human biota across all ecosystems.

5.4.11. In conclusion, the impacts of radioactive effluent discharges on non-human biota from the proposed Sizewell C nuclear power plant alone and in-combination with Sizewell B are predicted to be very low. As such, based on the international recognised models used in EDF's assessment, the outputs from which are below the screening value, it can be concluded that there would be no likely significant effect on European sites. Hence, radiological effects have been screened out.

5.5 Findings of the alone Stage 1 screening exercise

5.5.1. The European site scoping exercise identified 30 European sites for inclusion in the likely significant effect screening assessment, as identified in **Table 4.4** and **Table 4.5**.

5.5.2. For each qualifying feature of these European sites, the screening exercise assessed whether or not a likely significant effect for the Sizewell C Project alone had the potential to arise for ten (environmental effect) screening categories (agreed with the HRA Working Group).

5.5.3. The screening exercise concluded that likely significant effects could not be excluded for at least one screening category for 29 of the scoped in European sites (and certain relevant qualifying features). The exception was the Staverton Park and the Thicks, Wantisden SAC, for which likely significant effects could be excluded for all screening categories and qualifying features.

5.5.4. The remaining 29 European sites were, therefore, carried forward into the Appropriate Assessment stage of the HRA process (section 7, section 8, section 9, and section 10 of this report), where those effects that have the potential to have a significant influence on those qualifying features 'screened in' are considered further (all other potential effects and qualifying features being excluded from further examination). **Table 5.6**: summarises the qualifying features screened in for each European Site taken forward to the next stage.

Table 5.6: Qualifying interest features 'screened in' for further assessment

No.	European Site	Qualifying Interest Features Screened In To Further Assessment
1	Alde-Ore and Butley Estuaries SAC	• Estuaries • Mudflats and sandflats not covered by seawater at low tide • Atlantic salt meadows
2	Alde-Ore Estuary SPA	Breeding birds: • Avocet *Recurvirostra avosetta* • Marsh harrier *Circus aeruginosus* • Little tern *Sternula albifrons* • Sandwich tern *Thalasseus sandvicensis* • Lesser black-backed gull *Larus fuscus* Over wintering birds: • Avocet *Recurvirostra avosetta* • Redshank *Tringa totanus* • Ruff *Philomachus pugnax*
3	Alde-Ore Estuary Ramsar site[11]	• Ramsar criterion 2 - nationally-scarce plant species and British Red Data Book invertebrates • Ramsar criterion 3 - the site supports a notable assemblage of breeding and wintering wetland birds

[11] For all Ramsar sites, the qualifying interest features listed are those which are identified as qualifying 'Ramsar criteria' in the *Information Sheet on Ramsar Wetlands* for each Ramsar site. Other 'noteworthy flora and fauna' are not included as qualifying interest features of the Ramsar site. This approach aligns with that adopted for other recent HRAs for DCO applications (e.g. Wylfa Newydd Nuclear Power Station and East Anglia ONE North Offshore Windfarm).

No.	European Site	Qualifying Interest Features Screened In To Further Assessment
		• Ramsar criterion 6 - species/populations occurring at levels of international importance – lesser black-backed gull
4	Benacre to Easton Bavents Lagoons SAC	• Coastal lagoons
5	Benacre to Easton Bavents SPA	Breeding birds: • Bittern *Botaurus stellaris* • Little tern *Sternula albifrons* • Marsh harrier *Circus aeruginosus*
6	Deben Estuary SPA	Over wintering birds: • Avocet, *Recurvirostra avosetta* • Dark-bellied Brent goose *Branta bernicla bernicla*
7	Deben Estuary Ramsar site	• Ramsar criterion 6 - species/populations occurring at levels of international importance - dark-bellied Brent goose *Branta bernicla bernicla*
8	Dew's Ponds SAC	• Great crested newt *Triturus cristatus*
9	Humber Estuary SAC	• Grey seal *Halichoerus grypus* • Sea lamprey *Petromyzon marinus* • River lamprey *Lampetra fluviatilis*
10	Minsmere to Walberswick Heaths and Marshes SAC	• Annual vegetation of drift lines • European dry heaths • Perennial vegetation of stony banks
11	Minsmere-Walberswick SPA	Breeding birds: • Avocet *Recurvirostra avosetta* • Bittern *Botaurus stellaris* • Little tern *Sternula albifrons* • Marsh harrier *Circus aeruginosus* • Nightjar *Caprimulgus europaeus* • Shoveler *Anas clypeata* • Teal *Anas crecca* • Gadwall *Anas strepera* Over wintering birds: • Gadwall *Anas strepera* • Hen harrier *Circus cyaneus* • Shoveler *Anas clypeata* • White fronted goose *Anser albifrons albifrons*

No.	European Site	Qualifying Interest Features Screened In To Further Assessment
12	Minsmere-Walberswick Ramsar site	• Ramsar criterion 1 - mosaic of marine, freshwater, marshland and associated habitats • Ramsar criterion 2 - supports nine nationally scarce plants and at least 26 red data book invertebrates; an important assemblage of rare breeding birds associated with marshland and reedbeds
13	Orfordness-Shingle Street SAC	• Coastal lagoons • Annual vegetation of drift lines • Perennial vegetation of stony banks
14	Outer Thames Estuary SPA	Breeding birds: • Little tern *Sternula albifrons* • Common tern *Sterna hirundo* Over wintering birds: • Red-throated diver *Gavia stellata*
15	Sandlings SPA	Breeding birds: • Nightjar *Caprimulgus europaeus* • Woodlark *Lullula arborea*
16	Southern North Sea SAC	• Harbour porpoise *Phocoena phocoena*
17	Stour and Orwell Estuaries SPA	Breeding birds: • Avocet *Recurvirostra avosetta* Over wintering birds: • Pintail *Anas acuta* • Dark-bellied Brent goose • Dunlin *Calidris alpina alpine* • Knot *Calidris alpine* • Black-tailed godwit *Limosa limosa islandica* • Grey plover Pluvialis squatarola • Redshank *Tringa totanus* • Assemblage qualification: wetland of international importance and waterbird assemblage
18	Stour and Orwell Estuaries Ramsar site	• Ramsar criterion 2 - supports seven nationally scarce plants and five red data book invertebrates • Ramsar criterion 5 – assemblages of international importance: waterfowl • Ramsar criterion 6 - species/ populations occurring at levels of international importance
19	The Wash and Norfolk Coast SAC	• Harbour seal *Phoca vitulina*

No.	European Site	Qualifying Interest Features Screened In To Further Assessment
20	Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent SCI	• Twaite shad *Alosa fallax*
21	Unterweser SCI	• Twaite shad *Alosa fallax*
22	Weser bei Bremerhaven SCI	• Twaite shad *Alosa fallax*
23	Nebenarme der Weser mit Strohauser Plate und Juliusplate SCI	• Twaite shad *Alosa fallax*
24	Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI	• Twaite shad *Alosa fallax*
25	Unterelbe SCI	• Twaite shad *Alosa fallax*
26	Mühlenberger Loch/Neßsand SCI	• Twaite shad *Alosa fallax*
27	Rapfenschutzgebiet Hamburger Stromelbe SCI	• Twaite shad *Alosa fallax*
28	Hamburger Unterelbe SCI	• Twaite shad *Alosa fallax*
29	Elbe zwischen Geesthacht und Hamburg SCI	• Twaite shad *Alosa fallax*

5.6 Screening of in-combination effects

a) Identification of relevant plans and projects

5.6.1. A screening exercise was carried out for the Sizewell C Project which identified a 'long list' of plans or projects that could, potentially, cause a likely significant in-combination effect with the construction and operational phases of the Sizewell C Project. In this context, potential decommissioning effects are considered to be undefinable.

5.6.2. In order to produce the 'long-lists' of other plans and projects for HRA, a search of relevant local authority planning and the MMO's licence application portals (within the Sizewell C Project's wider ZOI) and a review of relevant

development plans (and emerging development plans) was undertaken to identify a list of plans and projects to be considered within the likely significant in-combination effect screening exercise. However, as set out section 3.4 of this report, it is only possible to assess proposals where there is sufficient available information to allow an in-combination assessment to be undertaken. Therefore, the search focused on proposals for which a planning application had been made/was valid or for which there was a current planning permission. An exception to this was made for any proposals identified during Pre-Application Consultation and for which information was publicly available prior to a planning application being made.

5.6.3. Not all of the projects identified from the planning search have the potential to have in-combination effects with the Sizewell C Project. That is, there are certain types of development that are considered to be insignificant in nature and scale (e.g. change of use or conversions to existing buildings and erection of agricultural buildings) and, as such, are unlikely to have the potential to contribute to significant in-combination effects. These types of development were, therefore, scoped out.

5.6.4. It is also acknowledged that some plans and projects may cause effects at a significant distance from the source because some ecological receptors are highly mobile. Hence, plans and projects were considered for inclusion in the likely significant in-combination effect screening exercise where they had the potential to affect the same qualifying interest features of European sites, irrespective of the distances between the sources of such effects.

5.6.5. An information gathering exercise was undertaken to collect relevant details of all the non-Sizewell C Project plans and projects included within the residual list. Data was gathered from the following sources:

- the planning search;
- the HRA Working Group; and
- direct liaison with agents/applicants.

5.6.6. This exercise provided the following:

- information on the design and spatial location of each non-Sizewell C plan or project;
- an understanding of the temporal aspects of each plan or project, for both its construction and operational phases (in this context developments that were found to be built were scoped out as any effects they will have caused will have been taken into account within the baseline description); and

- relevant environmental information to inform the in-combination assessment.

5.6.7. Using the information from the information gathering exercise, further scoping of non-Sizewell C Project plans and projects was undertaken based on expert judgement to develop a 'short list' of plans and projects to be considered in the likely significant in-combination effect screening exercise. The following criteria were used to guide this process:

- spatial overlaps;
- temporal overlaps;
- specificity of impacts (i.e. does the potential exist for the same receptors to be affected - if not, even though they may be spatially and temporally adjacent, an in-combination effect would not arise); and
- the availability of data that allowed a valid assessment to be undertaken.

5.6.8. The outcome of this exercise was a master list of non-Sizewell C plans and projects to be taken forward and considered further in the likely significant in-combination effect screening assessment as seen in **Appendix C** of this report.

b) Findings of the likely significant in-combination effect Stage 1 screening exercise

5.6.9. **Table C.1** (**Appendix C** of this report) provides details of each of the plans and projects that it was considered could act in-combination with the predicted effects of the Sizewell C Project and justifies whether the plan/project was screened in (and will be considered in the Appropriate Assessment in-combination assessment) or out (and will not be considered). The European sites for which a potential in-combination effect could occur are also listed in **Table C.1**.

5.6.10. The outcome of the likely significant in-combination effect assessment for each European site is reported in **Appendices B1** (for SACs), **B2** (for SPAs) and **B3** (for Ramsar sites).

6 Description of Baseline Conditions

6.1 Introduction

6.1.1. The following sections describe those European sites and their associated interest features for which a likely significant effect cannot be excluded (as previously summarised in section 5 of this report), and summarise the available information and evidence used to enable the Appropriate Assessment to be undertaken for the Sizewell C Project. A summary of relevant baseline information is presented in this section for:

- coastal, freshwater and terrestrial habitats;
- birds;
- marine mammals; and
- migratory fish.

6.2 Coastal, freshwater and terrestrial habitats

a) Introduction

6.2.1. The following sections summarise available information which is relevant to the assessment of the potential effects of the Sizewell C Project on the coastal, freshwater and terrestrial habitats of the following European sites:

- Alde, Ore and Butley Estuaries SAC.
- Alde-Ore Estuary Ramsar site.
- Benacre to Easton Bavents Lagoons SAC.
- Deben Estuary Ramsar site.
- Dew's Ponds SAC.
- Minsmere to Walberswick Heaths and Marshes SAC.
- Minsmere-Walberswick Ramsar site.
- Orfordness to Shingle Street SAC.
- Stour and Orwell Estuaries Ramsar site.

6.2.2. An overview of the shoreline and coastal environment, as well as key to the coastal processes that characterise the study area, is provided as content. European site citations and management plans have then been used to

provide a summary description of the baseline habitats present and the qualifying features screened into the Appropriate Assessment.

b) Coastal processes overview

6.2.3. The shoreline at Sizewell forms part of a longer 16km coastal bay (the Greater Sizewell Bay) defined by headlands at Southwold (Blyth Estuary training walls) in the north and Thorpeness (erosion-resistant Coralline Crag) in the south. This bay has a classic coastal curvature, with a long southern arm, extending between Thorpeness and Dunwich aligned approximately north-south, and a shorter northern arm aligned approximately north-east to south-west. The concrete outfall to Minsmere Sluice (built in 1830) also acts as a minor headland, resulting in a shallow bay between the sluice and Thorpeness. Hence, the coast can be defined by two 'nested' bays within a larger bay.

6.2.4. The bay coast comprises a beach that is relatively steep and composed of shingle in its upper part (with subordinate sand) (Ref. 6.1) becoming a shallow-sloping sand foreshore (intertidal) and shoreface (subtidal). The shallow subtidal zone is shaped into an inner longshore bar which is 50-150m from the coast (3m ordnance datum (OD) contour) with crest elevations between -1.2m and -3.0m OD and a larger outer longshore bar, 150-400m offshore with crest elevations of -2.5m to -4.5m OD. The bars are approximately shore-parallel and dissipate wave energy at the coast.

6.2.5. Approximately 3.5-4km offshore from the coast is Sizewell-Dunwich Bank, a sand bank system anchored to the south on the rocky Coralline Crag spurs that stretch across the sea bed from Thorpeness (Ref. 6.2). Its higher north end (Dunwich Bank at -4m to -5m elevation) and south end (Sizewell Bank at -3 m to -5 m elevation) are connected by a lower elevation (-7m) middle section. Sizewell-Dunwich Bank is separated from the outer longshore bar by a 1200m-wide up to 9m deep channel.

6.2.6. Between Southwold and Thorpeness the coastal landscape is controlled by the interaction between cliff erosion, alongshore sediment supply and transport, the movement of nearshore sand banks, tidal flows, waves and storm surges (Ref. 6.1). The complex shore system at Sizewell is maintained by sediment (sand) transport processes which begin with the input of sediment from cliff erosion to the north (Minsmere-Dunwich and Easton-Covehithe). This sediment is then transported south by low energy waves towards Thorpeness, where partial deposition of sediment occurs. It is then possible that the sand component is transported offshore to Sizewell-Dunwich Bank leaving the gravel component forming the core of Thorpeness. BEEMS Technical Report TR311 (Ref. 6.1) demonstrates that the shingle component of the beaches is effectively static; there is little or no exchange

of beach shingle with areas offshore and it moves very slowly in the longshore sediment transport system.

6.2.7. Although there is significant gross transport of sediment both to the north and south along the Southwold to Thorpeness shoreline, the net volume of sediment moving to the south along the coast is relatively small (Ref. 6.1). Potential alongshore sediment transport rates between Southwold and Thorpeness have been modelled by a study undertaken in 2010, which found that net transport to the south decreased from a rate of approximately 11,050 m^3/year at Minsmere to 3,500 m^3/year at Sizewell to 300 m^3/year at Thorpeness.

6.2.8. The Southwold to Thorpeness beaches are composed of sand and gravel and their general form is sensitive to changes in wave energy and sediment supply, which can cause quite large fluctuations in beach position. The coastline is frequently affected by storm surges which can result in significant beach, dune and cliff erosion. The sensitivity of the beaches to fluctuations in wave energy and sediment supply means they are sensitive to engineering interventions elsewhere along the shore (including Minsmere Sluice). The importance of alongshore sediment transport also means that the shore is sensitive to migration of nearshore banks, which influence patterns of wave approach and, therefore, sediment transport.

6.2.9. BEEMS Technical Report TR311 (Ref. 6.1) divides the Southwold to Thorpeness coast into nine behavioural systems based on its evolution from 1992 onwards. From north to south, these are:

- Dunwich cliffs: low rates of shoreline change, advancing in the north and south (0.0 m to 0.7 m/year) and eroding in the centre (about -0.1 m to -0.6 m/year);
- Minsmere north: highest rates of erosion in the bay with a generally persistent trend (-0.6 m to -2.2 m/year);
- Minsmere Sluice: highly variable shoreline position with near-zero or slowly advancing net shoreline change (0.2 m to 1.1 m/year);
- Minsmere south: relatively high rates of erosion with a generally persistent trend (-0.5 m to -1.4 m/year);
- Sizewell C: low rates of shoreline change, eroding to the north and stable and/or advancing to the south (-0.4 m to 0.5 m/year);
- Sizewell B: variable shoreline position with high rates of net shoreline advance (-0.1 m to 1.6 m/year);

- Sizewell Gap and south: variable shoreline position with low rates of shoreline change (-0.4 m to 0.3 m/year);
- Thorpeness north: variable shoreline position with near-zero or slowly eroding (0.2 m to -0.8 m/year); and
- Thorpeness: highly variable shoreline position with high rates of change near the tip of the ness (-1.4 m to 0.7 m/year).

6.2.10. Sizewell-Dunwich Bank represents a natural wave break, dissipating wave energy through bottom friction and preventing larger waves from propagating inshore and thus reducing erosion rates along this shoreline. As a result, Sizewell-Dunwich Bank forms an integral component of the shore defence and provides stability of the Sizewell coastal system. Tucker *et al*. (1983 – Ref. 6.3) showed that small waves experience negligible attenuation over Sizewell-Dunwich Bank, but large waves were reduced under storm conditions. BEEMS Technical Report TR319 (Ref. 6.4) shows that large waves (greater than 4m high offshore) break extensively on the bank. Hence, the bank imposes a cap on nearshore wave height (Ref. 6.5) because of this wave breaking during storms. However, as the bank elevation and width are not uniform, larger waves can penetrate to the nearshore zone through bank sections where the water is deeper or narrower.

6.2.11. It appears that the height and position of Sizewell-Dunwich Bank has varied over time. Over the last few decades, the bank system has rotated anticlockwise with the northern part migrating landwards at a rate of 6-7 m/year (Ref. 6.2) and the southern end anchored to the sea bed and Thorpeness headland outcrops of Coralline Crag. The northern (Dunwich) end of the bank system is not closely attached to a headland and is more variable in its position, height and width.

6.2.12. Studies of the evolution of the Sizewell-Dunwich Bank have identified that during periods of higher wave energy, cliff erosion to the north supplies relatively large volumes of sediment to the coastal zone to the south. Transport along the longshore bars delivers sediment onto the Sizewell beaches and then possibly to Sizewell-Dunwich Bank from Thorpeness, raising its height, and offering more protection from waves to the adjacent coastline (Ref. 6.6, Ref. 6.7 and Ref. 6.8). Cliff erosion (at least from Dunwich cliffs) and sediment supply to Sizewell-Dunwich Bank will then reduce in response to the higher bank and lowered inshore wave climate. In turn, bank volume and height will decline with time, and inshore wave energy levels and cliff erosion will rise again.

6.2.13. It is likely that the effects of climate-change induced sea-level rise could increase the supply of sediment from cliff erosion to the north (Ref. 6.9). In addition, an increase in sediment supply could occur if structures (such as

Minsmere Sluice) were to be removed or fall into disrepair. According to BEEMS Technical Report TR311 (Ref. 6.1), potentially additional sediment would reduce coastal erosion rates and increase accretion rates where they currently occur, and over the long-term could lead to slow growth of Sizewell-Dunwich Bank. A growing bank that keeps pace with sea-level rise would continue to dissipate wave energy, maintaining the low rates of longshore transport and coastal change in the Sizewell area.

c) Alde, Ore and Butley Estuaries SAC

i. Estuaries

6.2.14. The estuary complex is made up of three rivers, the Alde, the Ore and Butley, and covers an area of 1,076 ha, 0.34% of the total area of estuaries in the UK (Ref. 6.10).

6.2.15. The upper Alde is relatively shallow and meanders through extensive intertidal mudflats, which stretch across 1.5 km between Iken marshes and Blackheath. Mixed salinity sandy mud dominates, with widespread bivalve communities. At the head of the Alde, the muddy substrate supports mainly estuarine communities dominated by polychaete worms. Subtidal sediments here are primarily muddy (Ref. 6.11). Saltmarsh is present along the length of the river channel and along the north shore at Blackheath and Little Japan. South of Aldeburgh, the River Alde becomes the River Ore. Here the channel narrows and deepens, creating stronger currents and narrower mudflats along the shores with subtidal sediments becoming mixed. Recent evidence has found aggregations of ross worm *Sabellaria spinulosa* on subtidal mixed sediment near Havergate Island (Ref. 6.10).

6.2.16. Butley Creek is smaller and contains extensive saltmarsh in the upper reaches and western shore of the river with reedbeds bordering the intertidal mudflats. It flows into the River Ore at Boyton Marshes. The River Ore splits to flow around Havergate Island, which is made up of important coastal lagoon and saltmarsh habitats (Ref. 6.12; Ref. 6.13).

ii. Mudflats and sandflats not covered by seawater at low tide

6.2.17. At the time of designation, the area of mudflats and sandflats within the site was 6.25km^2, which represented 0.2% of the UK's total extent of the feature (Ref. 6.10). A study carried out in 2014 showed the extent to have decreased to approximately 5.55km^2 (Ref. 6.14).

6.2.18. The invertebrate communities of the mudflats and sandflats at the site are extremely diverse (Ref. 6.15). Muddy substrata at the head of the Alde is supported by typical upper estuary communities dominated by polychaetes and amphipods (Ref. 6.16) The bivalve Baltic tellin *Macoma balthica* and the

polychaete fanworm *Manayunkia aestuarina* are especially abundant in the mudflats and sandflats of the Alde, where the mud shrimp *Corophium volutator* and mud snail *Peringia ulvae* are also frequently observed. Sandy substrates support high densities of blow lug worm *Arenicola marina* and the rare tentacled lagoon worm *Alkmaria romijni* has been found at Butley Creek, Sudbourne and near Stoney Ditch on Orford Ness (Ref. 6.16). Fucoid seaweeds are also found scattered in narrow strips and on buried features throughout the flats.

6.2.19. Intertidal coarse sediment within the site consists of localised areas of barren littoral shingle at the mouth of the River Ore, where higher exposure to wave energy and tidal scour has reduced the proportions of fine and silty sediments present. Intertidal coarse sediment communities include species of ribbon worms (Nemertea), round worms (Nematoda), and bivalves. These communities are, however, sparse and highly variable, and are potentially present after being washed down from muddier habitat types located higher in the estuary or adjacent shores (Ref. 6.14).

6.2.20. The intertidal mixed sediment within the site is most prevalent on the banks of the Ore where it often occupies the full extent of intertidal area. Here the Alde, Butley and Ore systems meet, resulting in strong tidal scouring at all shore heights, restricting the settlement of finer sediments. Additional isolated patches of mixed sediment are also present along the lower shore of the Alde, where localised areas of tidal scour occur on otherwise sheltered banks, such as adjacent to Cobb Island. Intertidal mixed sediment communities within the site are characterised by abundant numbers of polychaete worms, including cirratulids (mostly *Aphelochaeta* species) and ragworm *Hediste diversicolor*, and the common occurrence of tubificid oligochaete worms. In one small area of mixed sediment in the lower Ore, abundant numbers of the mud shrimp *Corophium volutator* have also been found (Ref. 6.14).

6.2.21. Intertidal mud is the most common form of littoral sediment found within the site and is distributed throughout the Rivers Alde, Ore and Butley with the exception of the Lower Ore where currents restrict the settlement of finer sediments. In the Upper Alde, intertidal mud is found across comparatively broader banks compared to the rest of the site, with banks here stretching up to around 500m from the lower to the upper shore. Intertidal mud communities support a range of species but are largely characterised by the presence of ragworm *Hediste diversicolor*, Baltic tellin *Macoma balthica* and peppery furrow shell *Scrobicularia plana*. Along the narrower upper reaches of the Alde, where intertidal mud communities are more heavily influenced by freshwater, the mud shrimp *Corophium volutator* is particularly abundant due to its tolerance of variable salinity conditions (Ref. 6.14).

6.2.22. Intertidal sand and muddy sand is limited to two localised areas on the lower shores of the Upper Alde above which the broad intertidal mud banks are found. These patches of intertidal sand and muddy sand are located near areas where the effects of tidal scour are more evident. These contain slightly larger proportions of very fine to coarse sands than surrounding sediments from which the fine sediments have eroded. Intertidal sand and muddy sand communities have been found to support communities of edible cockle *Cerastoderma edule* and polychaetes (Ref. 6.14).

iii. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

6.2.23. Over the past several thousand years the development of the Alde-Ore Estuary has been intimately linked to the development of Orford Spit and the land-claim of saltmarsh formed in the shelter of the spit. Before embanking and land-claim, saltmarsh was much more extensive in the estuary. The main enclosure of saltmarsh took place in two phases, between the 11th and 13th centuries and in the 16th and 17th centuries.

6.2.24. The remaining active saltmarshes form a narrow fringe in front of the flood embankments along much of the estuary, with more extensive active marshes at Shingle Street, Havergate Island, Stony Ditch, the upper reaches of the Butley river and in places on the Alde river, including near Iken. Pye and Blott (Ref. 6.17) determined the average surface elevation of the mature active marshes along the Alde-Ore Estuary in 2012. There is a general trend for increasing elevation upstream in the estuary. The active marshes on the opposite side of the Butley Estuary to Gedgrave Marshes have median elevations of 1.53m to 1.56m OD, whereas the active marshes at Iken have median elevations of 1.56m OD (north Iken) and 1.60m OD (south Iken).

6.2.25. The saltmarsh present is mostly dominated by sea purslane, *Halimione portulacoides* and sea lavender, *Limonium vulgare*, but a wide range of other saltmarsh species also occur including sea heath, *Frankenia laevis*, glasswort, *Salicornia pusilla* and small cord grass, *Spartina maritima*. Higher saltmarsh grading into neutral grassland, dominated by sea couch grass, *Elymus athericus*, occurs on Havergate Island and Orfordness and on the extensive system of clay embankments throughout the site.

6.2.26. The Atlantic salt meadows feature comprises the following saltmarsh zones: low-mid marsh, upper marsh and transition and drift line marsh. The low-mid marsh is characterised by species-poor community NVC SM13, dominated by common saltmarsh grass. This community often develops from SM10 communities (transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima*) where land is inundated less frequently (Ref. 6.18). The upper marsh displays the sea wormwood *Artemisia maritima* and NVC SM17 saltmarsh community (*Artemisia maritima* saltmarsh community) throughout the entire estuary. Transition and drift line

saltmarsh is abundant along the sea wall and upper transition zones where there is no sea wall present. Transitional zones with abundant SM24 community (*Elymus athericus* saltmarsh community) are found in the upper most reaches of the Alde and Butley rivers. This is an important community as it holds a range of rare invertebrates, particularly the narrow-mouthed whorl snail *Vertigo angustior* and grey bushcricket *Platycleis albopunctata*.

6.2.27. Other plant species of note include slender hare's-ear *Bupleurum tenuissimum*, shrubby sea-blite *Suaeda vera*, golden samphire *Inula crithmoides*, and the only record of extended sedge *Carex extensa* in Suffolk. The nationally important population of small cord-grass *Spartina maritima* is scattered across the SAC but declining in extent. The diverse vegetation provides feeding opportunities for redshank, avocet, and other water birds (Ref. 6.18).

6.2.28. A site condition assessment carried out in 2010 shows that the majority of the site units designated as mudflats and sandflats and saltmarsh have been assessed as being either in favourable condition or unfavourable but recovering condition. At five areas, the site has been assessed as being unfavourable with no change (Ref. 6.19).

d) Alde-Ore Estuary Ramsar site

i. Ramsar criterion 2

6.2.29. The site comprises the estuary complex of the rivers Alde, Butley and Ore, including Havergate Island and Orfordness and a variety of habitats, such as intertidal mudflats, saltmarsh, vegetated shingle (including the second-largest and best-preserved area of such in Britain at Orfordness), saline lagoons and grazing marsh. The Orfordness/Shingle Street landform is unique within Britain in combining a shingle spit with a cuspate foreland. The site supports nationally-scarce plants, British Red Data Book invertebrates, and notable assemblages of breeding and wintering wetland birds (Ref. 6.20).

6.2.30. The Alde-Ore Ramsar site is legally underpinned by the Alde-Ore Estuary SSSI. As such, the following information relating to habitats and species (other than birds) is extracted from the SSSI citation (Ref. 6.21).

Botany

6.2.31. The botanical interest of this site is enriched by the variety of habitats present, including mudflats, saltmarsh, brackish lagoons, shingle beach, reedbeds, grassland, freshwater and brackish ditches. Mudflats of mixed clay, silt and shingle border the Ore, Butley and Alde rivers and Havergate Island within a tidal range of up to 2m. In places this supports the rare intertidal flowering

plant *Zostera angustifolia*. Narrow fringes of saltmarsh occur along the length of the rivers with wider expanses at Shingle Street, Havergate Island, Stony Ditch, the upper reaches of the Butley river and in places by the Alde river. These are mostly dominated by sea purslane *Halimione portulacoides* and sea lavender *Limonium vulgare*, but a wide range of other saltmarsh species also occur, including sea-heath *Frankenia laevis*, glasswort *Salicornia pusilla*, small cord-grass *Spartina maritima* and Borrer's saltmarsh-grass *Puccinellia fasciculata*.

6.2.32. The vegetated shingle present is a nationally rare and delicate habitat which supports a highly specialised flora. Species typical of exposed, shifting shingle such as sea pea *Lathyrus japonicus* and sea kale *Crambe maritima* are abundant whilst extensive areas of sea campion *Silene uniflora* and stonecrops *Sedum acre* and *S. anglicum* occur on more stable ground. Orfordness contains one of the best examples of zonation in the shingle vegetation. A wide range of rare or local species also occur, including yellow vetch *Vicia lutea* and the dwarf clovers *Trifolium suffocatum*, *T. glomeratum*, *T. striatum*, *T. scabrum* and bur medick *Medicago minima*. Lichen communities are also well developed here with extensive areas of *Cladonia heath*. A unique feature for East Anglia beach formations is the abundance on the ground of normally epiphytic lichens *Flavoparmelia caperata* and *Evernia prunastre*.

Invertebrates

6.2.33. The lagoons at Shingle street are notable for a number of brackish water species, particularly the rare anthozoan *Nematostella vectensis*, and the site is also noted for a number of rare spiders. Several nationally rare and scarce insects are found within ditches running through Hazelwood Marshes.

e) Benacre to Easton Bavents Lagoons SAC

i. Coastal lagoons

6.2.34. The coastline between Benacre Ness and Easton Bavents is dominated by two stretches of undefended cliff less than 6m high: Covehithe and Easton Bavents cliffs. These stretches of cliff are broken by a series of small brackish lagoons (and marsh). Benacre, Covehithe and Easton Broads have formed behind shingle barriers and are a feature of the geomorphologically dynamic system. Seawater enters the lagoons by percolation through the barriers, or by overtopping during storms and high spring tides (Ref. 6.22). Satellite images reveal that the SAC lagoons hold around 35 ha of open water in total, with extent and depth varying over time (Ref. 6.23).

6.2.35. Salinity fluctuates between the lagoons, creating a wide range of conditions from extremely low salinity in parts of Benacre Broad to highly saline

conditions at Benacre Pit. This range of salinity has resulted in a series of lagoonal vegetation types, which support distinctive communities of flora and fauna, including lagoonal specialists that are adapted to varying salinity. Other species include the isopod *Lekanesphaera hookeri*, sea slug *Tenellia adspersa*, lagoon cockle *Cerastoderma glaucum*, lagoon sand shrimp *Gammarus insensibilis* and starlet anemone *Nematostela vectensis* (Ref. 6.23).

6.2.36. The shingle barriers are under threat of breaching by coastal erosion. Washover deposits are common on the marsh surface. At Benacre Broad, the average rate of erosion has been over 4 m/year (Ref. 6.24) and is related to the northward migration of Benacre Ness. At Easton Broad, the average erosion rate is 2.2 m/year. Local exposure of intertidal mudflat and saltmarsh sediment on the foreshore is caused by erosion of the shingle. The shingle beaches fronting the lagoons are likely to 'roll-over' as a response to erosion, but are less likely to withstand future natural pressures, such as sea-level rise. Continued erosion of this stretch of coastline would ultimately lead to the loss of the lagoons and their associated habitats.

6.2.37. An ecological survey carried out in February 2012 (Ref. 6.25) found that Benacre Pit supported the most diverse and abundant aquatic plant and animal communities recorded. This included the starlet sea anemone and lagoon sand shrimp. The survey identified that the principal threat to the habitat was the potential encroachment and/or breaching of the shingle embankment on the eastern (seaward) side of the site.

6.2.38. For Benacre Broads, a 2012 survey (Ref. 6.25) found that the floral and faunal assemblages were poor following a 2011 seawater inundation event. The amphipod *Corophium volutator* was the dominant species, recorded at very high densities at a number of sites. At Covehithe Broad, faunal and floral assemblages were also very poor, with indications that the water was eutrophic. Finally, at Easton Broad, the fauna and flora were recorded as generally poor in terms of abundance and number of species with evidence of eutrophication.

f) Deben Estuary Ramsar site

i. Ramsar criterion 2

6.2.39. Deben Estuary Ramsar site qualifies under Ramsar criterion 2 (described above).

6.2.40. The Deben Estuary extends south-eastwards for over 12km from the town of Woodbridge to the sea just north of Felixstowe. It is relatively narrow and sheltered and has limited amounts of freshwater input. The estuary mouth is the narrowest section and is protected by the presence of shifting sandbanks.

The intertidal areas are constrained by sea walls. The saltmarsh and intertidal mudflats that occupy the majority of the site, however, display the most complete range of saltmarsh community types in Suffolk. The estuary holds a range of swamp communities that fringe the estuary, and occasionally form larger stands. In general, these are dominated by Common Reed *Phragmites australis* (Ref. 6.26).

6.2.41. The site is underpinned by the Deben Estuary SSSI, Ferry Cliff, Sutton SSSI and Ramsholt Cliff SSSI. For the Deben Estuary SSSI, in the period between 2009 and 2011, 16 out of the 22 site units were recorded as being in 'unfavourable – declining' condition, mainly as a result of coastal squeeze (all those being identified as in unfavourable condition representing littoral units). All other units in these SSSIs were deemed to be in 'favourable' condition (Ref. 6.27).

6.2.42. The site supports a supports a population of the mollusc *Vertigo angustior*. Martlesham Creek is one of approximately fourteen sites in Britain where this species survives (Ref. 6.28).

g) Dew's Ponds SAC

i. Great crested newt *Triturus cristatus*

6.2.43. The site is found in the parish of Bramfield, north-east Suffolk, some 5km south of the town of Halesworth and 10km west of the Suffolk coast. This part of Suffolk has a high density of farm ponds, supporting a widespread distribution of great crested newts. The majority of the site is on level ground with an underlying geology of chalk which is overlain by an extensive deposit of boulder clay. The clay gives rise to a poorly draining, moderately nutrient-rich heavy soil.

6.2.44. There are twelve ponds within the site ranging from long established farm ponds to recently created ponds (created in the 1990s). The ponds contain a variety of emergent and submerged aquatic vegetation including bearded stonewort *Chara canescens*. Surrounding the ponds is rough, semi-improved grassland with some scrub and hedgerow habitat. This terrestrial habitat is important to newts for feeding, shelter and hibernation during the non-breeding season.

6.2.45. Great crested newts have been recorded in at least nine of the twelve ponds in exceptional numbers. The site is currently identified as being in favourable condition (Ref. 6.29). The population of great crested newts at the site has been established as being between 101 to 250 individuals (Ref. 6.30).

6.2.46. Various other amphibians and reptiles also breed on site including the smooth newt *Triturus vulgaris*, common frog *Rana temporaria*, common toad

Bufo bufo, grass snake *Natrix natrix*, slow-worm *Anguis fragilis* and common lizard *Laccerta vivipara*.

h) Minsmere to Walberswick Heaths and Marshes SAC

i. Annual vegetation of drift lines

6.2.47. This site is one of two representatives of annual vegetation of drift lines on the east coast of England, occurring on a well-developed beach strandline of mixed sand and shingle and contains shingle species such as sea sandwort *Honckenya peploides* and sea beet *Beta vulgaris* ssp. *maritima*. Annual vegetation of drift lines is a scarce habitat type and the Joint Nature Conservation Committee (JNCC) (Ref. 6.31) estimate only 100ha remain in England. The Natural England Condition Assessment for this unit to the north of the Sizewell C power station (unit 113) states that *"this unit has been destroyed through natural processes, and the unit should be removed from the site accordingly"* (Ref. 6.32). Despite the "*annual vegetation of drift lines*" feature being the reason for the designation, given the above it is assumed that it is no longer present in this location.

ii. European dry heaths

6.2.48. The lowland European dry heaths occupy a large continuous tract of about 400ha at Minsmere, Dunwich and Westleton Heath, with smaller areas at Walberswick. It is at its extreme easterly range of heath development in the UK. The heathland is predominantly NVC type H8 *Calluna vulgaris – Ulex gallii* heath, dominated by heather *C. vulgaris*, western gorse *U. gallii*, and bell heather *Erica cinerea.* The heath vegetation present is to the north and seaward of the proposed Sizewell C power station.

iii. Perennial vegetation of stony banks

6.2.49. Perennial vegetation of stony banks is a qualifying feature of the site but not a primary reason for site selection. Located landward of the bare shingle at the high tide mark, the vegetated areas are dominated by sand dune lying on top of the underlying shingle. The dune supports elements of dry heath vegetation, with both heather and bell heather being present. Therefore, the heath vegetation present to the north and seaward of the proposed Sizewell C power station is considered to form part of the *"perennial vegetation of stoney banks"* SAC interest features (Ref. 6.31).

i) Minsmere-Walberswick Ramsar site

i. Ramsar criterion 1

6.2.50. This composite Suffolk coastal site contains a complex mosaic of habitats notably, areas of marsh with dykes, extensive reedbeds, mudflats, lagoons,

shingle, woodland and areas of lowland heath. The site supports the largest continuous stand of reed *Phragmites australis* in England and Wales and nationally rare transition in grazing marsh ditch plants from brackish to fresh water. The combination of habitats creates an exceptional area of scientific interest supporting nationally scarce plants, Red Data Book invertebrates and nationally important numbers of breeding and wintering birds.

6.2.51. This is one of few sites nationally for red-tipped cudweed *Filago lutescens* which occurs on light, sandy soils and the nationally rare species grey hair-grass *Corynephorus canescens* occurs on coastal dune habitat, both of which are Red Data Book species. The site supports a range of nationally scarce plant species characteristic of heathland, wetland and coastal habitats, and the transitions between them: marsh-mallow *Althaea officinalis,* whorled water-milfoil *Myriophyllum verticillatum,* spiral ditchgrass *Ruppia cirrhosa,* great water-parsnip *Sium latifolium,* marsh sowthistle *Sonchus palustris,* soft hornwort *Ceratophyllum submersum,* brackish water-crowfoot *Ranunculus baudotii,* and separated sedge *Carex divisa* (all nationally scarce) are associated with reedbeds, grazing marsh or ditches. Sea barley *Hordeum marinum* occurs on sea-walls, sea pea *Lathyrus japonicus* on coastal shingle, and moss pygmyweed *Crassula tillaea* on heathland.

6.2.52. There are a number of nationally important invertebrate species occurring on the site, including the following: *Ethmia bipunctella*, *Aleochara inconspicua*, *Philonthus dimidiatipennis, Deltote bankiana, Cephalops perspicuus, Erioptera bivittata, E. meijerei, Gymnancycla canella, Pisidium pseudosphaerium, Archanara neurica, Heliothis viriplaca, Pelosia muscerda, Photedes brevilinea, Senta flammea, Herminea tarsicrinalis, Haematopota grandis, Tipula marginata, Podalonia affinis, Arctosa fulvolineata, Eucosma catroptana, E.maritima, Melissoblaptes zelleri, Pima boisduvaliella, Acrotophthalmus bicolor, Limonia danica, Telmaturus tumidulus, Vertigo angustior* (a Habitats Directive Annex II species (S1014)).

6.2.53. A small lagoon isolated and adjacent to the coast with no direct connection to the Leiston Drain was identified for monitoring to determine any connectivity between the lagoon and the sea. Salinity monitoring between July 2014 and May 2015 showed that the lagoon is brackish in nature (6 to 25 psu), indicating some limited seawater input, entering the pond slowly, mostly likely via slow diffusion through the dune system that lies between the pond and the coast (Ref. 6.33).

ii. Ramsar criterion 2

6.2.54. The Ramsar site supports nine nationally scarce plants and at least 26 red data book invertebrates. It supports a population of the mollusc narrow-mouthed whorl snail *(Vertigo angustior)* (Habitats Directive Annex II; British

Red Data Book Endangered), recently discovered on the Blyth estuary river walls.

j) Orfordness to Shingle Street SAC

i. Coastal lagoons

6.2.55. The coastal lagoons in the Orfordness-Shingle Street SAC encompass a series of percolation lagoons and, together with Benacre to Easton Bavents and The Wash and North Norfolk Coast, form a significant part of the percolation lagoon resource on the south east coast of England. The shingle ridges that form Orfordness extend about 15km south from Aldeburgh on the Suffolk coast and diverts the River Ore for a similar distance. South of the river, the shingle ridges at Shingle Street continue southwards towards Bawdsey (Ref. 6.34).

6.2.56. The feed of shingle that is transported around Thorpeness moves south beyond Aldeburgh to form the beaches of Orford Spit and Ness. The spit diverts the course of the River Alde to join the River Ore, with a mouth at Orford Haven between Shingle Street and North Weir Point. The spit is backed by low-lying marsh through which the River Ore meanders. The shingle of the spit and ness is in the range 4mm to 75mm and is composed of a high proportion of highly resistant flint.

6.2.57. The lagoons are classified as percolation lagoons because their salinity is maintained by percolation through the shingle, although at high tides sea water can overtop the shingle bank (Ref. 6.35; Ref. 6.36).

6.2.58. Coastal lagoons are relatively uncommon in the UK and are, therefore, designated as a priority habitat type. The water in the lagoons can vary in salinity from brackish to hypersaline, and the plant and animal communities vary according to the physical characteristics and salinity regime of the lagoon. This also creates a unique habitat which can be very different compared to other marine habitats, usually with a limited range of species present that are especially adapted to the varying salinity regimes. Some are unique to lagoon habitats.

6.2.59. In the SAC, the fauna of the lagoons includes typical lagoon species, such as the cockle *Cerastoderma glaucum*, the ostracod *Cyprideis torosa,* the lagoon sand-shrimp *Gammarus insensibilis*, the mollusc *Onoba semicostata*, and the gastropods *Littorina saxatilis tenebrosa* and *Hydrobia ventrosa*. The nationally rare starlet sea anemone *Nematostella vectensis* is also found at the site (Ref. 6.36; Ref. 6.37). Flora within the lagoon has limited diversity and includes tassel pondweed *Ruppia maritima* and brackish water crowfoot *Ranunculus baudotii*. A variety of algal species are also present (Ref. 6.35; Ref. 6.37).

6.2.60. A biodiversity survey carried out in 2015 (Ref. 6.38) designated the lagoons in 'unfavourable' condition, having recently lost many of the rare species of importance. For example, the starlet sea anemone was not found during the survey.

ii. Annual vegetation of drift lines

6.2.61. Orfordness shingle spit is one of the two sites representing the qualifying interest feature of annual vegetation of drift lines on the east coast of England. In contrast to the Minsmere to Walberswick Heaths and Marshes, the drift-line vegetation occurs on the sheltered, western side of the spit, at the transition from shingle to saltmarsh, as well as on the exposed eastern coast. The drift-line community is widespread on the site and comprises see beet and orache *Atriplex* spp. (Ref. 6.36).

6.2.62. The Orfordness shingle spit is important as it supports one of the largest natural expanses in the UK of shingle vegetation affected by salt spray (Ref 6.35).

iii. Perennial vegetation of stony banks

6.2.63. Orfordness is the best-preserved vegetated shingle site in Britain. The southern end of the shingle spit has a particularly fine series of undisturbed ridges, with zonation of communities determined by the ridge pattern. Pioneer communities with sea pea *Lathyrus japonicus*, sea kale *Crambe maritima*, and false oat-grass *Arrhenatherum elatius* grassland occur. On more stable ground are extensive areas of sea campion *Silene uniflora* and stonecrops *Sedum acre* and *S. anglicum* occur. These communities are nutrient-enriched by the presence of a gull colony (Ref. 6.35; Ref. 6.37).

6.2.64. Above the high-water mark *Rumex crispus* and *Glaucium flavum* give a highly distinctive character to the mainly bare shingle, with *Lathyrus japonicus* becoming much more abundant within the matrix further inland. A wide range of rare or local species also occur including yellow vetch *Vicia lutea* and the dwarf clovers *Trifolium suffocatum*, *T. glomeratum, T. striatum, T. scabrum* and bur medick *Medicago minima*. Lichen communities are also well developed here with extensive areas of *Cladonia* heath. A unique feature for East Anglia beach formations is the abundance on the ground of normally epiphytic lichens *Flavoparmelia caperata* and *Evernia prunastre* (Ref. 6.35).

k) Stour and Orwell Estuaries Ramsar site

i. Ramsar criterion 2

6.2.65. Stour and Orwell Estuaries Ramsar site qualifies under Ramsar criterion 2 as a wetland of international importance, comprising extensive mudflats, low

cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. It provides habitats for an important assemblage of wetland birds in the non-breeding season and supports internationally important numbers of wintering and passage wildfowl and waders.

6.2.66. The site supports seven nationally scarce plants: stiff saltmarsh-grass *Puccinellia rupestris*; small cord-grass *Spartina maritima*; perennial glasswort *Sarcocornia perennis*; lax-flowered sea lavender *Limonium humile*; and the eelgrasses *Zostera marina* and *Z. noltei*.

6.2.67. The site also supports five red data book invertebrates: the muscid fly *Phaonia fusca*; the horsefly *Haematopota grandis*; two spiders, *Arctosa fulvolineata* and *Baryphema duffeyi*; and the endangered swollen spire snail *Mercuria confusa* (Ref 6.39).

6.2.68. The Stour and Orwell Estuaries Ramsar site is underpinned by the Cattawade Marshes SSSI, Orwell Estuary SSSI and Stour Estuary SSSI.

6.2.69. Cattawade Marshes is represented by 2 units of 'neutral grassland – lowland', one of which is classed as 'favourable' and the other which is classed as 'unfavourable – recovering', on account of the sub-optimal conditions of the wet grassland and marshy habitat present at its northern end that would benefit from ongoing management to increase winter water levels and reduce scrub cover (Ref. 6.40).

6.2.70. For the Orwell Estuary SSSI, for condition monitoring undertaken between 2009-2010, three of the 23 units are classed as having a status of 'unfavourable – declining', with a further four units are classed as 'unfavourable – no change'. All represent littoral sediments and are at unfavourable status due to coastal squeeze (Ref. 6.41).

6.2.71. For the Stour Estuary, nine out of 10 units last monitored in 2010 were found to be in 'favourable' condition. Unit 1 was classed as 'unfavourable – declining' due to coastal squeeze (Ref. 6.41).

6.3 Birds

a) Alde-Ore Estuary SPA

i. Introduction

6.3.1. The information presented on the baseline conditions for the Alde-Ore Estuary SPA comprises both an overview of population status within the SPA for the different qualifying features and a more in-depth consideration of the population trends and habitat use of those qualifying features that are dependent on the marine environment to a large extent for their foraging.

6.3.2. This structure and focus reflect both the extent and types of impact pathways that could affect the different qualifying features of the Alde-Ore Estuary SPA and the attention given to the different qualifying features during the collection of baseline survey data.

ii. Population estimates of SPA qualifying features

6.3.3. The citation and most recently available population estimates for the SPA show declines in numbers for the breeding qualifying features, other than marsh harrier, whilst recent population estimates for the wintering populations are higher than at citation (**Table 6.1**). Declines are particularly notable amongst the breeding seabirds, with neither of the two tern species which are qualifying features of the SPA currently being present as breeding species.

Table 6.1: Population estimates for the qualifying features of the Alde-Ore Estuary SPA, as determined at (or near) the time of citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Breeding	Avocet	104 bp (1990-94)	46 bp (2009-13)
	Marsh harrier	3 bp (1993/97)	3 bp (2013)
	Little tern	48 bp (1993/94-96/98)	4 bp (2013)[2]
	Sandwich tern	170 bp (1992-96)	0 bp (since 2009)[3]
	Lesser black-backed gull	14,070 bp (1994-97)	1,963 bp (2012-16)[3]
Non-breeding	Avocet	766 ind (1991/92-96/97)	1604 ind (2009/10-13/14)
	Redshank	1,622 ind (1989/90-1993/94)	2,178 (2009/10-2013/14)
	Ruff	3 ind (1991/92-1995/96)	6 ind (2009/10-2013/14)

[1] Count unit - bp = breeding pairs; ind = individuals.
[2] No longer recognised as a regular breeder at this site (Ref. 6.43).
[3] Based on Seabird Monitoring Programme (SMP) database (Ref. 6.44). All other estimates from Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9009112&SiteName=alde-ore+estuary&SiteNameDisplay=Alde-Ore+Estuary+SPA&countyCode=40&responsiblePerson=&SeaArea=&IFCAArea=)
[4]WeBS data for 1989/90-1993/94 gives a five year mean of 13 non-breeding ruff.

6.3.4. The SPA also qualifies on the basis of the breeding seabird assemblage and the wintering waterbird assemblage but estimates of the overall abundance of these features are not available.

iii. Population trends and habitat use of the seabird qualifying features

Little tern - breeding

SPA population

6.3.5. The Alde-Ore Estuary SPA's qualifying population of 48 pairs of little terns (**Table 6.1**) constituted at least 2% of the national breeding population. The last known nesting colony in the SPA was in 2013 at Sudbourne Beach, near Slaughden on Orford Ness and approximately 9km south of the main development site, when four pairs attempted to breed at the site but no young fledged (Ref. 6.42). Historically, little terns have also nested at Havergate Island, near the Ore-Butley estuaries confluence (most recently in 2006, when three breeding pairs were recorded).

6.3.6. The Alde-Ore Estuary SPA is no longer recognised as a "regularly occupied" breeding colony (Ref. 6.43). This has been attributed to a number of factors, including changes to the beach profile (and therefore habitat suitability), predation and disturbance.

Project-specific survey data

6.3.7. Vantage point (VP) surveys undertaken in 2011 (Ref. 6.45) recorded little tern foraging behaviour at 12 VPs along the coastline during the period 10th May 2011 to 24th June 2011. The most northerly of these sites (VP1) was *c.* 0.5 km north of the main development site and *c.* 9.5 km north of Alde-Ore Estuary SPA. The most southerly (VP12) was located at Orford Ness, within the SPA, approximately 6km south of Slaughden. **Figure 6.1** illustrates the location of the VPs along the Suffolk coastline.

6.3.8. A peak count of 18 birds was observed resting on Sudbourne Beach (VP10) in mid-May, after which up to 22 birds were present in the area until mid-June. During this period, little terns were frequently observed foraging over a spit approximately 1km offshore of Sudbourne Beach. Commuting birds were observed at 8 VPs during the survey period, notably during May, with a peak of 51 birds recorded during May from VP1.

6.3.9. In June 2011, a programme of colony surveys, undertaken to identify the flight direction of little terns when leaving or returning to colonies, included a survey at the Alde-Ore Estuary colony near Slaughden (Ref. 6.45). Flight lines and key foraging areas of little terns from the colony are presented in **Plate 6.1.** During the survey period, up to 22 birds were observed foraging

offshore and loafing around the colony, with mating activity recorded, but the colony was abandoned by 23rd June 2011.

6.3.10. Further bimonthly VP surveys were undertaken between 13th May and 21st August 2013 (Ref. 6.46), in which little tern activity was recorded at 15 VPs along the coastline. These VPs consisted of the 12 used in the 2011 surveys plus a further three (VPs 13, 14 and 15) located north of VP1, with the most northerly (VP15) being located at Dunwich, *c.* 6km north of the main development site and *c.* 15km north of Alde-Ore Estuary SPA (see **Figure 6.1**).

6.3.11. In the 2013 surveys, little tern was recorded a total of nine occasions at VPs 7, 8, 10, 11, 12 and 13, between Thorpeness and Orford Ness. The peak count was eight birds at VP10 (Sudbourne Beach) in early June 2013, at which point a colony attempted to establish. However, this was deserted by the time of the nest survey in late June. Flight lines and foraging areas of little terns around Alde-Ore Estuary (2013 surveys) are shown in **Plate 6.2**.

6.3.12. Although the project-specific survey data are 2011-2013, as described above, they derive from the most recent period for which there is documented breeding at the little tern colonies within the Alde-Ore Estuary SPA, which is no longer recognised as a “regularly occupied” breeding colony (Ref. 6.43).

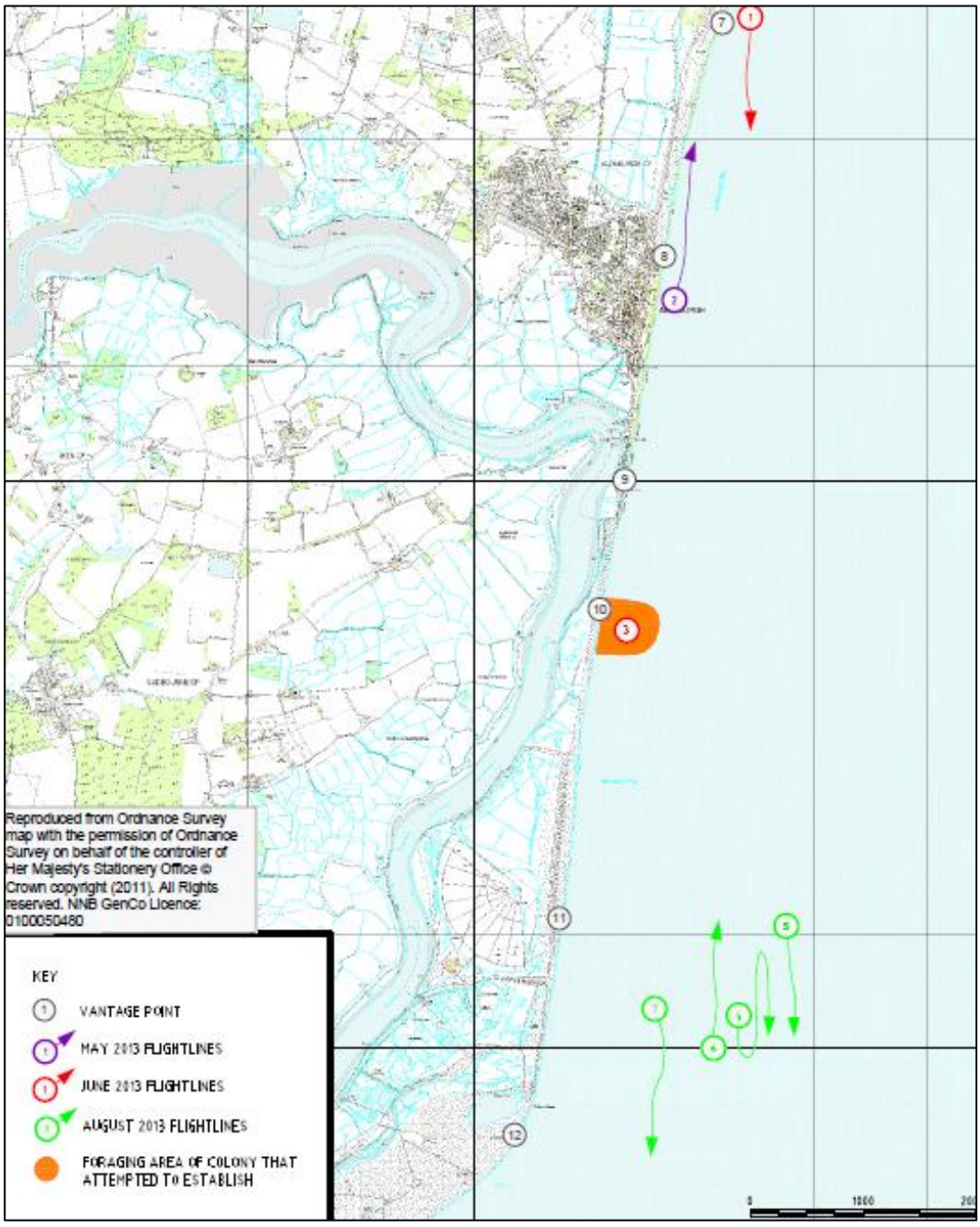
Foraging behaviour and diet

6.3.13. During the breeding season (May to August), little terns are found on sand / shingle beaches, islands and spits on British and Irish coasts. Little terns feed by fishing in the top few centimetres of water, often over the advancing tideline or in brackish lagoons and saltmarsh creeks, though they can forage up to 6km offshore (Ref. 6.47). The mean maximum foraging extent from breeding colonies in the SPA is expected to be around 3.9km alongshore and up to 2.4km seawards, based on surveys of foraging little terns at a range of colonies around the UK coastline (Ref. 6.43). Based on the mean maximum alongshore foraging range (3.9km) suggested by Parsons *et al.* (Ref. 6.43), breeding birds from a colony at Slaughden could be expected to generally forage no further south than Orford Ness and no further north than Thorpeness.

Plate 6.1: Flight lines and areas of concentrated foraging activity around Slaughden little tern colony during surveys in June 2011 (Ref. 6.45)



Plate 6.2: Flight lines and areas of concentrated foraging around Slaughden little tern colony during VP surveys in May – August 2013 (Ref. 6.46)



6.3.14. Little terns typically forage from a height of 4 – 8m, sometimes higher, and generally feed by plunge diving from a hover or dip to take prey at the surface (Ref. 6.48). Little tern adults and chicks consume a relatively wide variety of prey types, although the most important prey items in the southern North Sea are clupeids such as herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) (Ref. 6.49). When these fish are scarce, the isopod crustacean sea slater *Idotea linearis* and the ghost shrimp *Schistomysis spiritus* are also important.

6.3.15. Juvenile clupeids and sandeels *Ammodytes spp*. (30 – 70mm) are the dominant item in the chicks' diet; observations at North Denes (Norfolk) from 2002 to 2006 found that clupeids accounted for an average of 82% of identified prey items fed to chicks (Ref. 6.50). In nutritional terms, invertebrates are poor prey for chicks compared to lipid-rich fish (Ref. 6.51).

6.3.16. Due to their short foraging range, little terns rely on abundant supplies of small fish or invertebrates close to the colony to provision their chicks, and as such are rather specialised in their habitat requirements (Ref. 6.52). The diets of both adults and chicks differs by location due to availability of different habitat types and prey abundances. Based upon the availability of fish species at Sizewell, the prey of breeding little tern from Alde-Ore Estuary SPA during the period May to August is expected to consist predominantly of schooling pelagic fish that are found near to the surface during daylight hours, such as herring, sprat and anchovy (Ref. 6.53).

Sandwich tern - breeding

SPA population

6.3.17. The SPA's qualifying population of 170 pairs of Sandwich terns (**Table 6.1**) constituted 0.1% of the biogeographical (Western Europe / Western Africa) population and 1.2% of the national population (Ref. 6.54). However, since 2009 there have been no breeding pairs recorded in the SPA (Ref. 6.44).

6.3.18. Sandwich terns have been recorded as nesting in the SPA since 1986, primarily at Havergate Island (approximately 17km south along the coast from the main development site redline boundary) where historically there were large aggregations of over 100 birds. However, the colony was not occupied in 1997 and since then nesting has only occurred sporadically. The last recorded successful breeding at Havergate Island was in 2004 based upon the Seabird Monitoring Programme data (Ref. 6.44).

6.3.19. **Table 6.2** presents figures for the breeding numbers and productivity at Havergate Island between 1993 and 2009, with there being no subsequent breeding records (at least up to the most recent Seabird Monitoring Programme data from 2016; Ref. 6.44). Given the decline in both breeding

numbers and productivity since designation, the breeding population within the SPA has been given a restore objective by Natural England (Ref. 6.55).

Table 6.2: Sandwich tern breeding numbers (expressed as occupied nests) and productivity at Havergate Island, 1993-2009; no breeding pairs have been recorded in the SPA since 2009

Year	Occupied Nests	Fledged Young
1993	125	98
1994	300	201
1995	250	0
1996	104	30
1997	0	0
1998	0	0
1999	0	0
2000	7	5
2001	1	2
2002	2	2
2003	15	3
2004	2	3
2005	3	0
2006	0	0
2007	0	0
2008	0	0
2009	2	0

6.3.20. There have been years of complete breeding failure, when Sandwich terns have attempted to breed, notably in 1995, when 250 occupied nests were abandoned, but also more recently in 2005 and 2009. Declines may reflect movements of birds between breeding colonies in the wider region (Ref. 6.56), perhaps in response to breeding failure. Although Sandwich terns have not bred successfully within the SPA since 2004, birds are known to 'loaf' in the area towards the end of the breeding season (Ref. 6.57).

Project-specific survey data

6.3.21. Sandwich tern sightings were recorded during marine bird surveys undertaken from April 2011 to April 2012 at 12 VPs along the coastline (Ref. 6.45). The most northerly of these sites (VP1) was *c.* 0.5km north of the main development site and *c.* 9.5 km north of Alde-Ore Estuary SPA. The most southerly (VP12) was located at Orford Ness, within the SPA, *c.* 2.5km east

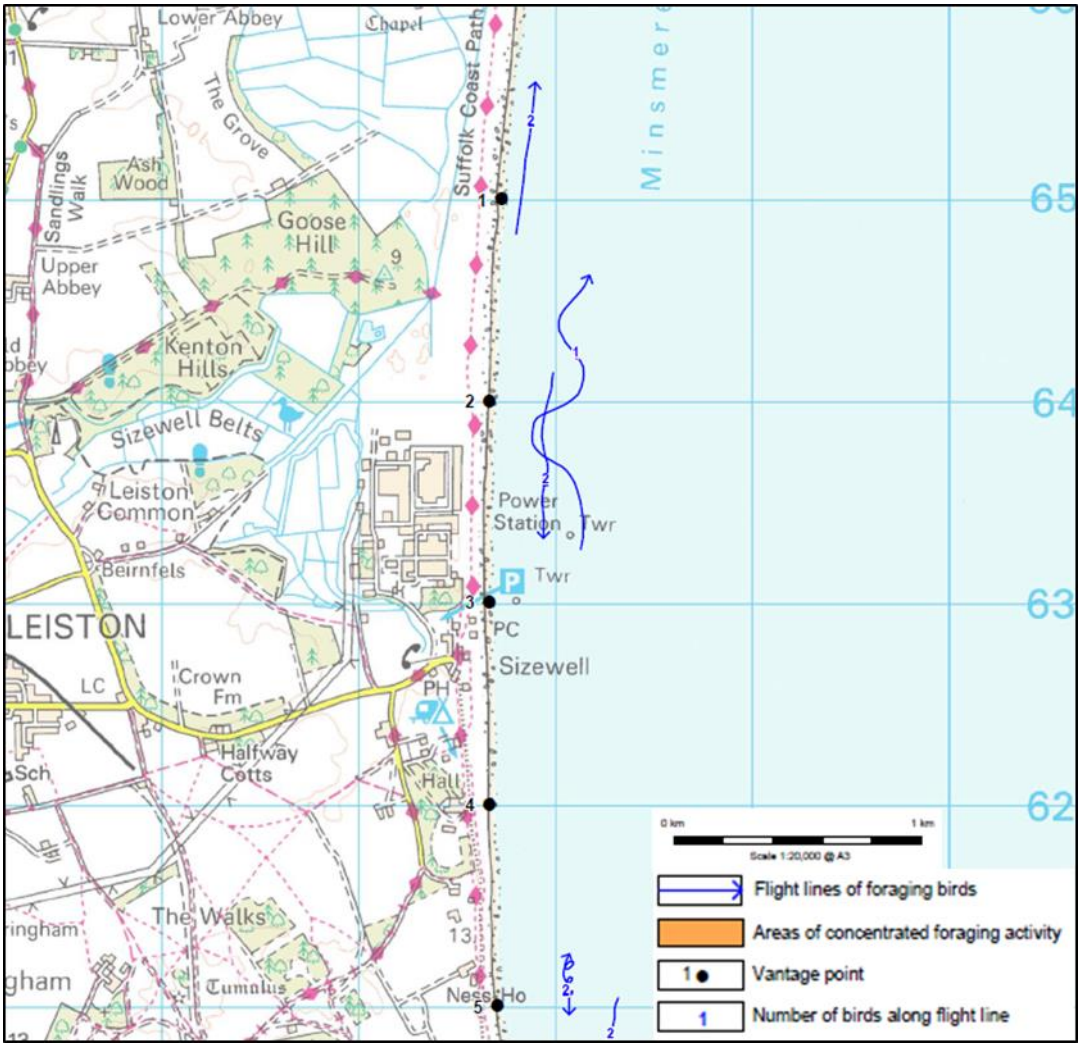
of Havergate Island (see **Figure 6.1**). The peak period for observations was July to September, coinciding with the likely occurrence of birds on passage.

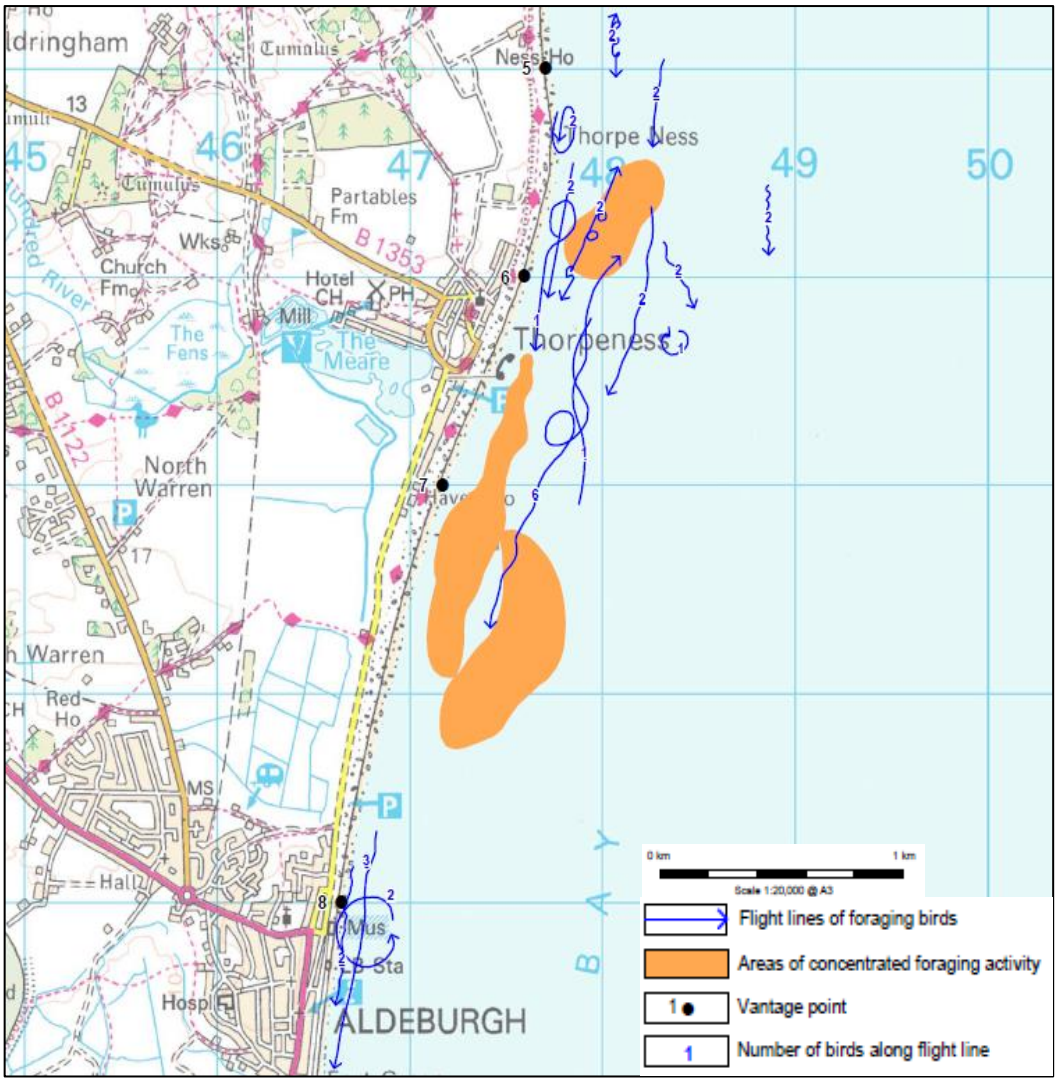
6.3.22. During the 2011-12 surveys (Ref. 6.45), small numbers of Sandwich terns were seen foraging offshore or commuting along the coastline, both close inshore and more than 1-2km offshore. Although generally in small groups of one to two birds, occasional groups of up to 10 individuals were seen during peak times in July and August. The favoured feeding areas were over the shallow coastal waters near to the SPA (VPs 11 and 12) and near to Thorpeness (VPs 6 and 7), whilst resting birds were recorded on lagoons within the SPA and at Slaughden. **Plate 6.3** shows the flight lines and key foraging areas of terns observed during the surveys.

6.3.23. Sandwich tern activity was also recorded during bimonthly surveys between 13th May and 21st August 2013 (Ref. 6.46) at 15 VPs along the coastline. These VPs consisted of the 12 used in the 2011 surveys plus a further three (VPs 13, 14 and 15) located north of VP1, with the most northerly (VP15) being located at Dunwich, *c.* 6km north of the main development site and *c.* 15 km north of Alde-Ore Estuary SPA (see **Figure 6.1**).

6.3.24. In the 2013 surveys, Sandwich terns were recorded on 52 occasions between early May and mid-August, usually in small groups of one to three birds but occasionally in groups of up to eight birds, including at VP9 within the SPA. Birds were predominantly observed commuting, but foraging behaviour was observed in 11 instances. Observations were concentrated south of Aldeburgh but also further north, around the coast adjacent to Minsmere RSPB reserve. **Plate 6.4** shows the flight lines and key foraging areas of terns observed during 2013.

Plate 6.3: Flight lines and foraging areas of Sandwich terns during vantage point surveys in April 2011 – April 2012 (Ref. 6.45); over three pages




Aldringham
Tumulus
Ness Ho
Thorpe Ness
45
46
47
48
49
50
Partables Fm
B 1353
Wks
Church Fm
Hotel
CH
PH
Mill
The Fens
The Meare
Thorpeness
B 1122
North Warren
Warren
Red Ho
MS
Hall
Mus
Sta
Hospl
ALDEBURGH
BAY
0 km
1 km
Scale 1:20,000 @ A3
Flight lines of foraging birds
Areas of concentrated foraging activity
Vantage point
Number of birds along flight line

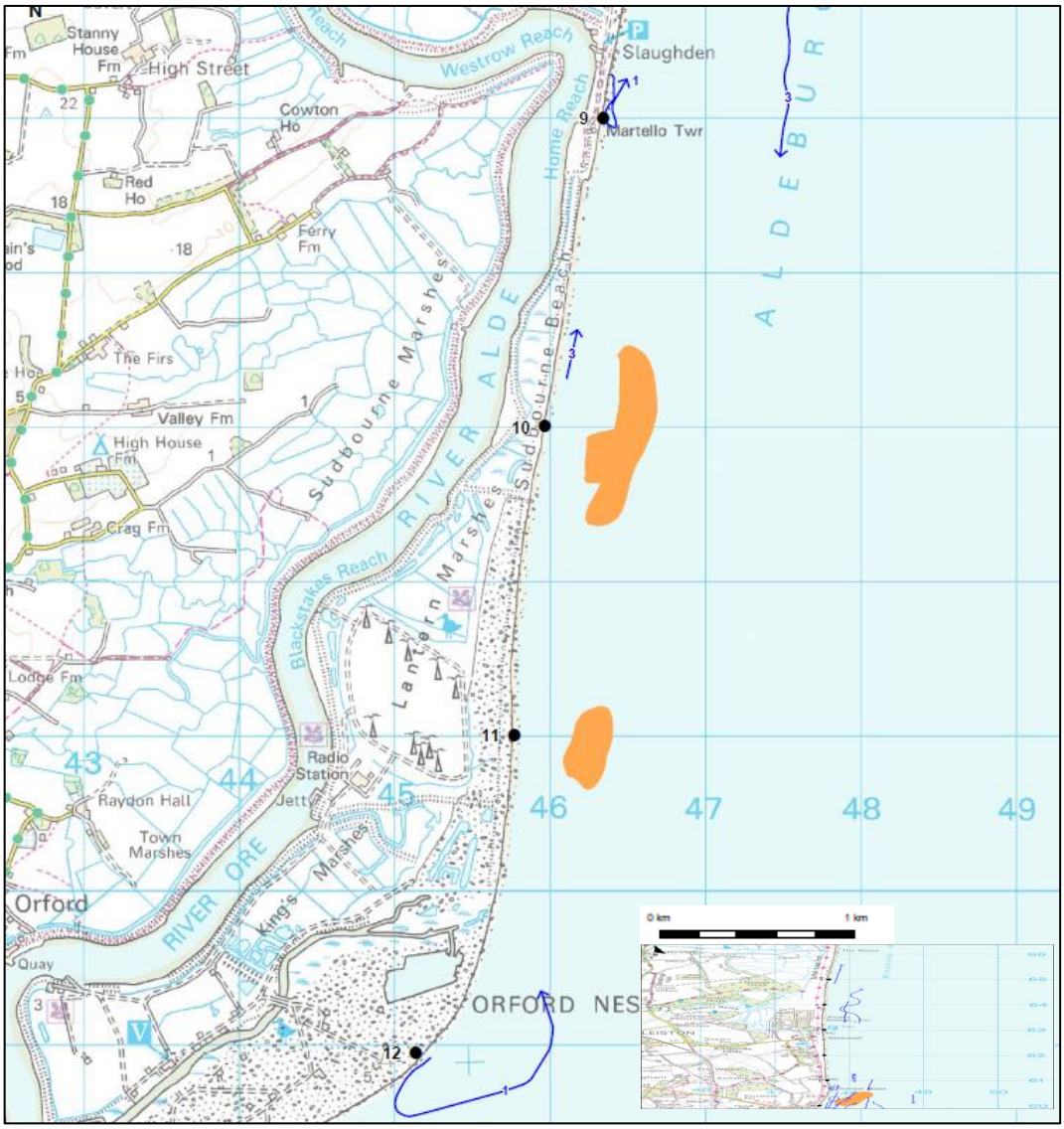
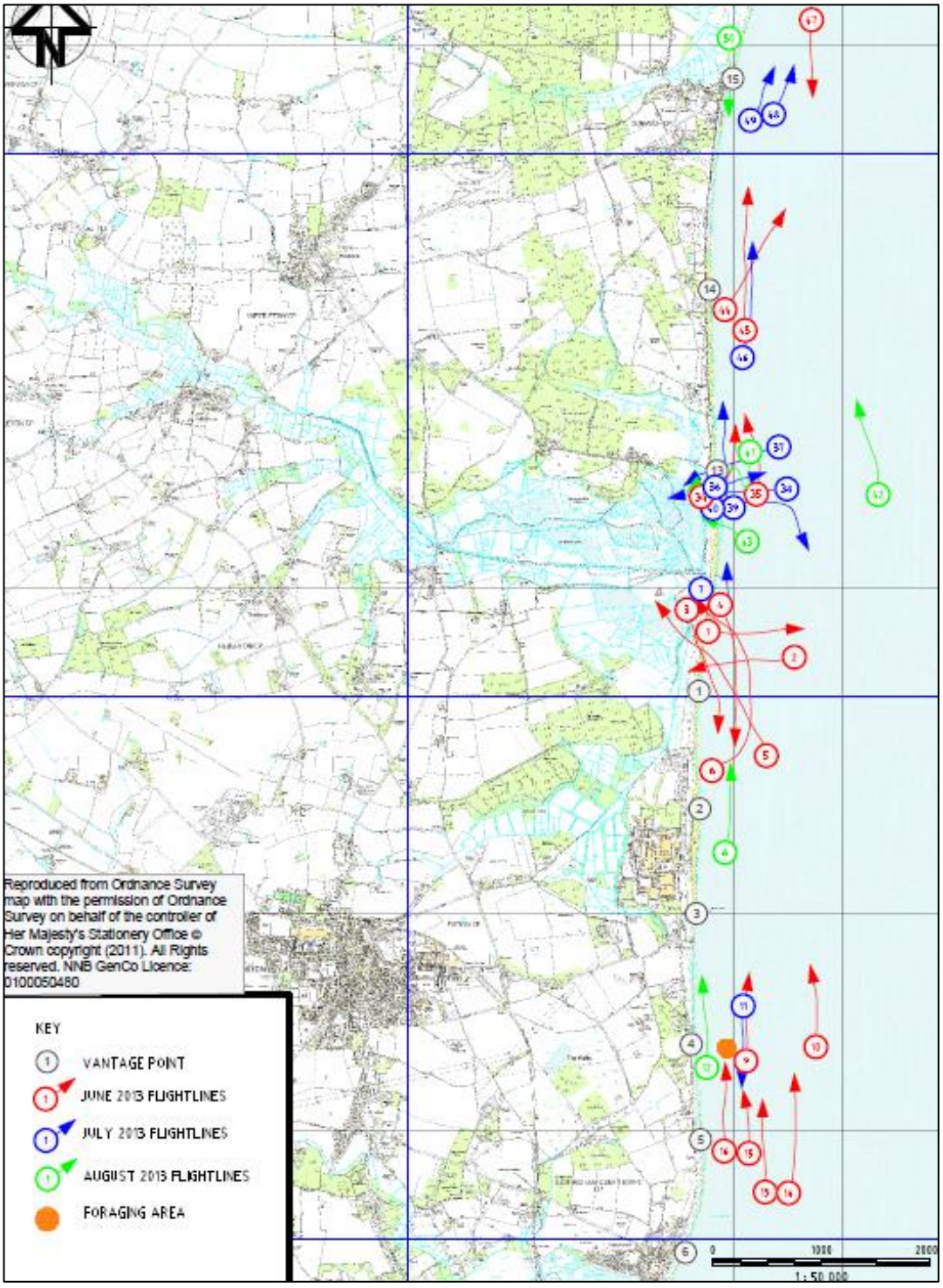
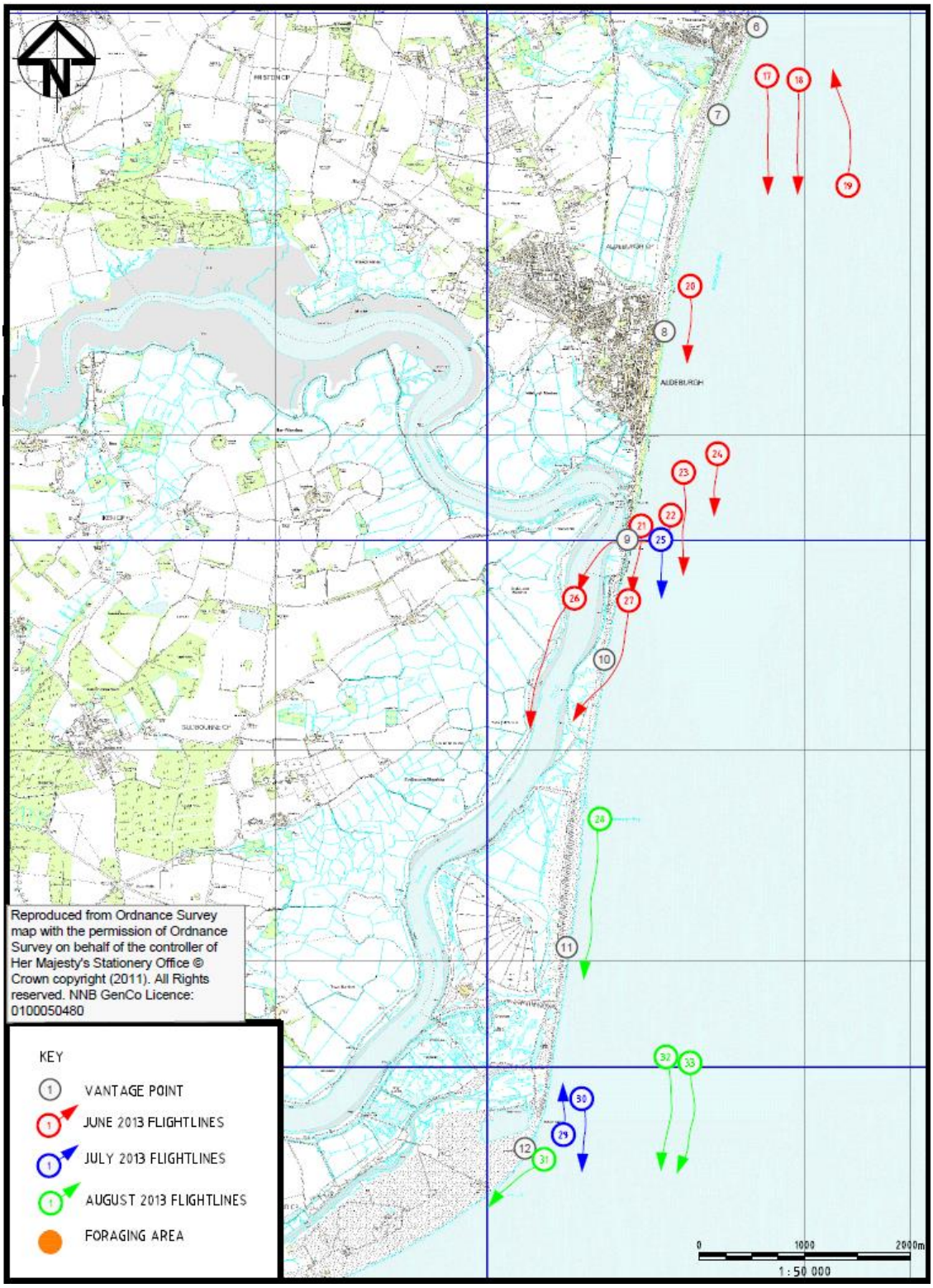

Stanny House Fm
High Street
Cowton Ho
Red Ho
Ferry Fm
The Firs
Valley Fm
High House Fm
Crag Fm
Lodge Fm
Radio Station
Jetty
Raydon Hall
Town Marshes
Orford
Quay
Slaughden
Martello Twr
Westrow Reach
Home Reach
Sudbourne Beach
Sudbourne Marshes
Blacktakes Reach
Lantern Marshes
RIVER ALDE
RIVER ORE
ALDEBURGH
ORFORD NESS
9
10
11
12
43
44
45
46
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48
49

Plate 6.4: Flight lines and foraging areas of Sandwich terns during vantage point surveys at VPs 1 – 6 and 13 – 15 in 2013 (Ref. 6.46); over two pages




N
Reproduced from Ordnance Survey map with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationery Office © Crown copyright (2011). All Rights reserved. NNB GenCo Licence: 0100050480
KEY
VANTAGE POINT
JUNE 2013 FLIGHTLINES
JULY 2013 FLIGHTLINES
AUGUST 2013 FLIGHTLINES
FORAGING AREA
0
1000
2000m
1 : 50 000

6.3.25. The surveys in 2011 and 2013 were undertaken in years when there was no occupied Sandwich tern breeding colony along the Suffolk coast. Therefore, fewer birds would be expected to be recorded during these years than during years when colonies were occupied but, as with little tern, there has been no documented breeding by the species in recent years at the Alde-Ore Estuary SPA and further (more recent) survey data would be unlikely to add information of significance to the assessment. Also, Sandwich terns may forage considerable distances offshore (Ref. 4.8, Ref. 6.48), and well beyond the distances at which birds can be recorded during shore-based surveys. Therefore, these surveys have limited value in determining the key foraging areas of this species.

Foraging behaviour and diet

6.3.26. During the breeding season (April to August), Sandwich terns are found on sandy islands, spits, dunes and shingle beaches (Ref. 6.47), feeding over inlets and at sea, typically within 1m of the surface, down to a maximum depth of 2m (Ref. 6.59). The mean maximum foraging range of Sandwich tern is approximately 32 km (based on a generic model of range usage derived from a UK-wide study encompassing a range of colonies) but has been recorded at over 50km (Ref. 6.58).

6.3.27. Based on the mean maximum foraging range (32 km) estimated by Wilson *et al.* (Ref. 6.58), breeding birds from a colony at Havergate Island could be expected to forage as far south as Hamford Water and the Clacton coast and as far north as Minsmere, as well as the same distance from the colony out to sea. However, the generic model of range usage by Sandwich terns around their colonies also predicts that, within the area defined by the mean maximum foraging range, usage will be greatest near shore (the term with the greatest effect size in the model), but in relatively deep waters, and close to the colony (Ref. 6.58).

6.3.28. Sandwich terns fly faster, make longer trips, dive deeper from greater heights and catch larger fish than the other British tern species (Ref. 6.60, Ref. 6.61). They are considered relative specialists compared to other tern species, with dependence upon a few prey species (e.g. clupeids and sandeels, including greater sandeel *Hyperoplus* sp.) obtained from across a wider foraging range. In the southern North Sea, key prey items for Sandwich tern include clupeids (herring and sprat) and sandeels (Ammodytidae spp.). A study on the island of Griend showed these prey species amounted to 99.3% of the chick diet, and parents tended to meet the increasing energy demands of chicks by adjusting prey size, rather than increasing delivery or switching prey species (Ref. 6.62).

6.3.29. Adult diet is not well studied but it is understood to differ from that of chicks (Ref. 6.52). The proportion of invertebrates in the diet is higher for adults than

chicks (as recorded on the east Norfolk coast), presumably because they will obtain their own food more opportunistically. Young-of-the-year clupeids also frequently occur in adult diets whereas older fish tend to make up a greater proportion of the chick diet (Ref. 6.63). During studies in north Norfolk, the median prey size provisioned to chicks (at 80 – 120mm) was generally some three to four times larger than that of prey consumed by the adults (Ref. 6.63).

6.3.30. Variation in the spatio-temporal availability and distribution of Sandwich tern prey is likely to influence foraging distribution and diet (Ref. 6.52). Based upon the availability of different fish species at Sizewell (Ref. 6.64), the prey of breeding Sandwich tern from Alde-Ore Estuary SPA during the period April to August is expected to consist of schooling pelagic fish species that are found near to the surface during daylight hours, such as herring, sprat and anchovy (Ref. 6.53).

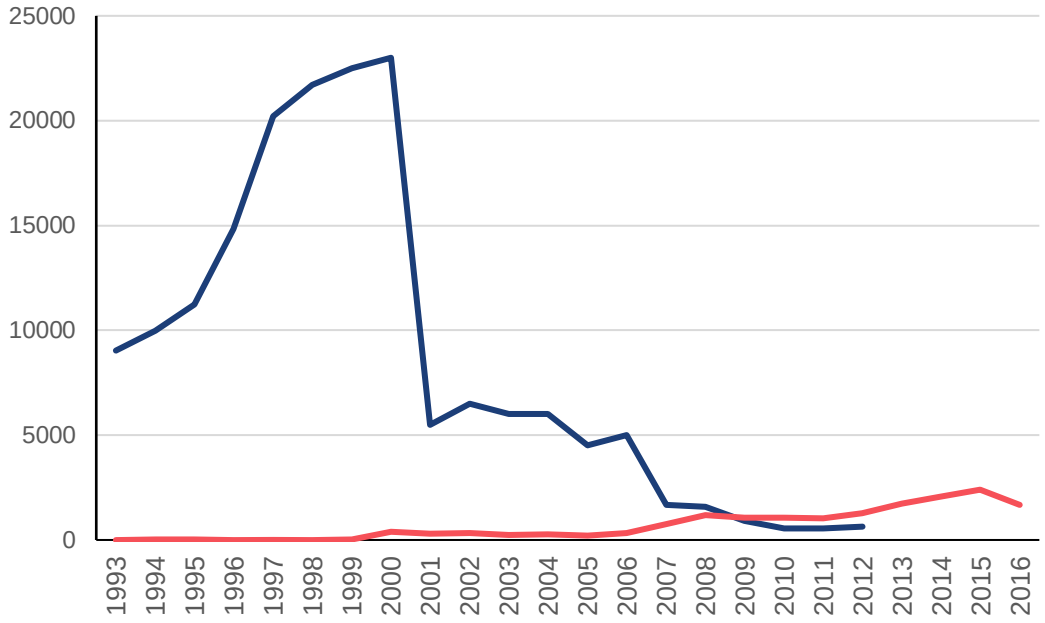
Lesser black-backed gull - breeding

SPA population

6.3.31. At the time of designation in 1996, the SPA population was estimated as 14,070 breeding pairs (**Table 6.1**), representing 12% of the British population and 8% of the world population of the *graellsii* race. A peak population size of 23,400 pairs was recorded in 2000, since when numbers have reduced substantially, with the mean population estimate for the SPA from 2012 to 2016 being 1,963 pairs (Ref. 6.44).

6.3.32. Historically, the primary breeding colony in the SPA was on Lantern Marshes at Orford Ness (c.12.5km south of the main development site), where numbers increased to a peak of approximately 23,000 pairs in the early 2000s, but decreased substantially since then, with around 550 – 640 pairs during the period 2010 – 2012. The main nesting areas are now on Havergate Island (c.17 km south of the main development site). Between 2000 and 2007 the number of occupied nests at Havergate Island was around 200 – 800 but since 2008 the number of occupied nests has been over 1,000, with as many as 2,399 in 2015 (Ref. 6.44; **Plate 6.5**).

Plate 6.5: Trends in the annual number of occupied lesser black-backed gull nests / territories estimated at the Orford Ness colony (blue line) and the Havergate Island colony (orange line) (Ref. 6.44)



Project-specific survey data

6.3.33. Lesser black-backed gull sightings were recorded during marine bird surveys between April 2011 and April 2012 (Ref. 6.45) at 12 VPs along the coastline near Sizewell. The most northerly of these sites (VP1) was *c.*9.5 km north of Alde-Ore Estuary SPA (and *c.*16 km north of Havergate Island and *c.*17 km north of Orford Ness). The most southerly (VP12) was at Orford Ness (see **Figure 6.1**).

6.3.34. During the 2011-12 surveys, lesser black-backed gulls were recorded resting or foraging at all VPs. Groups of up to 50 birds were seen resting on the beach near to Lantern Marshes and the colony at Orford Ness (VPs 10 – 12), while smaller groups were seen loafing further north around the outfalls at Sizewell A and B. There were large numbers of gulls reported commuting throughout the area, likely travelling offshore or inland to forage. Findings were broadly similar during the 2013 surveys, with birds recorded at all VP locations (Ref. 6.46).

6.3.35. Although qualifying as a breeding species and recognised to be largely migratory, small numbers of lesser black-backed gull remain in the area over winter and have been incidentally recorded commuting, foraging and loafing during winter surveys for red-throated divers and cormorants.

6.3.36. As for Sandwich tern, it is acknowledged that shore-based surveys are of limited value in determining the key areas of usage by lesser black-backed gull. The mean maximum foraging range for this species is estimated as 141km, so that a high proportion of foraging activity is likely to occur beyond areas encompassed by such surveys (Ref. 4.8).

Foraging behaviour and diet

6.3.37. During the breeding season (April to August), lesser black-backed gulls are found on coastal grassy slopes, sand dunes, cliffs and saltmarshes. They forage on arable land, pasture land, refuse dumps and at sea (Ref. 6.47). At sea they typically feed close to the sea surface, down to a maximum dive depth of 0.5 – 1m (Ref. 6.59).

6.3.38. As stated above, the mean maximum foraging range for breeding lesser black-backed gulls is estimated as 141km (Ref. 4.8), but for GPS-tracked birds breeding at Orford Ness in 2011 the offshore foraging range was up to 91km during the breeding season, with a mean of approximately 38km (Ref. 6.65). The duration of foraging periods between leaving and returning to the nest averaged *c.*7 hours but durations of up to 29 hours were recorded. Outside the breeding season, foraging range and trip duration are greater.

6.3.39. Based on the maximum offshore foraging range (91km) recorded from tracking of breeding lesser black-backed gulls at Orford Ness (Ref. 6.65), the SPA birds can be expected to forage as far south as the Kentish coastline and as far north as north Norfolk, as well as the same distance from the colony out to sea, during the breeding season. However, these data derive from 12 tracked birds from a single year, and it is likely that foraging distances of birds from the SPA colonies extend further than this (as indicated by the mean maximum foraging range estimate given in Ref. 4.8).

6.3.40. Based on fish species availabilities at Sizewell, the marine prey of breeding lesser black-backed gull during the period April to August is expected to consist of schooling pelagic fish (sprat, herring and anchovy) and crustacea (swimming crabs) that are found near to the sea surface, together with discards from fishing vessels (Ref. 6.53).

b) Alde-Ore Estuary Ramsar site

i. Qualification criteria

6.3.41. In relation to bird populations, the Alde-Ore Estuary Ramsar site qualifies under Ramsar criteria 3 (i.e. *"A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region."*) and Ramsar criteria 6 (i.e. *"A wetland should be considered internationally*

important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird").

6.3.42. Qualification under criterion 3 is on the basis of the site supporting a notable assemblage of breeding and wintering wetland birds; whilst for criterion 6 it is on the basis of the population of lesser black-backed gull which breed on the site.

6.3.43. Baseline data are as detailed for the Alde-Ore Estuary SPA.

c) Benacre to Easton Bavents SPA

i. Introduction

6.3.44. As for the Alde-Ore Estuary SPA, the information presented on the baseline conditions for the Benacre to Easton Bavents SPA comprises both an overview of population status within the SPA for the different qualifying features and a more in-depth consideration of the population trends and habitat use of those qualifying features that are dependent on the marine environment to a large extent for their foraging.

6.3.45. Again, as for the Alde-Ore Estuary SPA, this structure and focus reflect both the extent and types of impact pathways that could affect the different qualifying features of the Benacre to Easton Bavents SPA, as well as the attention given to the different qualifying features during the collection of baseline survey data.

ii. Population estimates of SPA qualifying features

6.3.46. The most recently available population estimates for the SPA indicate that numbers of breeding bittern and marsh harrier are currently higher than at the time of citation, whilst little tern numbers are similar (**Table 6.3**).

Table 6.3: Population estimates for the qualifying features of the Benacre to Easton Bavents SPA, as determined at citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Breeding	Bittern	2 males (1991-95)	4.4 bp (2014-18)
	Marsh harrier	6 bp (1990-94)	10.8 nests (2014-18)
	Little tern	39 bp (1991-95)	40 bp (2014-18)

[1] Count unit – bp = breeding pairs.
Estimates derived from Citation and SPA Conservation Objectives supplementary advice (http://publications.naturalengland.org.uk/publication/4750287944286208)

iii. Population trends and habitat use of seabird qualifying features

Little tern - breeding

SPA population

6.3.47. The Benacre to Easton Bavents SPA's qualifying population of 39 pairs of little terns (**Table 6.3**) constituted 1.6% of the national breeding population. Historically, there were known nesting colonies in the SPA at Easton Broad and Covehithe Broad, whilst more recently breeding has occurred on the sand and shingle beaches at Kessingland, Benacre and Covehithe Broads, located *c*.22km, *c*.20km and *c*.17km north of the main development site redline boundary, respectively.

Project-specific survey data

6.3.48. Surveys for little tern were undertaken in 2011 (Ref. 6.45) and 2013 (ref. 6.46); these included foraging surveys at 15 VPs along the coast between Dunwich and Orford Ness. The most northerly of these sites (VP15 at Dunwich) was approximately 11km south of Covehithe Broads. Given that the mean maximum foraging distance from breeding colonies in the SPA is expected to be around 3.9km alongshore (Ref. 6.43), the nearest VP is likely to be outside the maximum foraging range for little terns in this SPA. However, the greater distance of the Benacre to Easton Bavents SPA little tern colony from the main development site also means that there would be less potential for effects to arise on this SPA little tern population than on those at SPAs closer to the main development site. As such, information on colony location, size and predicted foraging range are sufficient for the purposes of the assessment on this SPA qualifying feature.

Foraging behaviour and diet

6.3.49. Details of the foraging behaviour and diet of little tern are given above (see Alde-Ore Estuary SPA baseline conditions). Based on the mean maximum alongshore foraging range (3.9 km) estimated by Parsons *et al.* (2015 – Ref. 6.43), breeding birds from the colony at Covehithe Broads could be expected to generally forage no further south than Southwold and no further north than Kessingland. As for the Alde-Ore Estuary SPA little tern population, the prey of breeding little tern from Benacre to Easton Bavents SPA during the period May to August is expected to consist predominantly of schooling pelagic fish that are found near to the surface during daylight hours, such as herring, sprat and anchovy, as based upon the availability of fish species at Sizewell (Ref. 6.53).

d) Deben Estuary SPA

i. Population estimates of SPA qualifying features

6.3.50. The most recently available population estimates for the SPA indicate that numbers of over-wintering avocet are now markedly higher than at the time of citation, whilst numbers of dark-bellied brent goose are similar (**Table 6.4**).

Table 6.4: Population estimates for the qualifying features of the Deben Estuary SPA, as determined at citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Non-breeding	Avocet	57 ind (1988/89-92/93)	339 ind (2011-16)
	Dark-bellied brent goose	1,889 ind (1988/89-92/93)	1,662 ind (2011-16)

[1] Count unit – ind = individuals.
Estimates derived from Citation and SPA Conservation Objectives supplementary advice (http://publications.naturalengland.org.uk/publication/5749484436848640; https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9009261&SiteName=Deben+Estuary&SiteNameDisplay=Deben+Estuary+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=)

e) Deben Estuary Ramsar site

i. Qualification criteria

6.3.51. In relation to bird populations, the Deben Estuary Ramsar site qualifies under Ramsar criterion 6. Qualification under this criterion is on the basis of the population of dark-bellied brent geese which over-winter on the site.

6.3.52. Baseline data are as detailed above for the Deben Estuary SPA.

f) Minsmere to Walberswick SPA

i. Introduction

6.3.53. The information presented on the baseline conditions for the Minsmere-Walberswick SPA comprises an overview of population status within the SPA for the different qualifying features and more in-depth consideration of population trends and aspects of habitat use where this is deemed to be required for the purposes of addressing particular impact pathways. Consideration is also given to the use of functionally linked habitat by qualifying features where there is considered to be the potential for adverse effects on these habitats or their use by qualifying features.

ii. Population estimates of SPA qualifying features

6.3.54. The citation and most recently available population estimates for the SPA show that show that for some abundance is currently considerably higher than at the time of citation, whilst for others the opposite is true (**Table 6.5**). Notable increases have occurred in the breeding populations of avocet and bittern, and in both the breeding and wintering populations of gadwall and shoveler. However, there have been marked declines in the breeding populations of little tern, teal and nightjar, and in the wintering population of hen harrier. Although the most recent estimates for wintering white-fronted goose are considerably lower than those from the time of citation, this may simply reflect the fact that these birds tend to use the SPA for roosting at night, with the main daytime feeding area being at North Warren[12] (RSPB, *in litt.*). Therefore, the SPA counts may underestimate their abundance.

Table 6.5: Population estimates for the qualifying features of the Minsmere-Walberswick SPA, as determined at citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Breeding	Avocet	47 bp (pre-1991)	109 bp (2011/12-15/16)
	Bittern	5 males (pre-1991)	17.6 males (2011/12-15/16)
	Marsh harrier	15 females (pre-1991)	16 bp (2014-18)[2]
	Little tern	32 bp (pre-1991)	1.6 bp (2014-18)[3]
	Gadwall	24 bp (pre-1991)	84 bp (2011/12-15/16)
	Shoveler	23 bp (pre-1991)	65 bp (2011/12-15/16)
	Teal	73 bp (pre-1991)	1 bp (2011/12-15/16)
	Nightjar	24 bp (pre-1991)	13 males (2011/12-15/16)
Non-breeding	Hen harrier	15 ind (1985/86-89/90)	<1 ind (5 years to 2018/19)
	Gadwall	90 ind (1985/86-89/90)	283 ind ((2013/14-2016/17)[4]

[12] https://app.bto.org/webs-reporting/

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
	Shoveler	100 ind (1985/86-89/90)	173 ind (2012/14-2016/17)[4]
	White-fronted goose	100 ind (1985/86-89/90)	16 ind (2012/13-2016/17)

[1] Count unit – bp = breeding pairs; ind = individuals.
[2] Based on data provided by RSPB, SWT and Natural England (mean value excludes 2015 as data incomplete in that year).
[3]10 pairs of little terns are reported to have nested in 2019 (RSPB, *unpubl. data)*
[4] Based on data from WeBS counts with counts for the Minsmere South Levels separated from those for the SPA section of the Minsmere WeBS count sector (see below).
All other estimates from Natural England's Designated Sites View (Ref. 6.66) (https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9009101&SiteName=minsmere&SiteNameDisplay=Minsmere-Walberswick+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=)

iii. Population trends and habitat use of qualifying features

Avocet - breeding

SPA population

6.3.55. The SPA breeding avocet population has more than doubled in size since the time of citation (**Table 6.5**) and currently represents approximately 6% of the UK breeding population of this species, which is estimated to be 1,791 breeding pairs (Ref. 6.67).

6.3.56. A high proportion of the SPA avocet population breed on the RSPB Minsmere Reserve, with the main breeding areas being on the coastal lagoon habitats (also referred to as 'scrapes') in the southeast of the SPA, immediately north of the Minsmere Sluice (RSPB, *unpublished data*). In recent years the RSPB Reserve has tended to support close to, or just over, 100 breeding pairs of avocets (RSPB, *unpublished data*). Numbers declined to 45 and 60 breeding pairs in 2014 and 2015, respectively, but by 2016 they had recovered to a level (i.e. 101 breeding pairs) similar to that for the years 2010 – 2013 (i.e. 97 – 110 breeding pairs). The RSPB Minsmere Reserve encompasses part of the Minsmere-Walberswick SPA only (and also extends onto non-SPA land in some places, such as the Minsmere South Levels), so that the avocet population estimates for the Reserve cannot be assumed to be fully representative of the SPA.

6.3.57. Within the SPA, avocets also breed at Dingle Marshes and Tinkers Marshes and occasionally in Hen Reedbed (Ref. 6.66).

Use of the Minsmere South Levels and Sizewell Marshes

6.3.58. The Minsmere South Levels[13] and Sizewell Marshes (which occur outside the SPA – **Figure 6.2**) comprise habitat that may be used by breeding avocet, so there is the potential for functional linkage with the SPA avocet population.

6.3.59. Avocet have been known to breed in the north eastern parts of the Minsmere South Levels but were last recorded breeding there in 2010 (when there were an estimated 13 breeding pairs - RSPB, unpublished. data). Breeding bird surveys (undertaken using the British Trust for Ornithology's Common Bird Census method (Ref. 68)) recorded no avocets in this area during annual surveys from 2011 – 2017 (Ref. 6.69).

Bittern - breeding

SPA population

6.3.60. The SPA bittern population has more than tripled in size since the time of citation, at least as measured by the number of booming males (which is the count unit used to survey this species; **Table 6.5**). The SPA population currently represents approximately 11% of the UK breeding population of this species, which is estimated to be 164 booming males (Ref. 6.67). The majority (approximately 60%) of the SPA population breeds on the RSPB Minsmere Reserve. RSPB monitoring data from the Minsmere Reserve show that the annual numbers of booming males fluctuated between eight and 11 between 2000 and 2010. There was a slight increase in more recent years so that 11 were recorded in 2014 and 12 annually between 2015 and 2017, and a subsequent decline, possibly due to cold weather early in 2018. The mean for 2015-2019 was 10.4 booming males (RSPB unpublished data).

6.3.61. The main breeding sites for the species on the Minsmere Reserve occur within the extensive area of reedbed habitat and open pool systems which is located immediately north of the Minsmere New Cut and represents some of the closest areas of the SPA to the main development site (at less than 1km at the closest point). Other areas identified as strongholds for breeding bittern within the SPA are Hen Reedbed and Westwood Marshes (Ref. 6.66); and Dingle Marshes is also managed for breeding bitterns (https://www.rspb.org.uk/reserves-and-events/reserves-a-z/dingle-marshes/). These areas are all considerably further from the main development site than the Minsmere RSPB reserve.

[13] The Minsmere South Levels occur within the Minsmere-Walberswick Heaths and Marshes SSSI.

Use of the Minsmere South Levels and Sizewell Marshes

6.3.62. The Minsmere South Levels and Sizewell Marshes (which occur outside the SPA – **Figure 6.2**) comprise habitat that may be used by bittern, so there is the potential for functional linkage with the SPA bittern population.

6.3.63. There is little evidence that these areas provide additional breeding habitat for the SPA population. Male bitterns have been heard booming in the Sizewell Marshes for short periods in spring in a number of recent years but there has been no evidence to suggest breeding has occurred in this area (Ref. 6.70; Ref. 6.71; Ref. 6.72). Although standard breeding bird surveys are unsuitable for estimating the abundance of breeding bittern, it is notable that during annual breeding bird surveys of the Sizewell Marshes from 2011 to 2017 there was only a single breeding season record for bittern (Ref. 6.69). Also, an extensive programme of walkover surveys in this area, undertaken from April 2011 to March 2012 failed to record the species (Ref. 6.45).

6.3.64. Both the Minsmere South Levels and Sizewell Marshes could be used as foraging habitat by breeding bitterns from the SPA during the breeding season, as well as by SPA birds outside the breeding season. Vantage point (VP) surveys were undertaken in 2008 and in 2011/12 to determine the extent to which bittern may commute between the SPA and these areas.

6.3.65. Over the course of 24 surveys, each of three hours duration, between 15th May and 4th August in 2008, a total of 10 bittern records were obtained (Ref. 6.73). These comprised five flights between the SPA and Minsmere South Levels, three flights over the Minsmere South Levels and two birds on the ground within the Minsmere South Levels. No commuting flights to, or from, the Sizewell Marshes were recorded (Ref. 6.73). The peak provisioning period of nestlings by female bittern is likely to be from late April to mid-June, although it may extend into August if there are replacement broods following failure of earlier breeding attempts (Ref. 6.74). Six of the 12 surveys in 2008 occurred between late April and mid-June.

6.3.66. The VP surveys in 2011 and 2012 extended over the full annual period (5th April 2011 – 16th March 2012), with surveys to detect birds commuting between the SPA and the Minsmere South Levels or Sizewell Marshes undertaken on a bi-monthly basis and comprising two surveys (each of three hours duration) on each survey day (Ref. 6.45). Additionally, further VP surveys were undertaken over this period across the Sizewell Marshes to record usage of this area by bittern. A total of five bittern records were obtained during these surveys, all of which were between October and early March (the non-breeding period). These comprised two commuting flights between the SPA and Minsmere South Levels, two flights over the Minsmere South Levels and one flight within the Sizewell Marshes (Ref. 6.45). Although these survey data are relatively old, there has been relatively little change in

the relevant habitats in the Minsmere South Levels and Sizewell Marshes and no substantive increase in bittern numbers within the RSPB Minsmere Reserve since these surveys. Therefore, it is likely that these findings remain representative of the current situation.

6.3.67. Other evidence on the use of the Sizewell Marshes by bittern derives from radio-tracking studies undertaken by RSPB in 2000 and 2001, which showed that the Sizewell Marshes were used by first winter birds from the SPA (Ref. 6.73). A first-year bird radio-tagged at Minsmere was also recorded commuting between Minsmere and Sizewell Marshes over winter (Ref 6.75; Ref. 6.73), and a dead radio-tagged bird was recovered from a ditch in Sizewell Marshes (Ref. 6.73). A review of the annual reports produced by SWT for the Sizewell Marshes reserve showed that bitterns are recorded, on average, once or twice annually, suggesting some usage of the marshes, mainly during the winter months.

6.3.68. Overall, the evidence outlined above suggests that breeding is limited to the SPA, and that breeding birds from the SPA may make limited use of the Minsmere South Levels (presumably for foraging) but rarely use the Sizewell Marshes. The available data suggest that most activity on the Minsmere South Levels occurs in the northern part of this area (i.e. closest to the reedbed breeding habitat within the SPA, and furthest from the main development site). Use of the Sizewell Marshes by bittern appears to be mainly in the non-breeding season and is often associated with first year birds. This is consistent with the fact that young birds in the UK are known to disperse widely from their natal sites (Ref. 6.76). During winter, bitterns may also move across to the UK from breeding populations on the European Continent (Ref. 6.77).

Marsh harrier - breeding

SPA population

6.3.69. Numbers of marsh harrier breeding within the SPA are currently at similar levels to those at the time of citation, although numbers were higher during the mid-2000s (**Table 6.5** and **Table 6.6**). Approximately 50% of the SPA population tend to occur on the RSPB's Minsmere Reserve in any given year (**Table 6.6**). Based upon the most recent five years of count data, the SPA population represents approximately 4 – 5% of the current British population of breeding marsh harrier, estimated to be 365 pairs (Ref. 6.67).

Table 6.6: Number of breeding pairs of marsh harrier within the Minsmere-Walberswick SPA (2004-2018)

Year	Minsmere Reserve	Hen Reedbed	Walberswick NNR	Total
2004	10	2	9	21
2005	12	4	8	24
2006	13	4	7	24
2007	17	6	8	31
2008	15	3	No data	More than 18
2009	12	3	9	24
2010	10	3	No data	More than 13
2011	12	3	7	22
2012	10	3	8	21
2013	9	2	No data	More than 11
2014	6	2	5	13
2015	9	No data	No data	More than 9-
2016	9	2	6	17
2017	9	2	6	17
2018	8	3	6	17

6.3.70. In addition to the birds breeding on the Minsmere-Walberswick SPA, there is also the potential for functional linkage between the Minsmere-Walberswick SPA breeding population and the marsh harriers that breed at the North Warren RSPB Reserve, which is outside the SPA and approximately 3.5km south of the main development site. There have been two breeding pairs at North Warren in each year from 2014 to 2018, except in 2015 when there was only a single pair. There has been a maximum of three pairs recorded in any one year since 2004.

Marsh harrier flight activity within the vicinity of the main development site

(i) Introduction

6.3.71. With the exception of the birds which breed at North Warren (for which there is the potential for a functional linkage with the SPA population), breeding is restricted to the SPA. However, marsh harriers range widely and hunt over land which is within and surrounding the main development site, so that impacts may arise via effects on foraging birds (or on the habitats on which they depend).

6.3.72. A considerable amount of field survey was undertaken to establish usage by marsh harrier of habitats within and in close proximity to the main development site for foraging purposes. A series of VP surveys were undertaken focusing on Minsmere South Levels, Sizewell Marshes and to a lesser extent arable farmland within the main development site (**Figure 6.2** to **Figure 6.7**). During each VP survey, all observed marsh harrier flight activity was recorded but with the subsequent analyses of flight activity restricted to those areas referred to as "high visibility areas" (HVAs – see below). During VP surveys, the marsh harrier flight lines were plotted on a base map, together with additional information including, height of flight, duration of flight, gender of bird, and prey items carried (if any). Survey work was undertaken as follows:

- (2008) – Amec surveys between May and July.
- (2011 - 2012) – Amec bimonthly surveys from April 2011 to March 2012.
- (2014 - 2015) – Hyder bimonthly surveys from April 2014 to September 2015.
- (2016) – Arcadis surveys from April 2016 to September 2016.

6.3.73. The available survey data were analysed and two metrics developed which provide a comparative measure of the intensity of marsh harrier flight activity within the overall study area. These metrics can be used to determine whether any areas within the study area are of particular importance for foraging for marsh harrier. A third metric was proposed by Natural England (following the 24 November 2015 stakeholder workshop), but comparisons of the outputs from this metric suggested that it produced broadly analogous findings to those from the metrics used in this report (see below; Ref. 6.78).

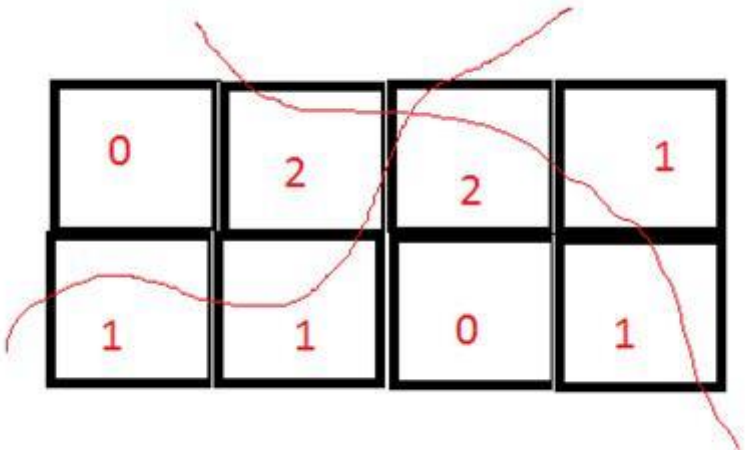
6.3.74. The objectives of the earlier surveys undertaken by Amec in 2008 and 2011 – 2012 differed from those of the later Hyder and Arcadis surveys. The former focused on determining the extent to which marsh harriers were commuting between the Minsmere to Walberswick SPA (or the RSPB Minsmere Reserve) and the EDF Energy Sizewell Estate, as opposed to determining a measure of the intensity of foraging by marsh harriers across Minsmere South Levels and Sizewell Marshes (Ref. 6.79). As such, the Amec surveys did not provide data from which foraging use on the Minsmere South Levels could be determined, although they did provide data on the usage of the Sizewell Marshes SSSI. Detailed consideration of the Amec surveys and the extent to which the resulting data can be used to inform the current assessment has been reported separately (Ref. 6.79). For the purposes of the current assessment, the information from these earlier surveys is used to supplement the findings from the more extensive data on marsh harrier foraging collected during the later Hyder and Arcadis surveys.

6.3.75. There are significant parts of Sizewell Marshes that are only partially visible or not visible from the selected VPs. Therefore, given that the habitats used by marsh harrier within Sizewell Marshes (reed bed and floodplain grassland) are relatively uniform across the marshes with no major differences in habitat structure (i.e. areas of reed bed are structurally similar to other areas of reedbed, and the coastal grazing marsh is relatively uniform in structure), it is assumed that the level of usage of areas outwith the HVAs by marsh harrier is likely to be similar to that observed within the HVAs in Sizewell Marshes. This assumption is considered to be valid, as greater usage of areas by marsh harrier not within HVAs is unlikely, given that birds would, more than likely, have to cross areas of full visibility in order to reach areas that were not visible during the VP surveys. This issue has been addressed in more detail through some of the additional work undertaken to address possible biases in the flight activity surveys, as identified from consultation with stakeholders (see below).

(ii) Flight path count metric (metric one)

6.3.76. This intensity of use analysis is based on counts of marsh harrier flight paths from the individual VPs used. It was recognised that visibility was not uniform from each VP, particularly within Sizewell Marshes, and it was therefore not possible to base the calculation of the intensity of use on the entire area of visibility from the VP (because of the variability in the extent to which the air space above this area was visible). To address this a zone of theoretical visibility (ZTV) modelling exercise using digital surface and terrain mapping data was undertaken to establish the areas of high visibility (i.e. those areas in which there is 100% visibility) for each VP. The boundaries of these areas were then calibrated in the field and in consultation with stakeholders before being used in this analysis. These comprise the HVAs and encompass the area of unrestricted visibility from ground level upwards. Once the HVAs were finalised it was then possible to calculate the intensity of marsh harrier usage (i.e. flight lines per ha per hour) based on the following method:

- The HVAs were split into 100m*100m (1ha cells). Cells on the edge of each HVA were clipped to the HVA extents and so had a smaller area.
- The number of mapped marsh harrier flights across each grid cell from corresponding VPs were counted, as shown in the diagram below.



- The per cell intensity of use was calculated as *ic* = *L/T* where: *ic* is the per cell intensity; *T* is the number of hours recorded at the VP for a specific season and *L* is the sum of the number of birds per flight line that cross the grid cell.

6.3.77. Using the above method, the variation in the intensity of use across each HVA has been calculated and the results mapped. To enable comparison between HVAs within the entire study area to be undertaken, the total number of survey hours for all of the VPs has been summed and used to derive a flight per hour metric.

6.3.78. **Figure 6.2** (2014 data alone) provides a graphic view of the intensity outputs and shows flights per hectare / hr for the breeding season based on the Hyder survey data for each of the VPs analysed.

(iii) Flight path length metric (metric two) and use of the Sizewell Marshes and Minsmere South Levels

6.3.79. This metric comprises the measurement of the length of observed and plotted flight lines within each of the HVAs and calculation of a simple metric that provides a measure of flight path (metre length) per hectare per hour (i.e. a measure of flight intensity). The results of this analysis are provided in **Table 6.7** for breeding season flight data from 2014, 2015 and 2016.

Table 6.7: Calculated marsh harrier flight activity intensity for individual HVAs, based upon the flightline length (m) per hr per ha metric

VP/ HVA	Year	Area (ha)	Total Flightline Length (m)	Total Survey Time (h)	Flightline Length / Hr / Ha	Mean Flightline Length / Hr / Ha
1	2014	8.74	5181	66	8.98	8.4
	2015		1484	38	4.46	

VP/ HVA	Year	Area (ha)	Total Flightline Length (m)	Total Survey Time (h)	Flightline Length / Hr / Ha	Mean Flightline Length / Hr / Ha
	2016		3599	36	11.43	
2	2014	13.26	2906	66	3.32	6.1
	2015		4819	36	10.10	
	2016		3353	36	7.03	
3	2014	136	169280	90	13.85	10.3
	2015		84248	72	8.6	
	2016		66566	66	7.42	
4	2014	9.78	2276	47	4.95	3.9
	2015		178	30	0.61	
	2016		1855	36	5.27	
5	2014	17.25	1275	48	1.54	2.1
	2015		992	30	1.92	
	2016		1812	36	2.92	
6	2014	1.62	413	30	8.49	7.8
	2015		530	30	10.92	
	2016		277	36	4.77	

6.3.80. The average value for this metric across Sizewell Marshes (i.e. as measured within HVAs 1, 2, 4 and 6, which combined cover approximately 43% of suitable foraging habitat within the Marshes) is 6.1m/ha/hr (based on 2014-2016 data), which compares with a value of 10.3m/ha/hr as recorded within HVA 3, which encompasses the Minsmere South Levels. Therefore, these flight activity data indicate that the average intensity of use of Minsmere South Levels is almost twice that of Sizewell Marshes.

6.3.81. Analysis of intensity of use at the 1ha level across each of the HVAs (the intensity of use metric calculated for each cell being flight path length divided first by survey effort (the same for each grid cell within a particular HVA) and then by the area of each grid cell) has also been undertaken. This approach takes account of the fact that grid cells around the margins of the HVAs were often less than a full ha in extent. The results of this analysis for the Sizewell Marshes and Minsmere South Levels HVAs are shown in **Figure 6.3** to **Figure 6.5** (for each of the 2014, 2015 and 2016 survey data, respectively). The outputs from this metric, compare favourably with those derived from the intensity of use metric based on the number of flights (presented in **Figure**

6.2 for the 2014 survey only), with both metrics showing a similar pattern in the variation of usage.

6.3.82. Overall, it is considered that the flight path metric provides a better measure of activity and intensity of use within a given area than the count metric. Unlike the count metric, the length metric enables a better calculation of the intensity of use of partial (ha) cells at the edges of the HVAs. It is also worth noting that the flight path length within a given area is likely to be highly correlated with flight time in that area. As such, the flight path length metric is broadly analogous to the metric recommended for quantifying levels of flight activity and its distribution within a survey area for the purposes of impact assessments for onshore wind farms, where flight activity is measured as the flight time within the survey area (Ref. 6.80).

6.3.83. It should be noted that both metrics show that there is significant variation of use by foraging marsh harrier across the Minsmere South Levels, with the southern end of this area being little used relative to the central and more northerly parts.

6.3.84. As detailed above, the surveys from the 2008 and 2011 breeding seasons were used to provide data on the use of the Sizewell Marshes only (Ref. 6.79). Based on these survey data the rate of occurrence of marsh harrier flights over the Sizewell Marshes SSSI was estimated as one flight every 4.8 hours in 2008 and one flight every 3.6 hours in 2011, which on the basis of a 12-hour day approximates to 2.5 to 3.5 flights per day (Ref. 6.79). A similar analysis undertaken on the Hyder surveys from the 2014 and 2015 breeding seasons gave an estimate of fewer than five flights per day over the Sizewell Marshes SSSI, suggesting a broad-level of between-year consistency in the usage of this area by marsh harriers (Ref. 6.79).

(iv) Flight activity over agricultural habitats

6.3.85. Agricultural habitats are known from various studies (e.g. Ref. 6.81; Ref. 6.82) to provide important foraging habitats for marsh harrier where wetland habitats are not present or form only a small component of the available habitats.

6.3.86. Limited flight activity surveys were undertaken in 2014 from one location (VP5) which covered agricultural land within the proposed main development site. During the 2015 and 2016 marsh harrier breeding seasons, further survey work was undertaken from an additional five VPs (**Figure 6.6** and **Figure 6.7**) to determine the extent to which foraging marsh harriers used land under agricultural cultivation within or adjacent to the boundary of the main development site. The locations for this additional VP work were selected, in part, to provide data on existing marsh harrier use of an area of

land that has the potential to provide enhanced foraging habitat for marsh harrier.

6.3.87. Expressing the usage of the agricultural habitats in terms of the flightpath length per hectare per hour gives annual values in the different HVAs that are almost invariably lower than those recorded for the Minsmere South Levels (i.e. HVA 3 in **Table 6.7**), and generally lower than for the HVAs located in the Sizewell Marshes (i.e. HVAs 1, 2, 4 and 6 in **Table 6.7**) (**Table 6.8**). The overall average intensity of flight activity on agricultural habitats as estimated from the 2015 and 2016 surveys is 4.0m/ha/hr, is lower than for the Sizewell Marshes (6.1 m/ha/hr) and less than half of that estimated for the Minsmere South Levels (10.3 m/ha/hr).

Table 6.8: Calculated marsh harrier flight activity intensity for individual HVAs covering arable land to the south-west of Minsmere in 2015 and 2016, based upon the flightline length (m) per hr per ha metric

VP/HVA	Year	Area (ha)	Total Flightline Length (m)	Total Survey Time (h)	Flightline Length / Hr / Ha	Mean Flightline Length / Hr / Ha
A	2015	10.42	4580	60	7.33	6.1
	2016		3157	62	4.89	
C	2015	4.97	1165	45	5.21	5.9
	2016		1264	37.5	6.78	
D	2015	4.73	1379	48	6.07	7.3
	2016		2435	63	8.16	
E	2015	10.40	720	39	1.77	3.4
	2016		2803	62	4.35	
F	2015	13.16	2887	45	4.88	3.9
	2016		2602	63	3.14	
5	2015	17.25	992	30	1.92	2.5
	2016		1812	36	2.92	

(v) Possible biases in estimating flight activity

6.3.88. Following discussions with, and comments from, stakeholders on the flight activity surveys (including at the stakeholder workshop hold on 24 November 2015), a number of potential biases in the recording and estimation of flight activity were identified. Details of the work undertaken to investigate each of these potential biases have been reported elsewhere (Ref. 6.78; Ref. 6.83), but a summary of this work and of the conclusions is provided below:

- Potential sex bias in birds foraging on the Minsmere South Levels and Sizewell Marshes: Male and female marsh harriers may exploit different prey resources (due in part, at least, to the larger size of the females). Any sex bias amongst the birds recorded foraging within the HVAs may be useful in informing the habitat management on the habitat improvement area. However, comparisons of the sex of marsh harriers during surveys may be complicated by plumage variation amongst male birds, with some retaining juvenile-type plumage throughout their lifecycle (Ref. 6.84). Therefore, a proportion of adult males may be misclassified as juveniles or adult females during surveys, which should be borne in mind when interpreting the survey findings.

  Comparisons of the (apparent) sex of marsh harriers observed during the 2014 and 2015 surveys revealed a greater proportion of flights by females than males during the 2014 breeding season (67% compared to 22%, with the remainder being juveniles or birds of undetermined sex) and 2014/15 winter period (84% compared to 11%, with the remainder being birds of undetermined sex) (Ref. 6.78). However, during the 2015 breeding season, 49% of flights were of identifiable males and 39% in female-type plumages (with the remainder of juveniles or birds of undetermined sex).

  Therefore, no clear conclusions can be made as to the likelihood of any sex bias in the birds using the areas surveyed for the assessment during the breeding season, which is the period of main interest to the current assessment (Ref. 6.78). Furthermore, habitat management on the proposed habitat improvement area aim to provide a range of prey types selected by marsh harriers throughout the breeding cycle, including larger prey such as rabbits as seen in section 8.8 d of this report.

- Under-recording of flight activity within the HVA 1: The HVA 1 was selected on the basis of covering a range of habitats that contributed to providing a representative sample of the habitats (from across the different HVAs) likely to be used by foraging marsh harriers within the Sizewell Marshes. This HVA encompassed approximately 20% of the reed bed within the two compartments to the south of Grimsey's wood, and concerns were expressed that the exclusion of the larger part of this reed bed may have led to an underestimation of flight activity (although this suggestion fails to account for the fact that reed beds form a small part of the Sizewell Marshes only, and extending the HVA to encompass a larger extent of this habitat could lead to its over-representation).

  To estimate the extent of any underestimation in flight activity, a second VP was established using a deer-shooting High Seat. Coverage of the

reed bed area in question was increased to 70% when surveys were conducted simultaneously from VP1 and the High Seat (Ref. 6.78).

During 20 hours of surveys conducted simultaneously from VP1 and the High Seat in 2015, a total of six marsh harrier flights were recorded, of which four were from VP1 (including flights of two birds over the HVA at the same time) and two from the High Seat (with the flights from VP1 not visible from the High Seat, and vice-versa). The total flight time recorded from the High Seat (120 seconds) was slightly greater than that recorded from VP1 (90 seconds).

These surveys provided no indication that the reed bed in question was a particular focus of marsh harrier activity within Sizewell Marshes, or that extending the sampled area (i.e. HVA 1) to have included a larger part of the reed bed would have resulted in higher estimates of the intensity of flight activity (Ref. 6.78). Furthermore, the habitat composition within HVA 1 (as used) is likely to be more representative of the habitat composition within Sizewell Marshes (including as it does approximately 20% reed bed coverage).

- Under-recording of low flying birds at distance within HVA 3: HVA 3 encompasses the Minsmere South Levels and, at 136ha, it is the largest of all the HVAs used (extending across an area which is eight to 84 times greater than that of the other HVAs - **Table 6.7** and **Table 6.8**). The most distant part of the HVA is 1.5km from VP3 (**Figure 6.2** to **Figure 6.5**), which raised concerns that marsh harrier flights may have been under-recorded at this distance, particularly for low flying birds that were against a dark background created by the pine plantations bordering parts of the HVA (Ref. 6.83).

  To assess whether there was a reduced detection rate of distant and low flying marsh harriers, surveys of the southern section of the HVA were conducted from VP3 simultaneously with surveys of this area from a second, closer, VP. These comparisons suggested that the detection of distant flights from VP3 was reduced (with a total of 13 flights recorded from the two VPs combined, of which seven were recorded from the closer VP but not VP3, whilst only one flight was recorded from VP3 but not from the closer VP) (Ref. 6.83). There was no indication that this reduced detection of flights was associated with flight height (Ref. 6.83).

  However, these surveys also indicated that the overall occurrence of flights in the southern part of this HVA was low and half of the missed flights were of birds passing very rapidly through the extremities of the survey area (Ref. 6.83). Therefore, the reduced detection of flights in this section of the Minsmere South Levels will not have affected the

findings of the assessment in any meaningful way. It is also important to note that this underestimation of flight activity only affects the estimates of flight activity derived for HVA 3 (with this being minimal because it relates to the area of HVA 3 within which flight activity was low). There is no effect on the flight activity estimates produced for the Sizewell Marshes or for the agricultural habitats because these were all derived from surveys specific to the other HVAs (and were independent of the surveys undertaken for HVA 3).

- Under-recording of flight activity when multiple birds are in flight over the HVA: Surveys were undertaken by single observers and concerns were expressed that this may have caused underestimation of flight activity when more than one bird was present within the HVA at any one time. However, few of the surveys recorded more than one bird in flight at any one time and a validation exercise (undertaken using two observers operating independently at VP3) demonstrated that flights missed by observers invariably involved situations where only one bird was known to be in flight over the HVA (Ref. 6.83). Although the validation exercise at VP3 demonstrated that a proportion of flights were missed by observers, this should not affect any of the comparisons of flight activity (e.g. between Minsmere South Levels and Sizewell Marshes) because they do not rely upon absolute measures of activity.

- Potential bias in flight path length metric: It was suggested that the estimated number of flights per day within a HVA may provide a more meaningful and clearer approach to estimating the intensity of flight activity than the flight path length metric currently used (**Table 6.7** and **Table 6.8**).

  Comparisons of flight activity between the Minsmere South Levels and the Sizewell Marshes based upon the number of flights per day revealed a broadly similar trend to that obtained using the flight path length metric, with substantially greater activity levels within the Minsmere South Levels (Ref. 6.78). Although the extent of this difference appeared to be greater when based upon the number of flights per day this is an artefact of the HVA for the Minsmere South Levels extending across an area four times greater than the total HVA area for the Sizewell Marshes (and would reduce accordingly if the metric incorporated survey area).

  Also, as noted above, the flight path length metric is broadly analogous to the metric recommended for quantifying levels of flight activity and its distribution within a survey area for the purposes of onshore wind farm impact assessments (Ref. 6.80). This further supports the view that flight path length is a suitable metric for the use in the current assessment.

6.3.89. Having reviewed in detail the concerns which emerged from the stakeholder workshop on 24 November 2015 over the flight activity surveys and the associated estimation of the intensity of flight activity, there was no strong justification for amending the approaches used to date. Rather, these investigations suggest that the currently derived estimates of the intensity of flight activity are appropriate for the purposes of informing the assessment of disturbance to foraging marsh harriers as a result of the Sizewell C development.

6.3.90. Additionally, although the vast majority of the survey data used to determine flight activity derive from 2014 to 2016, there has been little change since then in either the habitats of key interest (i.e. wetland habitats on the Minsmere South Levels and Sizewell Marshes) or in the numbers of marsh harrier nesting at Minsmere. Therefore, these survey data are likely to continue to provide a reliable representation of marsh harrier flight activity in the vicinity of the main development site.

(vi) Overview of the findings of the flight activity surveys

6.3.91. The detailed survey work undertaken from the VPs reveals that, for those areas surveyed, there is considerable variation in flight activity within the study area. For the purposes of this assessment, flight activity has been assumed to represent a proxy for foraging activity during the breeding season. The flight intensity plots (**Figure 6.2** to **Figure 6.5**) show clear variation across the Minsmere South Levels, with a core area of activity in the northwest of the area and a tailing off to the south and east. The data show that flight activity within this core area is three to four times greater than in the southernmost part of the Minsmere South Levels and the immediate coastal fringe. Although some underestimation of flight activity in the southern parts of the Minsmere South Levels is likely to have occurred due to their greater distance from VP3, the validation work confirmed low overall flight activity in this area and indicated that the level of underestimation would have had little effect on the survey findings (see above; Ref. 6.83).

6.3.92. While there is it not necessarily a direct relationship between flight activity and foraging success, the intensity of activity over the northwestern part of the Minsmere South Levels suggests that this is a preferred foraging area for marsh harrier. The ornithologists who carried out the survey work suggest this area supports taller vegetation (greater concentration of common reeds) which may offer higher quality foraging habitat, but this is based upon anecdotal observations only and has not been verified by detailed surveys. The higher flight activity in the northwest of the Minsmere South Levels probably results from both closer proximity to the nesting sites and greater prey availability (quality of the habitat) and accords with findings from other studies on the foraging ecology of this species (Ref. 6.82; Ref. 6.85).

6.3.93. The wetland habitats within the Sizewell Marshes provide a foraging resource for marsh harrier, as clearly shown by the recorded flight activity over this area. However, at 3km from the Minsmere Levels, the Sizewell Marshes is likely to be approaching the furthest limits of the breeding season foraging ranges of birds nesting in the Minsmere reed-beds. The flight activity intensity mapping indicates that levels of flight activity over the Sizewell Marshes average approximately 60% of that over the Minsmere South Levels, with differences particularly marked when comparisons are made with the northwest parts of the Minsmere South Levels (**Figure 6.2** to **Figure 6.5**).

6.3.94. The VP survey data covering agricultural land to the west of the Minsmere South Levels show that this area is overflown by marsh harrier on a reasonably regular basis. For the 2015 and 2016 breeding seasons, the average level of activity for this total area of arable is calculated as 4.0 m/ha/hr (inclusive of the 2015 data for VP5). Overall, this is approximately two thirds of the average levels of activity estimated for the Sizewell Marshes (at 6.1 m/ha/hr). However, as is apparent from comparison of the flight path length/hr/ha metric (**Table 6.7, Table 6.8**, and **Figure 6.3** to **Figure 6.7**), the extent of use varies spatially across both the arable land and the Sizewell Marshes, with some of the land currently under agricultural production supporting a similar level of flight activity to parts of the Sizewell Marshes.

Little tern - breeding

SPA population

6.3.95. The Minsmere-Walberswick SPA's qualifying population of 32 pairs of little terns (**Table 6.5**) constituted approximately 1.2% of the national breeding population at the time of classification in. Since then the number of little terns using the SPA has decreased by 95% to 1.6 breeding pairs (5 year mean, 2014 – 2018) (Ref. 6.86), although 10 pairs are reported to have bred at the Minsmere colony in 2019 (RSPB, *in litt.*). There are historic breeding colonies in the SPA at Dingle, Dunwich Beach, Minsmere and Walberswick. The closest little tern colony to the main development site (at approximately 1.5km) is at Minsmere. There had been no successful breeding at the Minsmere colony since 2009 (when a single breeding pair was recorded - RSPB, *unpublished data*) until 2019, when 10 pairs bred on the scrape with 7 young raised to fledging. Successful breeding has occurred since 2009 at both Dingle and Walberswick, *c.*7.5 – 9km north of the main development site (Ref. 6.45).

6.3.96. Historically, numbers of little tern breeding within the Minsmere-Walberswick SPA have fluctuated greatly between years, with some years having a high number of nesting pairs and then the next year having none at all. The decline in numbers on the SPA may be due to changes in breeding site selection within the Suffolk area to favour other sites, such as within the Benacre to

Easton Bavents SPA. Little tern colonies also occur to the south of the SPA at North Warren within the Sandlings SPA (Ref. 6.66). The causes of the recent decline in the numbers of breeding little tern on the Minsmere-Walberswick SPA are unknown but could involve predation, disturbance and/or changes in the availability prey species.

Project-specific survey data

6.3.97. As detailed above, shore-based surveys to record little tern flight activity and foraging were undertaken in 2010 (Ref. 6.87), 2011 (Ref. 6.45) and 2013 (Ref. 6.46) across a total of 15 VPs between Dunwich (VP15) and Orford Ness (VP12) (see **Figure 6.1**). In addition, colony surveys at Dingle and Minsmere were also undertaken in 2010 and 2011 (Ref. 6.45; Ref. 6.46).

6.3.98. During the 2010 surveys (Ref. 6.87), there was evidence of attempted nesting at both Dingle and Dunwich Beach, and colony surveys were undertaken at Minsmere and Dingle. No serious attempts at breeding were observed at Minsmere, whilst the attempted breeding by seven to eight pairs at Dingle was unsuccessful (with the RSPB Reserves Monitoring data suggesting only five of these pairs actually nested – see above). Foraging activity was concentrated close to shore near Dingle, with a peak of around 100 birds foraging or loafing on the beach at the end of June 2010. Beyond the colonies, peak foraging behaviour was observed at VP1, at the south end of the SPA.

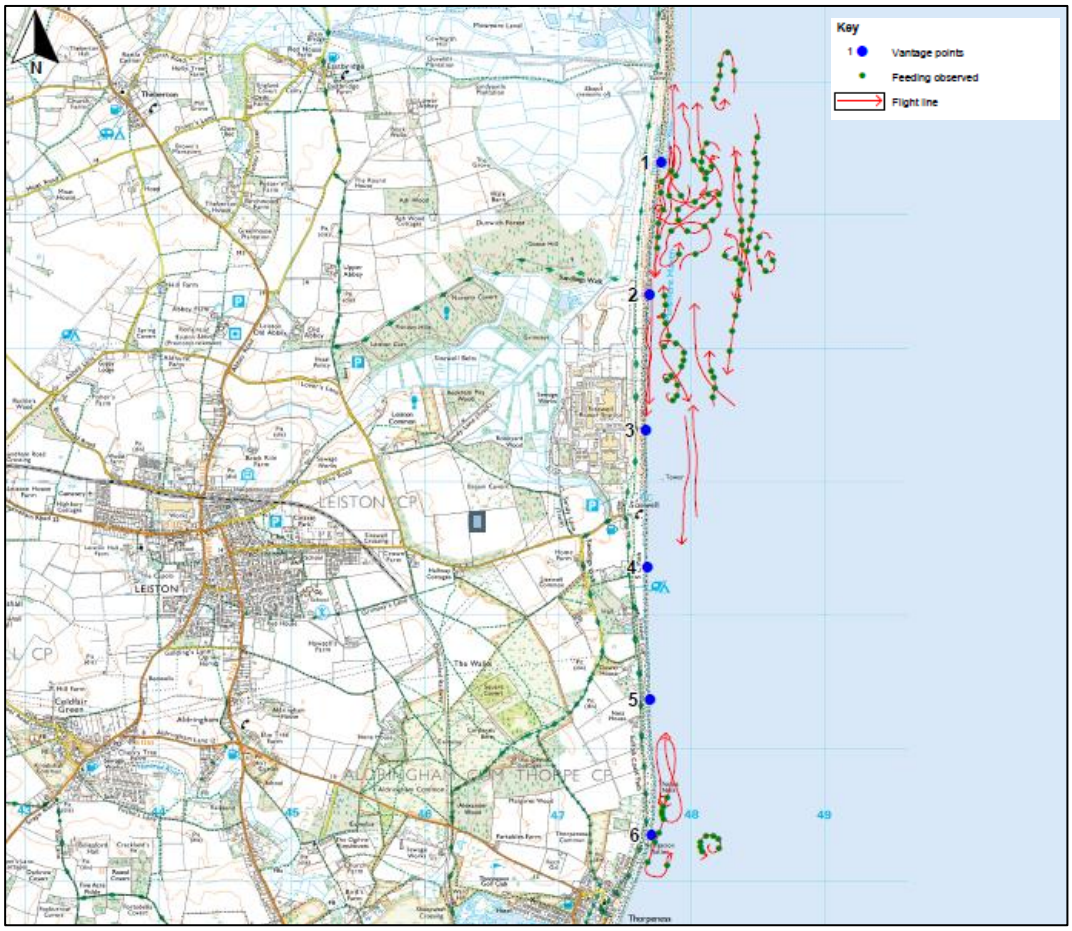
6.3.99. During the 2010 survey period, birds were recorded heading south from both the Dingle and Minsmere colonies, though at both colonies much of the foraging activity occurred in the shallow waters close offshore (generally within 700m of the shoreline). Flight line data indicated that birds were moving between the colonies but were also heading further south along the shoreline towards Sizewell. Surveys from the VPs near Sizewell (VPs 1 – 6 – **Figure 6.1**) showed much of the foraging activity of birds from the SPA was in shallow waters within 500m of the shore, as illustrated in **Plate 6.6**).

6.3.100. Results from colony surveys in May and June 2011 (Ref. 6.45) show that there were no nesting attempts at Minsmere (although up to 79 birds were prospecting in mid-May), but successful breeding was recorded at Dingle / Walberswick. At the Dingle colony, small numbers of birds (one to seven) were recorded between 17 May and 20 May, mostly commuting but occasionally displaying. First mating was recorded on 20 May. Up to 110 birds were present at the beginning of June, and by late June a total of *c.*40 pairs were present at the colony of which 26 pairs attempted to breed.

6.3.101. The first chick of 2011 was seen on 29 June and by mid-July there were 8 fledged young and six chicks from the Walberswick section of the colony. Peak counts at Dingle of 180 birds, including 150 loafing on the beach

(including 10 fledged young), were recorded in late July before numbers started to decrease, with the colony vacated by 12 August. Much of the recorded foraging activity for the provisioning of chicks was relatively close inshore (within 1km of the colony) though occasionally birds were recorded foraging further offshore.

Plate 6.6: Flight lines of little terns from VP surveys at Sizewell, May - July 2010 (Ref. 6.87)



6.3.102. Areas of concentrated foraging activity and flight lines of foraging and commuting birds recorded at the Dingle and Minsmere colonies in the AMEC (Ref. 6.45) surveys are shown in **Plate 6.7** and **Plate 6.8**. Of the nine sightings of little tern during the 2013 VP foraging surveys, two were from VP13, north of the main development site and the only sightings within the mean maximum foraging range of birds breeding within the Minsmere-Walberswick SPA (**Plate 6.9**). These sightings were of one to two individuals, foraging from Minsmere and moving south towards Sizewell.

6.3.103. Although the project-specific survey data are from 2011-2013, as described above, in most years since their collection only small numbers of pairs have nested at the SPA colonies. Therefore, had more recent surveys been undertaken, it is unclear whether they would have provided data which were any more representative of the current main foraging areas of the SPA breeding little tern population.

Foraging behaviour and diet

6.3.104. Details of the foraging behaviour and diet of little tern are given above (see Alde-Ore Estuary SPA baseline conditions). Based on the mean maximum alongshore foraging range (3.9km) estimated by Parsons *et al.* (2015 – Ref. 6.43), breeding birds from the Dingle colony could be expected to generally forage no further south than Dunwich Heath and no further north than Southwold, whilst those from the Minsmere colony could be expected to generally forage no further south than Sizewell and no further north than Dunwich. As such, breeding birds from the Minsmere colony are the only ones likely to forage in the waters around the main development site.

6.3.105. As for the Alde-Ore Estuary SPA little tern population, the prey of breeding little tern from the Minsmere-Walberswick SPA during the period May to August is expected to consist predominantly of schooling pelagic fish that are found near to the surface during daylight hours, such as herring, sprat and anchovy, based upon the fish availabilities at Sizewell (Ref. 6.53).

Gadwall - breeding

SPA population

6.3.106. The SPA breeding gadwall population has more than tripled in size since the time of citation (**Table 6.5**). A high proportion (more than 80%) of the SPA gadwall population breed on the RSPB Minsmere Reserve (RSPB *unpublished data*), but the Reserve encompasses part of the Minsmere-Walberswick SPA only (and also extends onto non-SPA land in some places, such as the Minsmere South Levels), so that the gadwall population estimates for the Reserve cannot be assumed to be fully representative of the SPA. The numbers of pairs estimated to breed on the RSPB Minsmere Reserve varied from 44 to 96 between 2010 and 2016 (**Table 6.9**).

Plate 6.7: Flight lines and areas of concentrated foraging activity around Dingle little tern colony during colony surveys in May – August 2011 (Ref. 6.45)

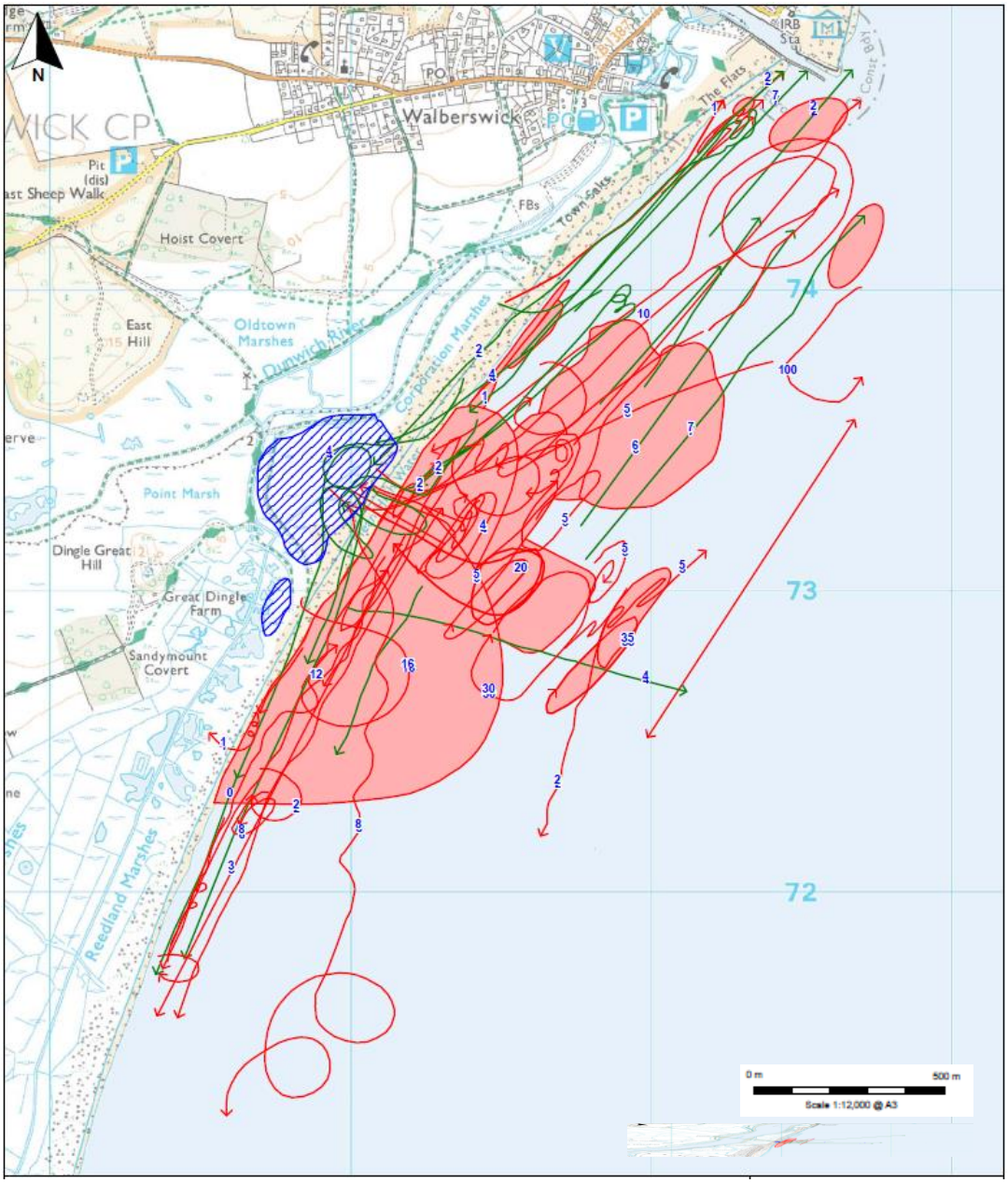


Plate 6.8: Flight lines and areas of concentrated foraging activity around Minsmere little tern colony during colony surveys in May – August 2011 (Ref. 6.45)

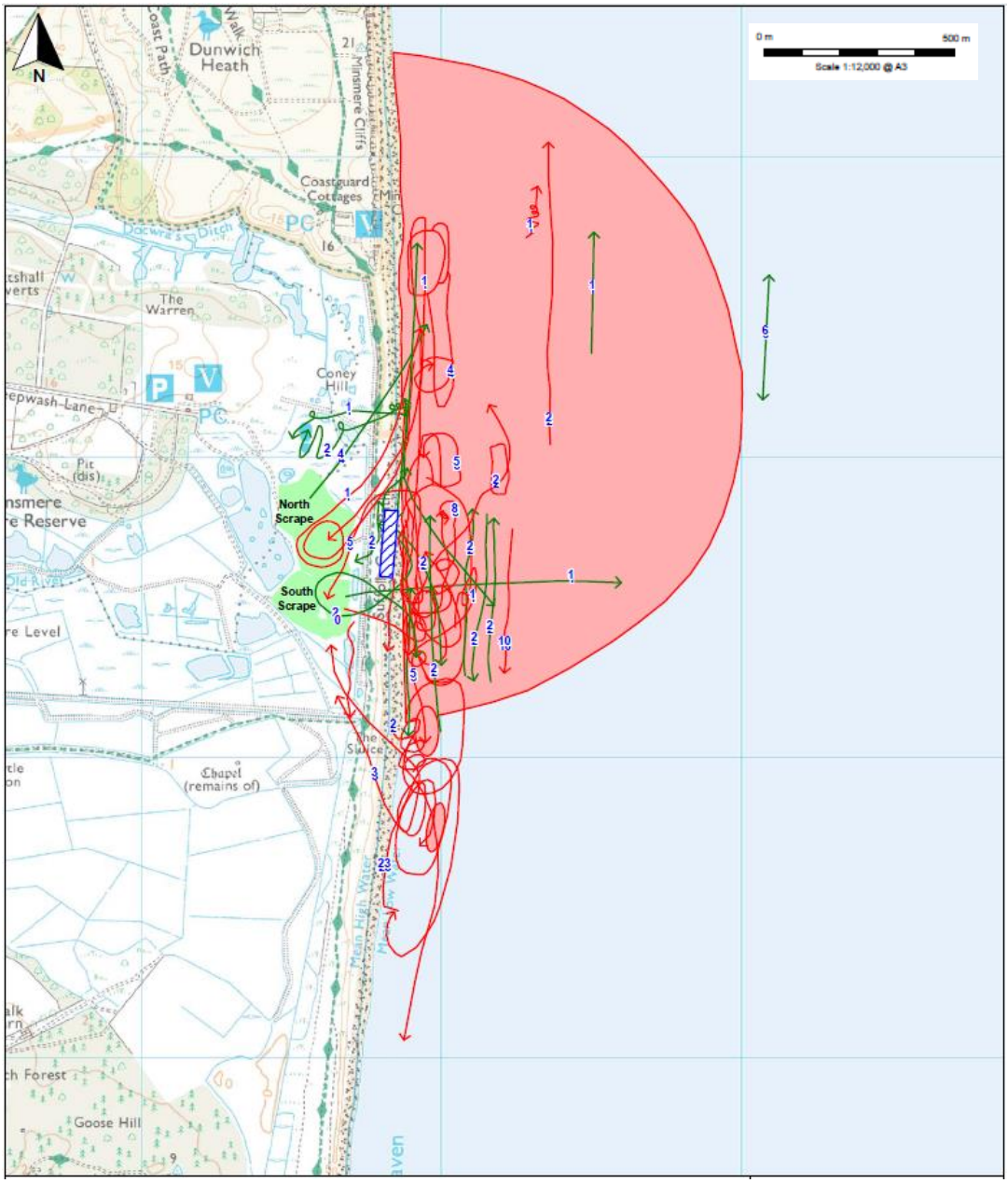
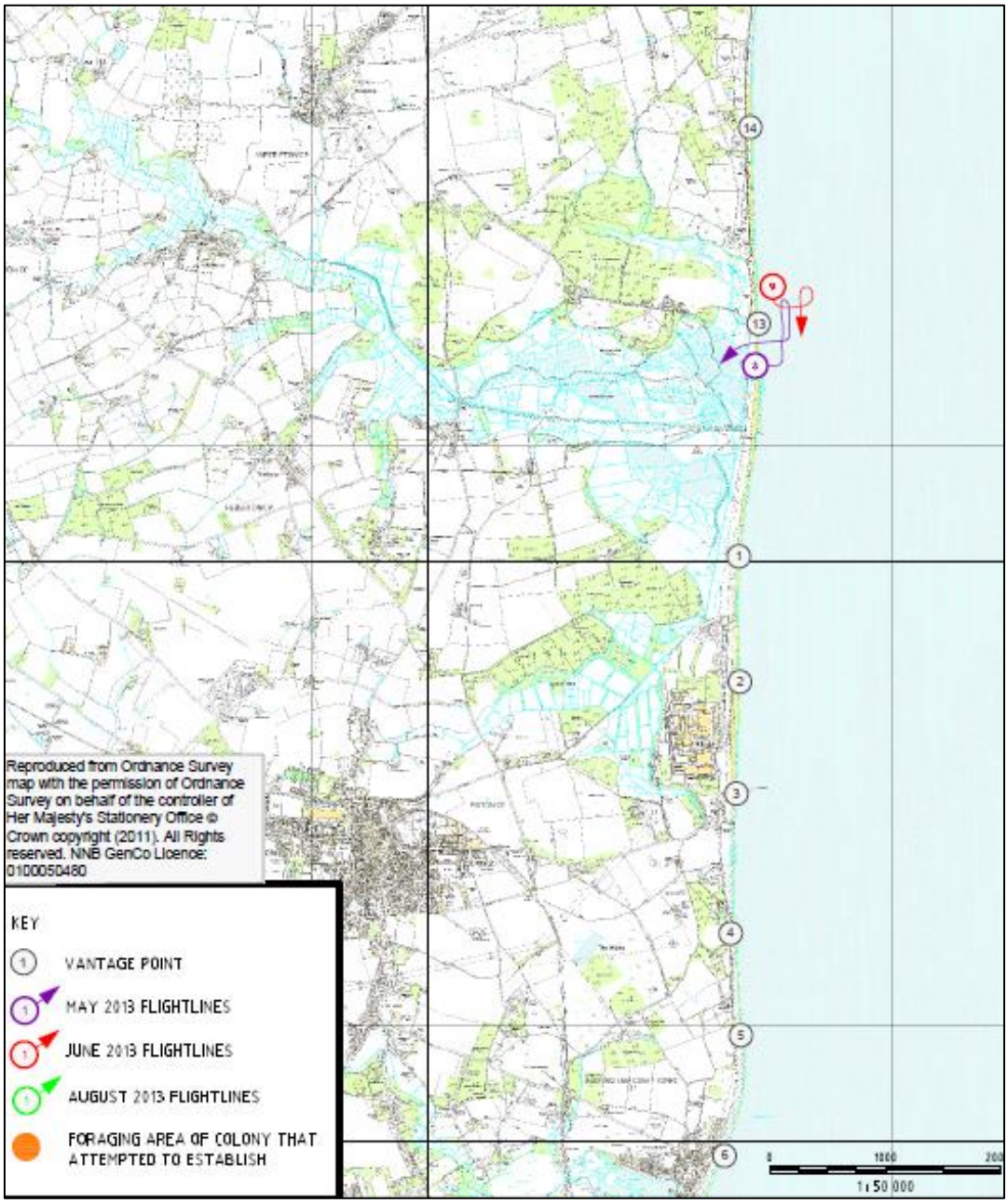


Plate 6.9: Flight lines and foraging areas of little terns recorded within the likely mean maximum foraging range of the Minsmere-Walberswick SPA during vantage point surveys in 2013 (Ref. 6.46)



Use of the Minsmere South Levels and Sizewell Marshes

6.3.107. The Minsmere South Levels and Sizewell Marshes (which occur outside the SPA – **Figure 6.2**) comprise habitat that may be used by breeding gadwall, so there is the potential for functional linkage with the SPA gadwall population.

6.3.108. Numbers of gadwall breeding on the Minsmere South Levels are monitored by RSPB as part of the monitoring programme for the Minsmere Reserve, whilst numbers breeding on the Sizewell Marshes have been estimated from surveys undertaken using the British Trust for Ornithology's Common Bird Census method (Ref. 6.68; Ref. 6.69). The numbers of pairs estimated to breed on the Minsmere South Levels varied from one to 40 between 2010 and 2017, whilst those on the Sizewell Marshes varied from three to seven between 2011 and 2017 (**Table 6.9**). Data are not available on the distribution of breeding gadwall within either the Minsmere South Levels or Sizewell Marshes.

Table 6.9: Annual numbers of breeding pairs of gadwall, shoveler and teal recorded on the RSPB Minsmere Reserve (MR), the Minsmere South Levels (MSL) and Sizewell Marshes (SM); data for MR and MSL are derived from RSPB monitoring data, whilst those for SM are from Ref. 6.69

Year	Gadwall			Shoveler			Teal		
	Entire MR[1]	MSL	SM	Entire MR[1]	MSL	SM	Entire MR[1]	MSL	SM
2010	96	14	-	63	17	-	0	0	-
2011	44	14	4	59	2	0	0	0	0
2012	80	12	4	105	7	0	0	0	0
2013	90	40	7	54	35	0	0	0	1
2014	86	16	6	43	4	1	0	0	0
2015[2]	67	-	4	33	-	1	0	-	0
2016	48	1	3	68	2	0	0	0	0
2017	-	5	4	-	9	0	-	0	0

[1] Counts for the entire MR are inclusive of the counts for the MSL.
[2] No counts available for the waterfowl species in the Minsmere South Levels in 2015.

Shoveler - breeding

SPA population

6.3.109. The SPA breeding shoveler population has almost tripled in size since the time of citation (**Table 6.5**). A high proportion of the SPA shoveler population

breed on the RSPB Minsmere Reserve, but the Reserve encompasses part of the Minsmere-Walberswick SPA only (and also extends onto non-SPA land in some places, such as the Minsmere South Levels), so that the shoveler population estimates for the Reserve cannot be assumed to be fully representative of the SPA. The numbers of pairs estimated to breed on the RSPB Minsmere Reserve varied from 33 to 105 between 2010 and 2016 (**Table 6.9**).

Use of the Minsmere South Levels and Sizewell Marshes

6.3.110. The Minsmere South Levels and Sizewell Marshes (which occur outside the SPA – **Figure 6.2**) comprise habitat that may be used by breeding shoveler, so there is the potential for functional linkage with the SPA shoveler population.

6.3.111. Numbers of shoveler breeding on the Minsmere South Levels are monitored by RSPB as part of the monitoring programme for the Minsmere Reserve, whilst numbers breeding on the Sizewell Marshes have been estimated from surveys undertaken using the British Trust for Ornithology's Common Bird Census method (Ref. 6.68, Ref. 6.69). The numbers of pairs estimated to breed on the Minsmere South Levels varied from two to 35 between 2010 and 2017, whilst records from the Sizewell Marshes are limited to single pairs in 2014 and 2015 (**Table 6.9**). Data are not available on the distribution of breeding shoveler within either the Minsmere South Levels or Sizewell Marshes.

Teal - breeding

SPA population

6.3.112. Teal are now virtually absent from the SPA as a breeding species, with the most recently available 5 year mean peak count being one breeding pair, representing a major decline from the estimated citation population of 73 pairs (**Table 6.5**).

Use of the Minsmere South Levels and Sizewell Marshes

6.3.113. The Minsmere South Levels and Sizewell Marshes (which occur outside the SPA – **Figure 6.2**) comprise habitat that may be used by breeding teal, so there is the potential for functional linkage with the SPA teal population. However, no teal have been recorded breeding on the Minsmere South Levels since before 2010 (as is the case for the rest of the RSPB Minsmere Reserve), whilst only a single pair were recorded in the breeding bird surveys undertaken on the Sizewell Marshes between 2011 and 2017 (**Table 6.9**).

Nightjar - breeding

SPA population

6.3.114. The number of breeding pairs of nightjars estimated to breed on the SPA is currently approximately half of that estimated at the time of citation (**Table 6.5**). The RSPB Minsmere Reserve provides the main nesting areas for the species within the SPA, with birds also nesting in the Dunwich Forest parts of the Dingle Marshes Reserve. Nesting areas within the SPA occur on heathland and woodland and scrub habitats, with the nesting areas considerably more than 1km from the main development site boundary (RSPB, *unpublished data*). Between 2010 and 2016 numbers on the Minsmere Reserve declined from 13 to nine breeding pairs, whilst on the Dingle Marshes Reserve they increased from two to four pairs (RSPB *unpublished data*).

Occurrence on habitat within the vicinity of the main development site

6.3.115. Surveys for breeding nightjar have been undertaken in areas within or close to potentially suitable breeding habitat (i.e. lowland heathland and open coniferous woodland (Ref. 6.68, Ref. 6.69) that is outwith the SPA and within closer proximity of the main development site. Thus, surveys of the Kenton Hills and Goose Hill plantations, undertaken specifically for nightjar, recorded no birds in any of the three visits (i.e. 19th May and 23rd June 2014 and 17th May 2015). Also, nightjar surveys of land immediately south of the main development site in 2012 recorded nightjar only in those parts of the survey area which encroached into the Sandlings SPA (Ref. 6.45).

Hen harrier – non-breeding

SPA population

6.3.116. At the time of citation, a non-breeding aggregation of 15 hen harriers was estimated to occur on the SPA, representing at least 2% of the UK wintering population of the species which was estimated to be 750 birds at that time (Ref. 6.66). However, only a single individual hen harrier has been recorded on the SPA in the past five years (Ref. 6.66).

Use of habitats within the vicinity of the main development site

6.3.117. Given the current scarcity of wintering hen harrier on the SPA, there is unlikely to be any extensive use of areas within the vicinity of the main development site by this qualifying feature. However, when present, hen harriers may range widely and could hunt over the Minsmere South Levels and Sizewell Marshes, as well as agricultural habitats within the vicinity of the main development site.

6.3.118. Surveys to determine use of habitats within the vicinity of the main development site by hen harrier were undertaken over the winters of 2011/12 and 2014/15, with the following findings:

- Walkover surveys of the Sizewell Marshes: These were undertaken between April 2011 and March 2012, with 12 during the winter period (defined as October to March for the current purposes). Each survey was seven to nine hours in duration, with no hen harrier sightings recorded in any of the surveys (Ref. 6.45).
- VP surveys, 2011/12: Hen harrier occurrence was also recorded during the bi-monthly VP surveys undertaken in 2011 and 2012 to record commuting flights of bittern between the SPA and Minsmere South Levels and Sizewell Marshes (see above). Two surveys (each of three hours duration) were undertaken on each survey day, with two hen harrier sightings obtained over the wintering period (in October and November survey) and both involving birds hunting over the Minsmere South Levels (Ref. 6.45).
- VP surveys, 2014/15: Hen harrier occurrence was recorded during VP surveys undertaken from October 2014 to March 2015 at the VP locations used to record marsh harrier flight activity over the Minsmere South Levels and Sizewell Marshes (i.e. VPs 1 – 6 – **Figure 6.2** to **Figure 6.5**). All sightings were of single birds (comprising one adult male, two adult females, six which were either adult females or juveniles and one with no assigned age or sex), and nine of the sightings were of birds in flight (either commuting or hunting) with one of a perched bird (which subsequently flew off). Four of the records were from the Minsmere South Levels and six from the Sizewell Marshes as seen in the **ES, Volume 2 Chapter 14** (Doc Ref. 6.3), Terrestrial Ecology and Ornithology, **Appendix 14A7** Ornithology, **Annex 14A7.5**.

Gadwall, shoveler and white-fronted goose – non-breeding

SPA populations

6.3.119. The qualifying features considered in this section are all over-wintering populations of waterbird species. They are considered together in a single section because the data which are used to characterise the baseline conditions for these qualifying features derive from the same series of surveys and share a number of common attributes.

6.3.120. Of these qualifying features, the SPA population size of over-wintering gadwall is estimated to be more than three times higher than at the time of citation, whilst that of shoveler is almost twice as high as at the time of citation (**Table 6.5**). By contrast, the most recent estimate of the SPA white-fronted

goose population is considerably lower than at the time of citation. However, as detailed above, recent SPA counts for this qualifying feature may be underestimated because the SPA is now used mainly as a nocturnal roost.

Use and importance of the Minsmere South Levels and Sizewell Marshes

(i) Introduction

6.3.121. In addition to the habitats used by these qualifying features within the SPA, suitable habitat also occurs on the Minsmere South Levels and Sizewell Marshes and wintering waterbirds occur on these areas. Given this, it is possible that the SPA populations of wintering waterbirds also depend upon these areas (e.g. for the provision of additional foraging resources) and that there is functional linkage with the SPA.

6.3.122. Consequently, baseline survey data were used to quantify the relative use of the SPA, the Minsmere South Levels and Sizewell Marshes by wintering gadwall, shoveler and white-fronted goose. The baseline data were derived both from project-specific surveys of the latter two areas and by accessing British Trust for Ornithology's Wetland Bird Survey (WeBS) data from count sectors within and close to the main development site and Minsmere-Walberswick SPA.

(ii) Project-specific surveys – coverage and methods

6.3.123. Winter waterbird surveys specifically commissioned to support the consent of the proposed development were carried out by Arcadis over two seasons in 2014-15 and 2018-19. Four survey areas were covered once a month in both winter periods, but with the 2014-15 surveys extending from November to March and the 2018-19 surveys from December to February (**Table 6.10)**. The surveys covered the Minsmere South Levels and the suitable waterbird habitat within the Sizewell Marshes, with the latter comprising the discrete areas identified as Sizewell Belts, Goodrum's Fen and SSSI Reedbed, and Rookyard Woods (**Figure 6.8**).

Table 6.10: Details of the location and timing of the project-specific surveys for wintering waterbirds

Survey Area	Location Relative To The Main Development Site (Main Development Site)	Survey Dates And Times 2014-15	Survey Dates And Times 2018-19	Overlap With Designated Sites	
				SSSIs	SPA/ Ramsar sites
Sizewell Belts	Within 250m largely surrounded by main development site	11/11 1310-1415 04/12 1000-1110	11/12 1035-1135 10/01 1115-1230	Sizewell Marshes	None

Survey Area	Location Relative To The Main Development Site (Main Development Site)	Survey Dates And Times 2014-15	Survey Dates And Times 2018-19	Overlap With Designated Sites	
				SSSIs	SPA/ Ramsar sites
		08/01 1200-1330 05/02 1200-1415 05/03 1015-1145	07/02 1105-1205		
Rookyard Woods	Overlaps and largely surrounded by main development site	27/11 1230-1345 18/12 0750-0910 08/01 1200-1400 19/02 1000-1120 03/03 0845-1015	11/12 1245-1440 10/01 0920-1100 07/02 1315-1425		
Goodrum's Fen and SSSI Reedbed		11/11 1130-1240 04/12 0810-0930 08/01 1015-1140 05/02 0930-1145 05/03 0900-0950	11/12 0950-1030 10/01 1330-1445 07/02 0940-1040		
Minsmere South Levels	Adjacent to northern boundary of main development site	11/11 1200-1410 04/12 0800-1200 08/01 1100-1340 05/02 1000-1240 05/03 0830-1100	11/12 1030-1430 10/01 0930-1330 07/02 0930-1250	Minsmere-Walberswick Heaths and Marshes	

6.3.124. Surveys were undertaken within two to three hours of high tide, following the British Trust for Ornithology's WeBS methods to obtain a count of waterbirds recorded either visually or audibly within the specified survey area (Ref. 6.68).

6.3.125. For the Minsmere South Levels, the surveyors walked a transect around the boundary of the survey area (the periphery bund and sea wall), stopping at specific VPs to carry out point counts (**Figure 6.8**). The VPs were located on the raised areas around the Minsmere South Levels (i.e. the sea wall) and, therefore, provided good visibility over the entire Minsmere South Levels, as well as avoiding disturbance to the waterbirds within the survey area. During each survey the number of each species was recorded, with the locations of each aggregation plotted onto field maps.

6.3.126. Within Sizewell Marshes, waterbirds were mainly present within ditches. Therefore, an alternative method was adopted, with the side of each ditch walked and any birds observed or flushed counted. Aggregations of each waterfowl species were plotted onto maps.

6.3.127. In 2018-19, the surveys of the Minsmere South Levels and the Sizewell Marshes were undertaken simultaneously to reduce the chances of double counting of birds moving between the two areas.

(iii) WeBS data – coverage and methods

6.3.128. WeBS core count data were obtained from the British Trust for Ornithology's and RSPB for five count sectors located in the same region as the proposed development, with the objectives of augmenting the project-specific baseline data and providing an up-to-date overview of the population status of the relevant species in the wider area (including the Minsmere-Walberswick SPA). Details of the location of these count sectors relative to the main development site boundary and the Minsmere-Walberswick SPA, and the winter periods for which data were available, are provided in **Table 6.11** and **Figure 6.9**.

6.3.129. In relation to these WeBS data, it is important to note that the Minsmere South-Levels is subsumed within the Minsmere sector, but the RSPB-provided data allowed the counts within the Minsmere South Levels to be distinguished.

Table 6.11: Details of the location of WeBS count sectors used in this assessment together with the winter periods for which data were obtained

Count Sector	Location Relative To The Main Development Site	Data Availability	Overlap With Designated Sites	
			SSSIs	SPA/Ramsar sites
Sizewell Belts[1]	Overlaps and largely surrounded by main development site	Seven winter seasons (2010-11 to 2016-17)	Sizewell Marshes	None

Count Sector	Location Relative To The Main Development Site	Data Availability	Overlap With Designated Sites	
			SSSIs	SPA/Ramsar sites
Minsmere South Levels	150m north of main development site	Seven winter seasons (2012-13 to 2018-19)	Minsmere-Walberswick Heaths and Marshes	
Minsmere	150m north of main development site	Seven winter seasons (2012-13 to 2018-19)		Minsmere-Walberswick
Dingle Marshes and Walberswick NNR	5.5km north of main development site			
Blyth Estuary	10km north of main development site			

[1]The WeBS Sizewell Belts count sector is not equivalent to the project-specific survey area termed the Sizewell Belts (see text and **Figures 9** and **10**).

6.3.130. The WeBS core count surveys were carried out according to the standard WeBS methods (Ref. 6.68). For any given survey month, surveys of all the count sectors in **Table 6.11** for which counts were undertaken were carried out on the same day to minimise the risk of birds being double counted. In all cases, the species coverage in these surveys was classified as "good".

(iv) Comparison of the methods and coverage of the project-specific surveys and WeBS

6.3.131. As described above, project-specific surveys used WeBS survey methods and, as such, it is likely that the outputs from the two survey programmes are broadly comparable.

6.3.132. There is a non-exact spatial overlap between the project-specific survey areas and the WeBS count sectors from which data have been obtained (**Figure 6.8** and **Figure 6.9**).

6.3.133. The WeBS Sizewell Belts count sector consists of a single polygon which encompasses almost all of the Rookyard Woods and most of the Sizewell Belts project-specific survey areas within the Sizewell Marshes. However, the western extent of the project-specific Sizewell Belts survey area is not covered by the WeBS count sector of the same name. The Sizewell Belts WeBS count sector has no overlap with the Goodrum's Fen and SSSI Reedbed project-specific survey area but does include some of the land between the three discrete project-specific survey areas within Sizewell Marshes (**Figure 6.8** and **Figure 6.9**). The project-specific surveys for the Minsmere South Levels cover some small areas of land (near to VPs 4 and 5) which appear to lie outwith the WeBS Minsmere South Levels count sector

(**Figure 6.8** and **Figure 6.9**). Given these differences in coverage, the Sizewell Belts and Minsmere South Levels WeBS count sectors are subsequently termed 'WeBS Sizewell Belts' and 'WeBS Minsmere South Levels' in this report.

6.3.134. The Minsmere, Dingle Marshes and Walberswick NNR and Blyth Estuary WeBS count sectors cover large parts of the Minsmere-Walberswick SPA and Ramsar site. These areas are not covered by the project-specific surveys.

6.3.135. In terms of temporal overlap, there are seven seasons of WeBS data available for WeBS Sizewell Belts (winters 2010-11 to 2016-17), four for the Dingle Marshes and Walberswick NNR and the Blyth Estuary count sectors (winters 2010-11 to 2013-14), and seven for the Minsmere count sector (winters 2012-13 to 2018-19). The RSPB-provided WeBS data enabled separation of the counts within the WeBS Minsmere South Levels from the rest of the Minsmere count sector for each of these winter periods. For the purposes of establishing the baseline for assessing impacts on the SPA wintering waterbirds, the winter season is defined as October to March (which encompasses the period over which project-specific survey data were collected and is the annual period for which the WeBS data are extracted).

6.3.136. The project-specific surveys were undertaken in the winters of 2014-15 and 2018-19.

(v) Baseline survey results - gadwall

6.3.137. Numbers of gadwall recorded during the baseline surveys varied both between survey areas during individual surveys and between individual surveys within survey areas. During 2014-15, numbers were consistently higher in the Minsmere South Levels than in the Sizewell Marshes, with the respective peak count in the Minsmere South Levels being four times that in the Sizewell Marshes (**Table 6.12**). However, the reverse pattern occurred in 2018-19, with numbers consistently higher in the Sizewell Marshes, where the peak count was almost three times that in the Minsmere South Levels (**Table 6.12**).

6.3.138. Within Sizewell Marshes, gadwall numbers were highest in the Goodrum's Fen and SSSI Reedbed survey area in both winters and consistently low in the Sizewell Belts area (**Table 6.12**, **Figure 6.10** and **Figure 6.11**). The Rookyard Woods survey area held lowest numbers in 2014-15 (with a seasonal peak count of two) but substantially higher numbers in 2018-19 (when the seasonal peak count was 31).

Table 6.12: Number of gadwall recorded during project-specific winter waterbird surveys in the Sizewell Marshes and Minsmere South Levels

Winter Season	Date	Sizewell Marshes				Minsmere South Levels
		Sizewell Belts	Rookyard Woods	Goodrum's Fen and SSSI Reedbed	Total	
2014-15	11/11	0	-	0	0	0
	27/11	-	0	-		-
	04/12	0	-	0	2	50
	18/12	-	2	-:		-
	08/01	0	0	3	3	110
	05/02	2	-	29	31	55
	19/02	-	0	-		-
	03/03	-	0	-	4	-
	05/03	4	-	0		126
	Seasonal Peak	4	2	29	31	126
2018-19	11/12	4	2	0	6	2
	10/01	8	31	41	80	3
	07/02	0	23	24	47	28
	Seasonal Peak	8	31	41	80	28

6.3.139. Peak numbers of gadwall as recorded in different winter periods by the WeBS counts are presented in

6.3.140. **Table** 6.13 along with a mean peak value from the most recent four year period for which data are available for all count sectors (i.e. 2013-14 to 2016-17).

Table 6.13: Peak numbers of gadwall recorded in each winter period for which data are available between 2010-11 and 2018-19 during WeBS surveys in count sectors in close proximity to the main development site and/or the Minsmere-Walberswick SPA

Winter Season	Sizewell Belts	Minsmere			Dingle Marshes and Walberswick NNR	Blyth Estuary
		Whole Count Area[1]	Minsmere Excluding South Levels	Minsmere South Levels		
2010-11	151	-	-		-	-
2011-12	9	-	-		-	-
2012-13	40	632	252	474	-	-
2013-14	25	548	132	442	52	0
2014-15	30	437	318	338	46	2
2015-16	27	270	262	154	38	0
2016-17	21	161	161	14	122	0
2017-18	-	292	188	238	-	-
2018-19	-	237	237	12	-	-
Mean peak count 2013-14 to 2016-17 (all years)	25.7 (43.3)	354.0 (368.1)	205.3 (214.0)	237.0 (238.9)	64.5	0.5

[1] Peak numbers for the whole count area are less than the summed peak numbers for Minsmere excluding the South Levels plus Minsmere South Levels because the peak numbers on the different parts of the Minsmere count sector occur on different survey visits.

6.3.141. These data show that largest numbers occur within the Minsmere WeBS count sector. Considering the numbers from this count sector with those for the other sectors within the Minsmere-Walberswick SPA (i.e. Dingle Marshes and Walberswick NNR and Blyth Estuary) gives a mean peak count of 419 birds for the period from 2013-14 to 2016-17on the SPA and Minsmere South Levels combined, with the peak counts for the individual winter periods ranging from approximately 280 to 600 birds (and exceeding 600 if the 2012-13 data are included) (**Table 6.13**).

6.3.142. Numbers on the Minsmere South Levels were often relatively high, particularly in the earlier years for which data were obtained. They accounted for an average of 30% of the birds (range 0% – 91%) across all available counts in the Minsmere sector (i.e. from 2012-13 to 2018-19) and of 44% (range 0% - 82%) across the peak counts for the individual winter periods

(2012-13 to 2018-19). Excluding the data from the Minsmere South Levels gives a mean peak count of 283 birds on the count sectors within the SPA between 2013-14 and 2016-17, with the peak counts for the individual winter periods ranging from approximately 180 to 370 birds (**Table 6.13**). This mean peak count is substantially larger than the citation population of 90 birds (**Table 6.5**).

6.3.143. Within the WeBS Sizewell Belts count sector, the peak winter counts recorded for gadwall have been relatively consistent, except in 2010-11 for which the peak count of 151 birds is almost six times greater than the mean peak count of approximately 26 for 2013-14 to 2016-17 (**Table 6.13**).

6.3.144. There are some common patterns present in the data collected from both survey programmes with respect to relative bird distribution, as well as differences between the survey programmes with respect to the overall numbers of birds recorded. Overall, the data show that numbers of gadwall on the Sizewell Marshes tend to be low compared to those on the Minsmere-Walberswick SPA, but that the Minsmere South Levels may hold relatively high numbers, albeit with some marked variation in the peak counts from different winter periods.

6.3.145. Both survey programmes recorded birds at the Minsmere South Levels, with the same between-year pattern of higher numbers in the 2014-15 winter than in the 2018-19 winter (with the numbers recorded by both surveys in 2018-19 being notably low – **Table 6.12** and **Table 6.13**). However, the peak WeBS count for the Minsmere South Levels in 2014-15 was markedly higher than that for the project-specific surveys. The vast majority of records from the project-specific surveys in 2014-15 occurred on the largest pool system in the survey area to the east of the centre of the survey area, which is also within the WeBS count sector (**Figure 6.10**). This pool system is located approximately 1km from the main development site boundary at the nearest point.

6.3.146. The peak numbers recorded in the Sizewell Marshes by both WeBS and the project-specific surveys were similar in 2014-15 but none of the more recent WeBS counts recorded numbers as high as those in the 2018-19 project-specific surveys (**Table 6.12** and **Table 6.13**). A possible explanation for this difference is that the WeBS Sizewell Belts count sector excludes the Goodum's Fen and SSSI Reedbed area, which is where highest numbers have been recorded in the Sizewell Marshes during the project-specific surveys.

(vi) Baseline survey results – shoveler

6.3.147. Shoveler were scarce or absent from the Sizewell Marshes during the baseline surveys in both winters 2014-15 and 2018-19, but were relatively

abundant on the Minsmere South Levels where seasonal peak counts of 85 and 18 were recorded in 2014-15 and 2018-19, respectively (**Table 6.14**). In both winters, shoveler records on the Minsmere South Levels were concentrated on the largest pool system in the survey area to the east of the centre of the survey area (**Figure 6.12** and **Figure 6.13**).

Table 6.14: Number of shoveler recorded during project-specific winter waterbird surveys in the Sizewell Marshes and Minsmere South Levels

Winter Season	Date	Sizewell Marshes				Minsmere South Levels
		Sizewell Belts	Rookyard Woods	Goodrum's Fen and SSSI Reedbed	Total	
2014-15	11/11	0	-	0	0	10
	27/11	-	0	-		-
	04/12	0	-	0	0	45
	18/12	-	0	-		-
	08/01	0	0	0	0	79
	05/02	0	-	2	2	85
	19/02	-	0	-		-
	03/03	-	0	-	0	-
	05/03	0	-	0		61
	Seasonal Peak	0	0	2	2	85
2018-19	11/12	0	0	0	0	0
	10/01	0	0	0	0	1
	07/02	0	0	0	0	18
	Seasonal Peak	0	0	0	0	18

6.3.148. Peak numbers of shoveler as recorded in different winter periods by the WeBS counts are presented in **Table 6.15**, along with a mean peak value from the most recent four-year period for which data are available for all count sectors (i.e. 2013-14 to 2016-17).

Table 6.15: Peak numbers of shoveler recorded in each winter period for which data are available between 2010-11 and 2018-19 during WeBS surveys in count sectors in close proximity to the main development site and/or the Minsmere-Walberswick SPA

Winter Season	Sizewell Belts	Minsmere			Dingle Marshes and Walberswick NNR	Blyth Estuary
		Whole Count Area[1]	Minsmere Excluding South Levels	Minsmere South Levels		
2010-11	10	-	-		-	-
2011-12	0	-	-		-	-
2012-13	26	226	226	171	-	-
2013-14	15	371	212	282	34	5
2014-15	18	259	124	152	16	4
2015-16	17	136	126	60	8	5
2016-17	17	109	109	28	47	0
2017-18	-	145	131	64	-	-
2018-19	-	260	260	24	-	-
Mean peak count 2013-14 to 2016-17 (all years)	16.8 (14.7)	218.8 (215.1)	142.8 (169.7)	130.5 (111.6)	26.2	3.5

[1] Peak numbers for the whole count area are less than the summed peak numbers for Minsmere excluding the South Levels plus Minsmere South Levels because the peak numbers on the different parts of the Minsmere count sector occur on different survey visits.

6.3.149. These data show that largest numbers occur within the Minsmere WeBS count sector. Considering the numbers from this count sector with those for the other sectors within the Minsmere-Walberswick SPA (i.e. Dingle Marshes and Walberswick NNR and Blyth Estuary) gives a mean peak count of 249 birds for the period from 2013-14 to 2016-17 on the SPA and Minsmere South Levels combined, with the peak counts for the individual winter periods ranging from approximately 150 to 400 birds (**Table 6.15**).

6.3.150. Numbers on the Minsmere South Levels were often relatively high, particularly in the earlier years for which data were obtained. They accounted for an average of 23% of the birds (range 0% – 83%) across all available counts in the Minsmere sector (i.e. from 2012-13 to 2018-19) and of 27% (range 0% - 76%) across the peak counts for the individual winter periods (2012-13 to 2018-19). Excluding the data from the Minsmere South Levels

gives a mean peak count of 173 birds on the count sectors within the SPA between 2013-14 and 2016-17, with the peak counts for the individual winter periods ranging from approximately 140 to 250 birds (**Table 6.15**). This mean peak count is substantially larger than the citation population of 100 birds (**Table 6.5**).

6.3.151. Within the WeBS Sizewell Belts count sector, the peak winter counts recorded for shoveler have been relatively consistent, with a mean peak count of approximately 17 for the period from 2013-14 to 2016-17, although no birds were recorded in 2011-12 (**Table 6.15**). Despite the relative consistency in the mean peak counts the occurrence of shoveler within this count sector has been variable, with no birds recorded in 12 of the 30 surveys undertaken between October and March over the last five years.

6.3.152. As for the gadwall data, there are some common patterns present in the shoveler data collected from both survey programmes with respect to bird distribution, though there are also some differences between the survey programmes with respect to the numbers of birds recorded. Overall, the data show that the numbers of shoveler on the Sizewell Marshes tend to be low compared to those on the Minsmere-Walberswick SPA, but that the Minsmere South Levels may hold relatively high numbers, albeit with some marked variation in the peak numbers from different winter periods and a trend for lower numbers in more recent winters.

6.3.153. As for gadwall, both survey programmes recorded birds at the Minsmere South Levels, with the same between-year pattern of higher numbers in the 2014-15 winter than in the 2018-19 winter (with numbers recorded by both surveys in 2018-19 being notably low – **Table 6.14** and **Table 6.15**). However, the peak WeBS count for the Minsmere South Levels in 2014-15 was higher than that for the project-specific surveys. Again, as for gadwall, the vast majority of shoveler records on the Minsmere South Levels during the 2014-15 project-specific surveys occurred on the largest pool system in the survey area to the east of the centre of the survey area, which is also within the WeBS count sector (**Figure 6.12**). This pool system is located approximately 1km from the nearest boundary of the main development site.

6.3.154. Greater numbers of shoveler were recorded during WeBS counts within the WeBS Sizewell Belts count sector (with peak counts of 10 or more birds in six of the seven years for which data were obtained) than during project-specific surveys of the Sizewell Marshes, which recorded only two birds in this area during the two winters of survey (**Table 6.14** and **Table 6.15**). Such a marked discrepancy between the respective counts is difficult to explain, although it is notable that shoveler were recorded in a relatively low proportion (i.e. 60%) of the WeBS Sizewell Belts counts. This, together with the scarcity of records from the project-specific surveys, suggests their occurrence within the Sizewell Marshes in winter may be sporadic.

(vii) Baseline survey results – white-fronted goose

6.3.155. White-fronted goose was not recorded in any of the project-specific surveys of the Minsmere South Levels or Sizewell Marshes. For the WeBS counts that were accessed there was only a single record (of 13 birds in January 2016) from the Minsmere South Levels and no records from the Sizewell Marshes.

6.3.156. However, North Warren provides the main daytime feeding area for this species in Suffolk[12] and those birds are reported to often roost on the Minsmere-Walberswick SPA, and sometimes Minsmere South Levels (RSPB, *in litt.*). Arrival at these roosting areas is reported to occur after dark with departure before dawn, so daytime counts are likely to underestimate the numbers present.

g) Minsmere to Walberswick Ramsar site

i. Qualification criteria

6.3.157. In relation to bird populations, the Minsmere to Walberswick Ramsar site qualifies under Ramsar criterion 2 for an important assemblage of rare breeding birds associated with marshland and reedbeds, including: Bittern *(Botaurus stellaris)*, gadwall *(Anas strepera)*, teal *(Anas crecca*), shoveler *(Anas clypeata)*, marsh harrier *(Circus aeruginosus)*, avocet *(Recurvirostra avosetta)* and bearded tit *(Panurus biarmicus)*.

6.3.158. Baseline data for the majority of the key species associated with this breeding assemblage are detailed above for the Minsmere-Walberswick SPA. Other species which may contribute to this assemblage include black-headed gull, Mediterranean gull, lesser black-backed gull and Sandwich tern. Of these species, black-headed gulls are generally present in large numbers (although these have shown fluctuations – e.g. declining from almost 2,000 breeding pairs in 2011 to 395 in 2014, but increasing again to 2,500 breeding pairs in 2018 – Ref. 6.66), whilst Mediterranean gulls are more sporadic in occurrence as a breeding species (e.g. with only a single pair attempting to breed in 2014 but 36 breeding pairs reported at Minsmere in 2017 – Ref. 6.90, Ref. 6.91), and lesser black-backed gulls are present in small numbers only (with annual totals ranging from 0 to 6 breeding pairs from 2010 to 2018 – Ref. 6.44). Sandwich terns also currently breed at Minsmere, with numbers increasing from one to 32 breeding pairs between 2014 and 2018, following a long period of infrequent occurrence (Ref. 6.44).

6.3.159. No data have been obtained on the abundance and trends of the Ramsar site population of bearded tit, but it is considered likely that this species will occur widely across the reedbed habitats within this site.

h) Outer Thames Estuary SPA

i. Introduction

6.3.160. The Outer Thames Estuary SPA was first designated in 2010 on the basis of the over-wintering red-throated diver population it supports and was subsequently extended in October 2017 to enable greater provision of important marine foraging areas for both breeding little tern and common tern from a range of colonies on the east coast of England, which are now also qualifying features (Ref. 6.92). Details of the population status and habitat use of each of these qualifying features are presented below.

ii. Population status and habitat use of qualifying features

Little tern - breeding

SPA population

6.3.161. At the time of inclusion as a qualifying feature, the SPA was estimated to provide supporting habitat for 373 pairs of breeding little tern (based on counts from 2011 – 2015), constituting 20% of the breeding population for Great Britain (Ref. 6.92; Ref. 6.93). These breeding pairs derive from breeding colonies at (or functionally linked to) the Alde-Ore Estuary, Benacre to Easton Bavents and Minsmere-Walberswick SPAs, which are 'screened in' to the current assessment, as well as from colonies at (or functionally linked to) several other SPAs, which are 'screened out' of this assessment (

6.3.162. **Table** 6.16). Numbers of breeding little tern associated with these different 'breeding colony SPAs' have increased since the designation of these SPAs in two cases but in others there have been marked declines, with some of the SPAs currently holding no breeding pairs and no longer recognised as regular breeding sites for the species (

6.3.163. **Table** 6.16 and **Table 6.1**).

Table 6.16: Breeding little tern population estimates at coastal SPAs for which the Outer Thames Estuary SPA provides supporting habitat, as determined at (or near) the time of citation and at the time of designation of the Outer Thames Estuary SPA (bold indicates SPAs 'screened into' the current assessment)

SPA	Approximate Distance To The Main Development Site (km)	Population Size At (Or Near) The Time Of Breeding Colony SPA Citation (Breeding Pairs)	Mean Population Size For 2011-2015 (Breeding Pairs) [1]
Great Yarmouth North Denes[2]	45	277	314

SPA	Approximate Distance To The Main Development Site (km)	Population Size At (Or Near) The Time Of Breeding Colony SPA Citation (Breeding Pairs)	Mean Population Size For 2011-2015 (Breeding Pairs) [1]
Benacre to Easton Bavents[2]	**14.5**	**39**	**57.6**
Minsmere-Walberswick	<1	**32**	**0.8**
Alde-Ore Estuary	**8**	**48**	**0.8**
Foulness	73	73	0
Thanet Coast and Sandwich Bay	>90	30	0
Total		451	373

[1] Estimates differ from those presented in Tables 6.1, 6.3 and 6.5 for the respective SPAs because the period relevant to the designation of the Outer Thames Estuary SPA is not the most recent period for which data are available.
[2] Includes colonies considered to be functionally linked to the SPA as well as colonies within the SPA (Ref. 6.94). Population size estimates are derived from the respective Citation and SPA Conservation Objectives Supplementary Advice (as presented in Tables 6.1, 6.3 and 6.5) and/or from Ref. 6.94).

Project-specific survey data

6.3.164. As detailed above for the Alde-Ore Estuary SPA, see section 6.3a of this report, VP surveys of little tern foraging and commuting activity were undertaken at a range of VP locations in 2011 and 2013 (Ref. 6.45; Ref. 6.46). These VP locations straddled the full extent of the breeding colonies associated with the Minsmere-Walberswick SPA and the Alde-Ore Estuary SPA in 2013 (from Orford Ness in the south to Dunwich in the north), although in 2011 they excluded the three most northern locations (VPs 13 – 15) and extended to c.0.5km north of the main development site only (at VP1) (**Figure 6.1**). However, flight lines and areas of concentrated foraging activity were recorded at the Dingle and Minsmere colonies in 2011, with the findings from these surveys presented in **Plate 6.9, 6.7** and **6.8**.

6.3.165. In 2011 a monthly peak count of 51 commuting birds was recorded from VP1, near to the main development site, in May. A single count of 18 birds was observed resting on Sudbourne Beach (VP10) in mid-May, after which up to 22 birds were present in the area until mid-June. During this period, little terns were frequently observed foraging over a spit approximately 1km offshore of Sudbourne Beach. Little terns were also seen heading south from both the Dingle and Minsmere colonies, though at both colonies much of the foraging activity occurred in the shallow waters close offshore (generally within 700m of the shoreline). Flight line data indicated that birds were moving between the colonies but were also heading further south along the shoreline towards Sizewell. Surveys from the VPs near Sizewell (VPs 1 – 6) showed much of

the foraging activity of birds near to the main development site was in shallow waters within 300m of the shore (**Plate 6.10**).

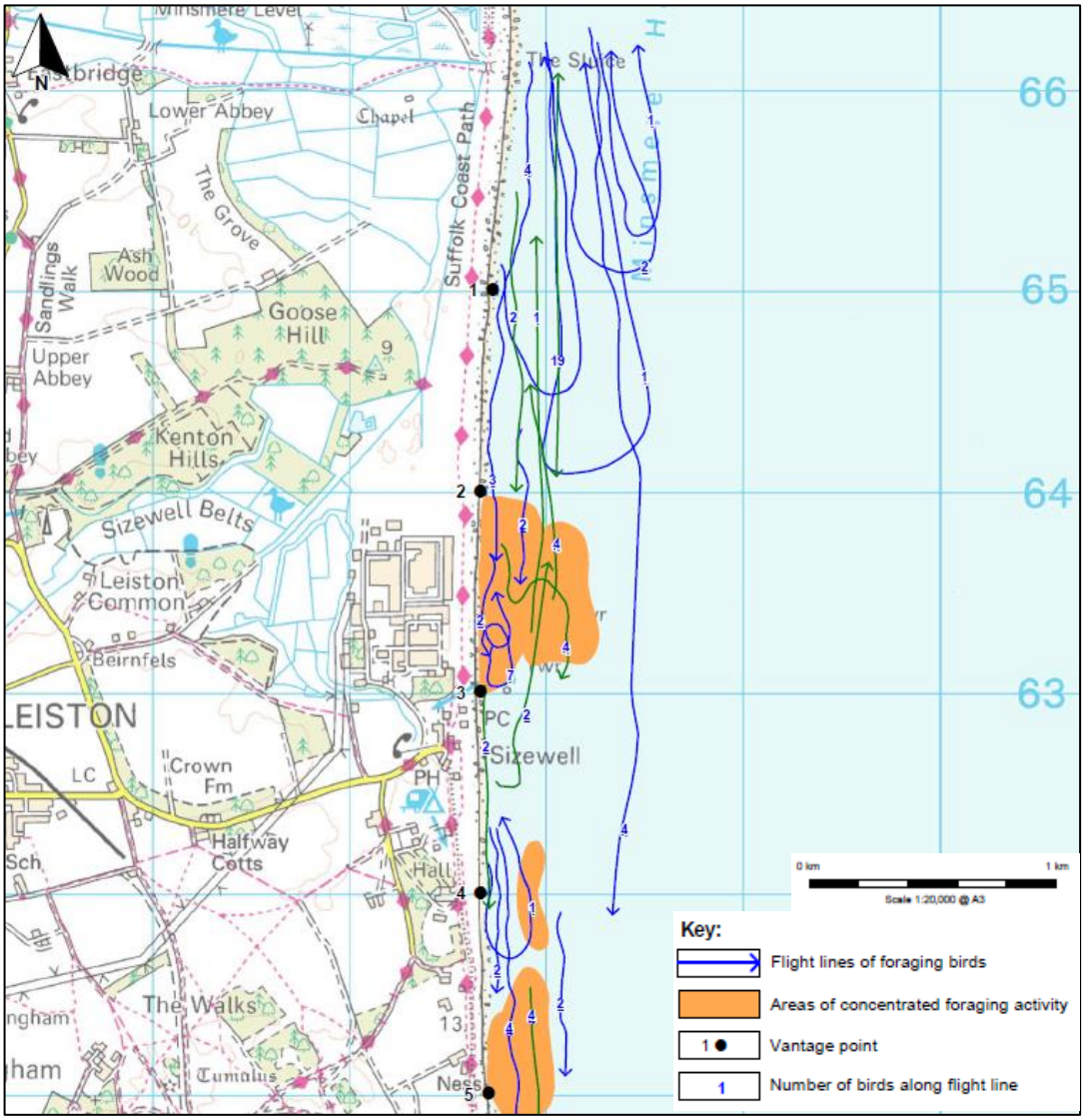
6.3.166. Of the nine sightings of little tern during the 2013 VP foraging surveys, two were from VP 13, north of the main development site and the only sightings within the mean maximum foraging range of birds breeding within Minsmere-Walberswick SPA (**Plate 6.9**). These sightings were of one to two individuals, foraging from Minsmere and moving south towards Sizewell.

Foraging behaviour and diet

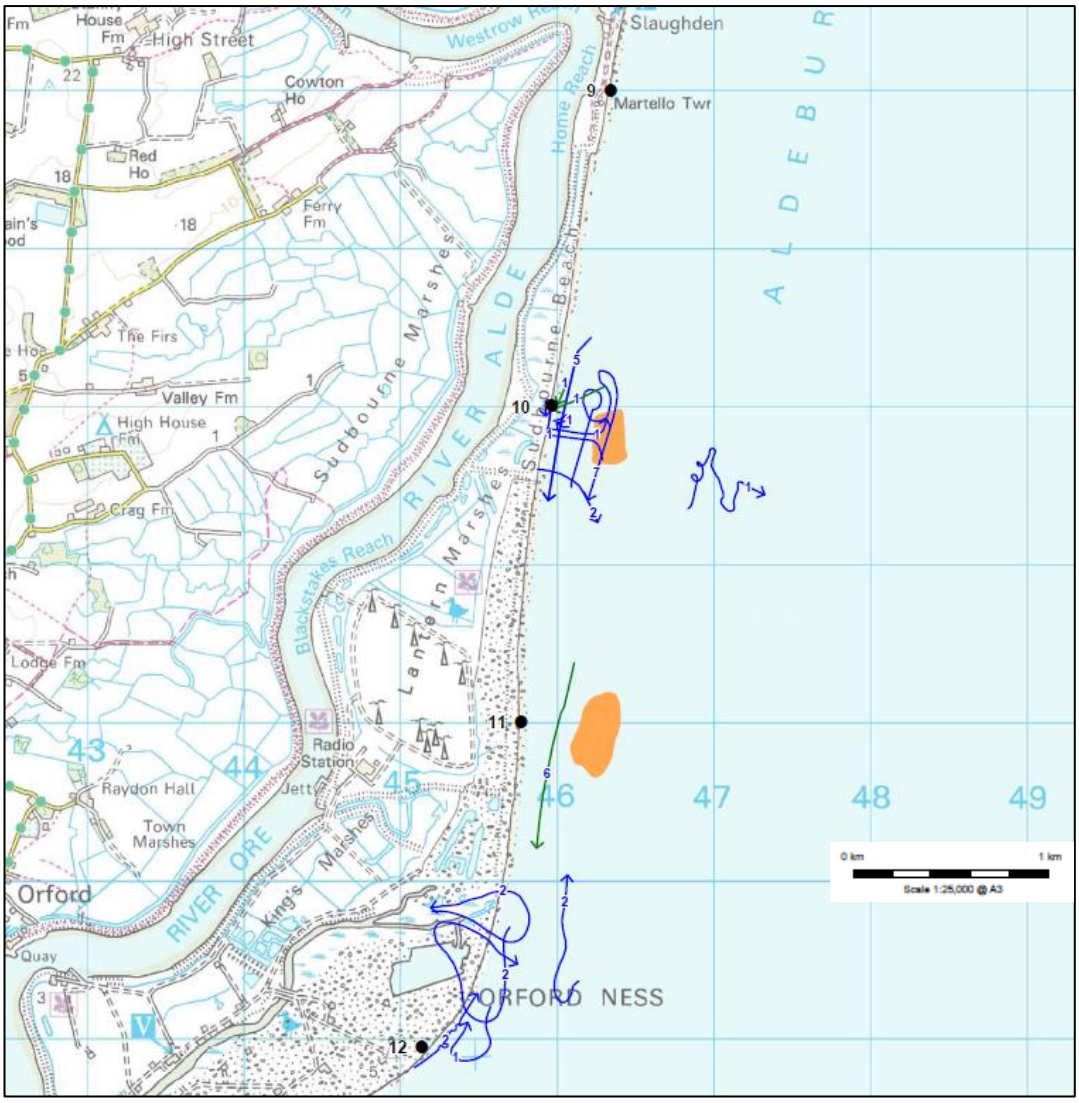
6.3.167. Details of the foraging behaviour and diet of little tern are given above (see Alde-Ore Estuary SPA baseline conditions). The areas which are likely to encompass the key foraging areas for breeding little tern within the Outer Thames SPA are defined by the estimated mean maximum alongshore and offshore foraging ranges from each of the different colony locations (i.e. 3.9km and 2.4km, respectively (Ref. 6.43).

6.3.168. Based upon the fish availabilities at Sizewell, the prey of breeding little tern foraging within Outer Thames Estuary SPA during the period May to August are expected to consist predominantly of schooling pelagic fish that are found near to the surface during daylight hours, such as herring, sprat and anchovy (Ref. 6.53).

Plate 6.10: Flight lines and areas of concentrated foraging activity of little terns during vantage point surveys (VPs 1 – 5) in May – June 2011 (Ref. 6.45); over three pages




Aldringham Ho
The Walks
Tumulus
Ness
Thorpe Ness
Partables Fm
B 1353
Church Fm
Wks
Hotel
CH
PH
Mill
The Fens
The Meare
Thorpeness
North Warren
Haven Ho
The Haven
Red Ho
MS
Hall
Mus
LB Sta
Hosp
ALDEBURGH
Fort Green
45
46
47
48
49
50
13
17
0 km
1 km



Common tern - breeding

SPA population

6.3.169. The Outer Thames Estuary SPA provides supporting habitat for breeding common terns, which are a qualifying feature of the Breydon Water and Foulness SPAs. Both of these SPAs are beyond the mean maximum foraging range of common terns from the main development site (at 18.6km) and have been 'screened out' of the current assessment (Ref. 6.58; **Table 6.17**). In addition, the Outer Thames Estuary SPA supports breeding birds from a number of other colonies, including within the Minsmere-Walberswick SPA (at Minsmere) and the Alde-Ore Estuary SPA (at Orford Ness and Havergate Island), although in neither case is the species a qualifying feature of these SPAs.

Table 6.17: Breeding common tern populations at coastal SPAs for which Outer Thames Estuary SPA provides important supporting habitat (bold indicates SPAs 'screened into' the current assessment)

SPA	Approximate Distance To The Main Development Site (km)	Current Breeding Population (Breeding Pairs)[1]	SPA Qualifying Feature
Breydon Water[2]	*c.*40 km	252	Yes
Foulness	*c.*75 km	17.5	Yes
Minsmere-Walberswick	***c.*1 km**	**103**	**No**
Alde-Ore Estuary	***c.*17 km**	**19**	**No**

[1] Estimates derive from 2011-15 for Breydon Water and Foulness (Ref. 6.94), from 2012-15 and 2018 for Minsmere-Walberswick (Ref. 6.44) and 2014-18 for Alde-Ore (Ref. 6.44).
[2] Includes colonies considered to be functionally linked to the SPA as well as colonies within the SPA (Ref. 6.94).

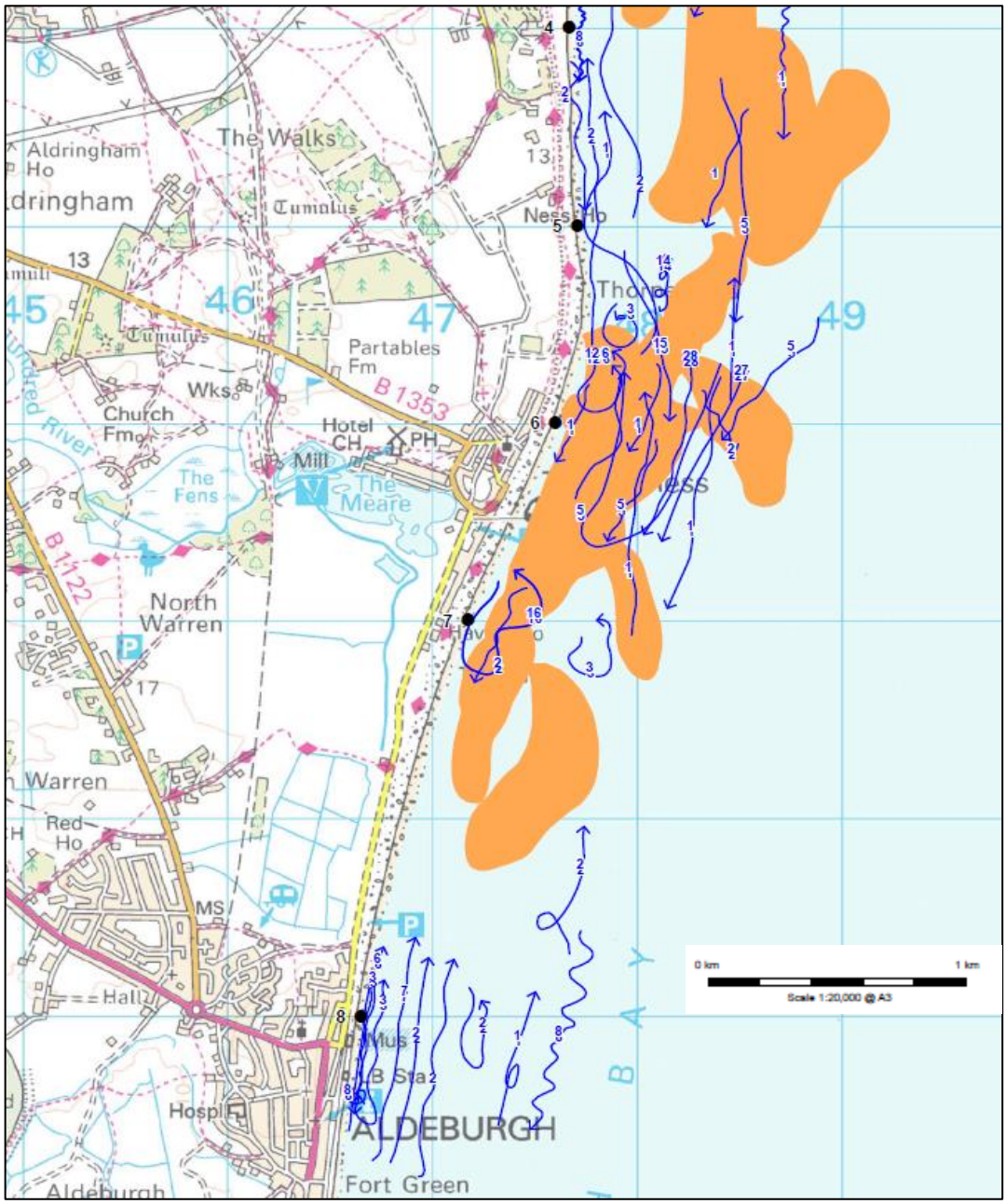
6.3.170. At the time of inclusion as a qualifying species, the Outer Thames Estuary SPA was estimated to support 270 pairs of breeding common tern from SPA breeding colonies, constituting almost 3% of the breeding population in Great Britain (based on counts from 2011-2015 – after Ref. 6.92; Ref. 6.93). Additional birds are supported from non-designated colonies. Numbers of common terns within the Alde-Ore Estuary SPA have declined to very low levels in recent years (with no birds breeding on Havergate Island and single pairs only recorded at Orford Ness in both 2017 and 2018), whilst within the Minsmere-Walberswick SPA they have tended to range between 100 to 150 pairs (Ref. 6.44; **Table 6.17**).

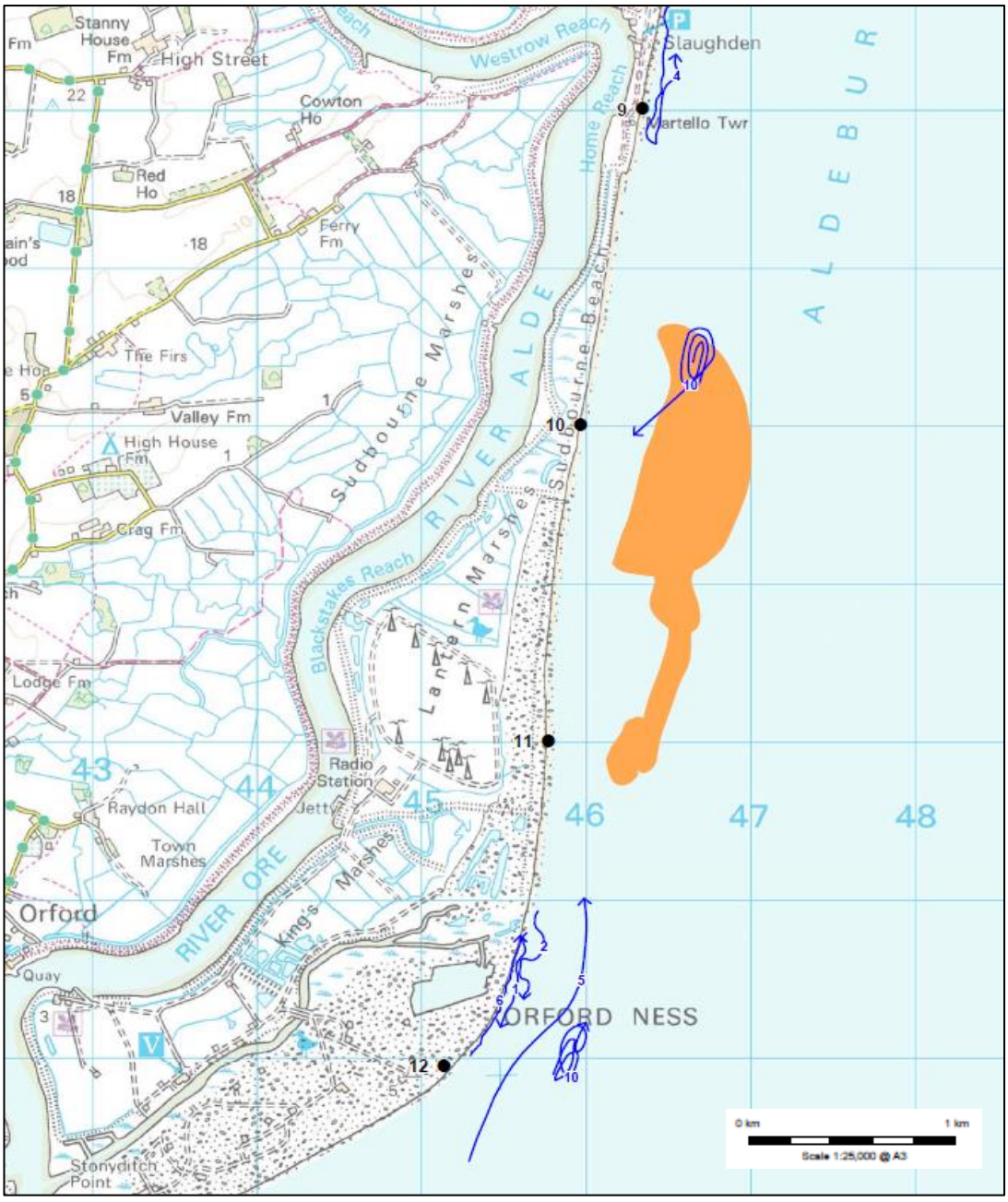
Project-specific survey data

6.3.171. As for little tern, common tern flight activity was recorded during the 2011 and 2012 surveys, using 12 coastal VPs in the vicinity of Sizewell, from Orford Ness north to a location approximately 0.5km north of the main development site, (Ref. 6.452; **Figure 6.1**). During these surveys, birds were recorded in the Sizewell / Minsmere area between April and October 2011, with returning birds recorded in April 2012. These records comprised large numbers of foraging birds (including juveniles) at all VPs between July and September. Much of this foraging activity occurred close inshore, with 47% of records less than 100m from the coastline and 79% within 500m. Common terns were also regularly recorded commuting up and down the coast, often 2 – 3km from the shoreline. Foraging activity and flight lines recorded during the survey period are presented in **Plate 6.11**.

Plate 6.11: Flight lines and areas of concentrated foraging activity of common terns during vantage point surveys (VPs 1 – 5) in April 2011 – April 2012 (Ref. 6.45); over three pages




The Walks
Aldringham Ho
Tumulus
Ness
Partables Fm
B 1353
Church Fm
Hotel
CH
PH
Mill
The Fens
The Meare
North Warren
B 1122
Warren
Red Ho
MS
Hall
Mus
B Sta
Hospl
ALDEBURGH
Fort Green
Aldeburgh
0 km
1 km
Scale 1:20,000 @ A3



6.3.172. During the VP surveys in 2011 and 2012, common terns were regularly observed foraging around the Sizewell B outfall, with birds returning from the waters around the outfall to nests at Minsmere often carrying food items for young. Numbers peaked in July and August, with up to 230 birds recorded in August. Once breeding terns had departed from Minsmere, the number of terns (including juveniles) recorded at the outfall and resting on the adjacent beach increased. As such, it seems likely that the outfall provides an important foraging resource for common terns from the Minsmere colony.

6.3.173. Common tern activity near Sizewell was also recorded during VP surveys in March to August 2013 (Ref. 6.46). Fifteen VPs were used as for the 2013 little tern surveys, giving increased coverage north of the main development site compared to the 2011 and 2012 (**Figure 6.1**). Most foraging activity recorded in 2013 was close to the shoreline adjacent to Minsmere-Walberswick SPA and near to Sizewell B outfall (VPs 1, 2, 13 and 14) (**Plate 6.12**).

6.3.174. As for Sandwich tern, common terns may forage considerable distances offshore (Ref. 4.8; Ref. 6.58) and well beyond the distances at which birds can be recorded during shore-based surveys. Therefore, these surveys have limited value in determining the full extent of the important marine foraging areas of this species.

Foraging behaviour and diet

6.3.175. During the breeding season (May to August), common terns are found around most of the UK coast and have a wide variety of nesting habitats, including shingle beaches, rocky islands and saltmarsh in coastal areas, as well as inland on lakes, reservoirs and gravel pits (often on artificial nesting platforms) (Ref. 6.52). They feed over freshwater and at sea by fishing in the upper few centimetres of water (Ref. 6.47), down to a maximum depth of 1m (Ref. 6.59). The mean maximum foraging range of breeding common terns is estimated as 18.6km, based on a generic model of range usage derived from a UK-wide study encompassing a range of colonies, although distances of up to 30km have been recorded (Ref. 6.58).

6.3.176. Based on the mean maximum foraging range, breeding birds from the designated populations at the Breydon Water and Foulness SPAs are unlikely to forage in waters within the vicinity of the main development site. The majority of birds using the waters in the Sizewell area during the breeding season are likely to derive from the non-designated colonies at the Alde-Ore Estuary SPA and Minsmere-Walberswick SPA. The generic model of range usage by common terns around their colonies also predicts that, within the area defined by the mean maximum foraging range, usage will be greatest near the colony (the term with the greatest effect size in the model), and in relatively shallow waters which are close to the shore (Ref. 6.58).

Plate 6.12: Main foraging areas of common terns identified during vantage point surveys, March – August 2013 (Ref. 6.46)



6.3.177. Common terns tend to use a greater variety of habitats and feeding techniques, and exploit a greater range of prey items, than other tern species (Ref. 6.95). They use a variety of foraging methods including plunge diving, diving to surface, hawking, dipping, kleptoparasitism and perch-feeding and feed on a wide range of prey including fish, crustaceans, squid and marine worms, as well as aquatic or terrestrial insects (Ref. 6.52).

6.3.178. The diet of adults is likely to include a higher proportion of invertebrates and less energy-rich components than are provisioned to chicks (Ref. 6.52). In the marine environment, the main prey delivered to chicks are herring, sprat, sandeel, saithe, whiting and cod, though this varies between years and locations (Ref. 6.96). Herring and sprat are the key prey resources of breeding common terns in the southeast North Sea / Wadden Sea (Ref. 6.97).

6.3.179. Based upon fish availabilities at Sizewell (Ref. 6.64), the prey of breeding common tern in the coastal areas of Outer Thames Estuary (incorporating the waters in the vicinity of the main development site) during the period May to August is expected to consist of schooling pelagic fish species that are found near to the sea surface during daylight hours, such as sprat, herring and anchovy (Ref. 6.53).

Red-throated diver – non-breeding

SPA population

6.3.180. When first classified in 2010, the Outer Thames Estuary SPA supported an estimated 6,446 non-breeding red-throated divers, representing approximately 38% of the non-breeding population estimated for Great Britain (i.e. 17,116 individuals – Ref. 6.92). There is likely to be interchange of birds between the SPA and other North Sea wintering grounds, such as the Wadden Sea, and the SPA population largely originates from Scottish and Scandinavian breeding populations along with some birds from as far afield as Greenland (Ref. 6.98).

6.3.181. The earlier estimates of red-throated diver numbers in the SPA are likely to be underestimates and subsequent surveys, undertaken using improved methods and technology, give higher estimates. In February 2013, aerial surveys undertaken using high-resolution digital photography suggested that the SPA population was around 14,161 individuals (95% confidence interval (CI) of 8,230 – 22,245), which at the time was the highest number recorded for any site in northwest Europe (Ref. 6.99; Ref. 6.100). A further survey commissioned by Natural England in February 2018, using more advanced aerial survey techniques, estimated a peak abundance of 22,280 individuals (95% CI 15,611 – 29,784) across the entirety of the SPA (including the recent

extension), of which 21,997 individuals (95% CI 15,351 – 29,4150) were estimated to be within the original SPA area (Ref. 6.101).

Project-specific survey data

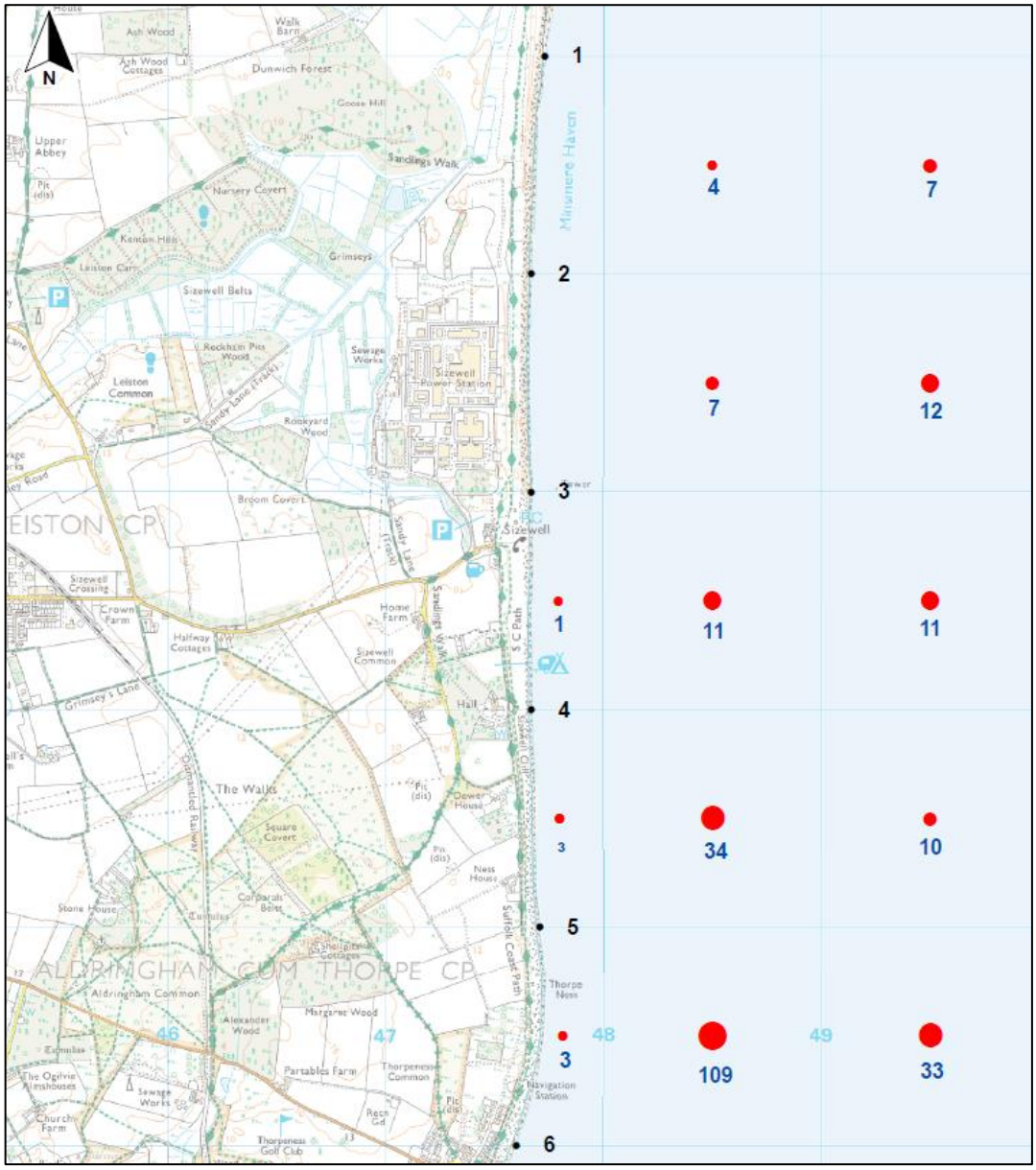
6.3.182. Red-throated diver abundance and behaviour was recorded during coastal VP surveys from March 2011 to April 2012, using the 12 VPs in the vicinity of Sizewell, from Orford Ness north to a location approximately 0.5km north of the main development site (Ref. 6.45; **Figure 6.1**). These surveys were conducted every two weeks over the winter period (October to March), with each survey at each VP being 45 minutes duration. A total of 5,056 divers were recorded during the survey period, of which 3,997 were commuting through the survey area and 1,059 were foraging or resting on the sea. The highest number of divers were seen in March and April 2011, and again in December 2011 to April 2012, with smaller numbers from August to October 2011 and none from May to July 2011.

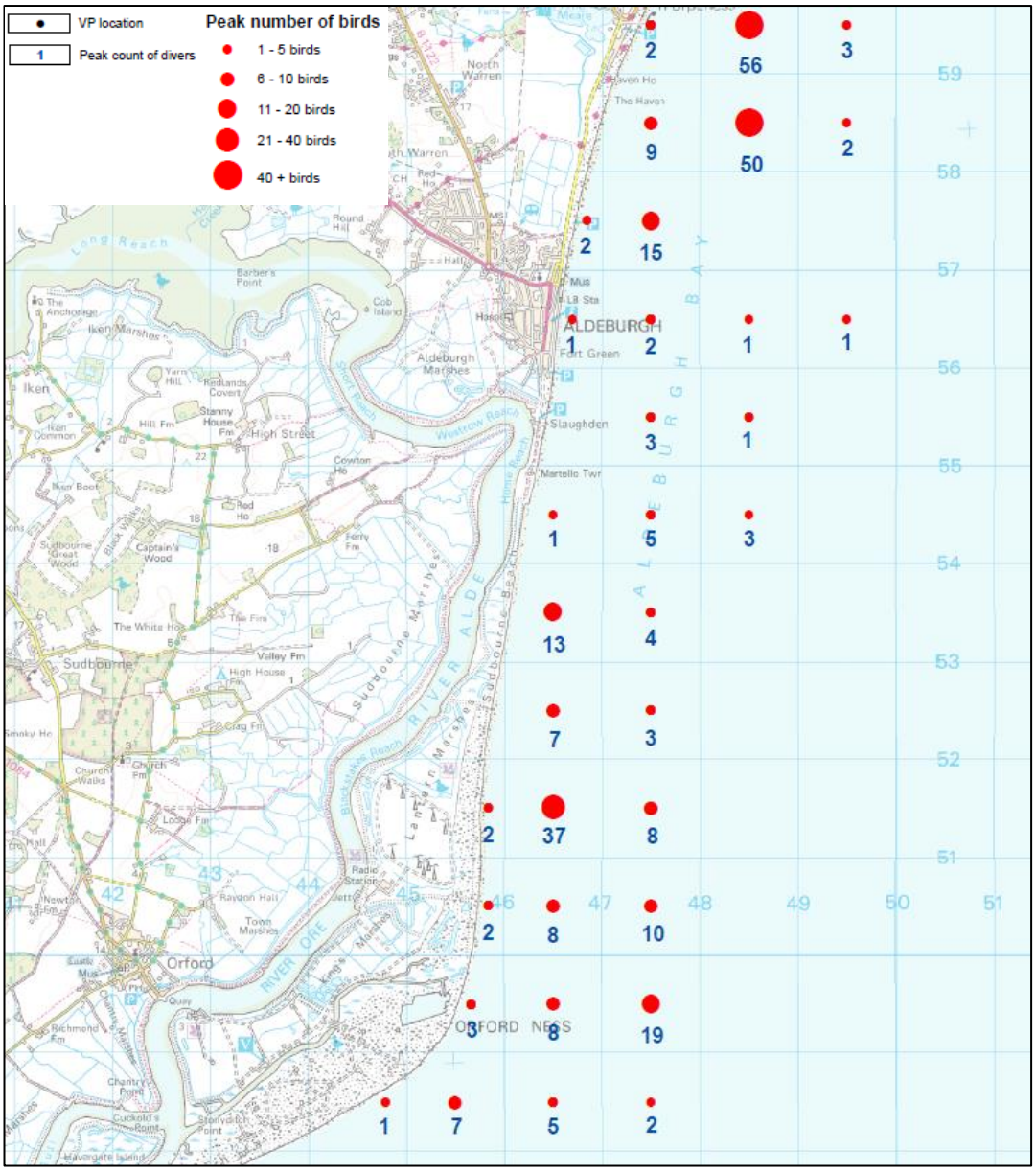
6.3.183. Overall, the highest numbers of red-throated diver were recorded from the most southern VP (12) at Orford Ness, although relatively few of the birds recorded from this location were foraging or loafing (**Table 6.18**). The highest numbers of foraging and loafing birds were recorded at VPs 5 – 7 (near Thorpeness and south of the main development site) and at VP11 (Orford Ness). The distribution of the peak number of divers recorded foraging or loafing in 1km grid squares viewable from the VPs is shown in **Plate 6.13**.

Table 6.18: Distribution of red-throated diver records across the 12 Vantage Points (VPs) used in surveys from March 2011 – April 2012 (see Figure 6.1 for VP locations)

VP	Number Of Birds Commuting	Number Of Birds Foraging / Loafing
1	213	128
2	208	62
3	112	47
4	464	50
5	210	222
6	264	157
7	322	119
8	379	38
9	102	18
10	322	57
11	445	108
12	956	53

Plate 6.13: Peak numbers of foraging and loafing red-throated divers in each 1km square, VPs 1 - 6, March 2011 to April 2012; over two pages





6.3.184. Further red-throated diver surveys were undertaken during the winter period (October – March) in 2012 – 2013 and 2013 – 2014 at 15 VPs along the coastline between Dunwich (i.e. VP15, *c.* 6km north of the main development site) and Orford Ness (i.e. VP12, *c.* 16km south of the main development site) (**Figure 6.1**). As well as the addition of the three more northerly VP locations, these later surveys also incorporated coverage of dawn and dusk periods at the four VPs closest to the main development site (i.e. VPs 1 – 4), but otherwise followed the same methods as used in the 2011-12 surveys (Ref. 6.46; Ref. 6.102).

6.3.185. A total of 2,543 sightings were recorded during the 2012 – 2013 surveys (mostly in February and March, with 19% and 67% of records, respectively) and 4,497 sightings during 2013 – 2014 surveys (mostly in December, January and February with 46%, 23% and 28% of records, respectively), with a maximum single count of 700 birds from VP 15 (at Dunwich) in December 2013.

6.3.186. As for the earlier 2011-12 survey data, numbers tended to be relatively high at the southern VPs (11 and 12) but there were also high peak counts in the northern parts of the survey area, particularly at VPs 1, 13 and 15 (**Table 6.19**). Relatively few birds were recorded in immediate proximity to the offshore extent of the main development site (i.e. at VPs 2 and 3).

Table 6.19: Peak and mean numbers of red-throated diver recorded at each of the 15 VPs used in the 2012-13 and 2013-14 winter surveys

VP	2012-13		2013-14	
	Peak Count	Mean Count Per Survey Visit	Peak Count	Mean Count Per Survey Visit
1	108	13.8	200	42.8
2	34	6.2	6	6.9
3	28	5.4	14	7.9
4	50	8.8	8	8.8
5	25	5.0	55	7.8
6	20	2.5	50	8.7
7	72	10	24	23.0
8	147	19.6	43	13.4
9	167	22.7	24	9.6
10	68	22.9	100	31.6
11	227	42.1	200	83.9
12	155	40.6	120	51.5
13	133	20.3	60	18.3
14	86	19.1	80	28.7
15	65	14.7	700	87.5

6.3.187. During the 2012-13 and 2013-14 winter surveys, red-throated divers were recorded out to a maximum distance of 3km (considered to be the limit for the shore-based survey method used – Ref. 6.46; Ref. 6.102), but with few records from beyond 2km (reflecting the problems in locating and identifying divers at this distance). Only 5.7% of all records were within 500m of the shore, whilst 40% and 54% were between 500m and 1km and 1km and 2km,

respectively. Therefore, even allowing for the increased area of sea within these wider distance bands, densities are clearly relatively low within 500m of the shore (bearing in mind that detectability of birds will also decline with distance from the shore and is likely to be relatively low at distances beyond 1km).

Distribution and abundance within the SPA

6.3.188. The Outer Thames Estuary SPA comprises three discrete sections, with the main development site occurring within the north-western section which abuts the coast between the Deben Estuary in the south and Great Yarmouth in the north (**Figure 4.1**). The 2018 aerial surveys of the SPA provide separate estimates of the abundance and densities of red-throated divers in each of these SPA sections.

6.3.189. Of the three separate SPA sections, the southern section holds the bulk of the SPA population with densities estimated to be almost twice as high as those in the north-western section during the second survey visit (when peak numbers occurred) and over five times higher during the first survey visit (Ref. 6.101). The peak abundance within the north-western SPA section was estimated as 4,587 (95% CI 2,499 – 7,114) individuals, representing 21% of the peak estimate for the entire SPA (22,280, 95% CI 15,611 – 29,784) (Ref. 6.101). During the first survey visit, when numbers across the SPA were lower, the abundance in the north-western SPA section represented only 7% of the SPA total.

6.3.190. Similar differences in the densities of red-throated divers between the three discrete SPA sections were also noted during the earlier aerial surveys, with the southern section again holding the bulk of the SPA population during two surveys undertaken in January and February in 2013 (Ref. 6.99). Furthermore, distribution maps for both the 2013 and 2018 surveys indicate that relative to the overall densities within the north-western SPA section, densities in the coastal waters immediately adjacent to the main development site tend to be low to moderate (Ref. 6.99; Ref. 6.101).

Foraging behaviour and diet

6.3.191. Red-throated divers are opportunistic feeders and feed mainly on fish, particularly during wintering periods in coastal areas, but diet composition is understood to depend on local availability of prey rather than food specialisation (Ref. 6.103). They are pursuit divers and forage in marine waters by diving from the surface to a typical mean depth of 2 – 8m and maximum depth of 9 – 10m for up to 1 minute at a time (Ref. 6.59).

6.3.192. Typical dietary components for non-breeding divers in the North Sea and Baltic Sea include clupeids (herring and sprat), gadoids (including whiting

Merlangius merlangus, blue whiting *Micromesistius poutassou* and cod *Gadus morhua*), gobies, sandeels and smelt (Ref. 6.103; Ref. 6.104; Ref. 6.105). There is an element of selective feeding, since locally common flatfish tend to be avoided when other prey is available (Ref. 6.103).

6.3.193. Individual fish prey ranges in size from *c.* 2.5cm (0.1 g) to *c.* 30cm (180 g), with a tendency to consume smaller prey items in winter than in spring (e.g. mean herring sizes of 12cm and 21-23cm, respectively), though this may be a reflection of the local populations of wintering juvenile fish commonly found in coastal areas (Ref. 6.103; Ref. 6.106). It has been estimated that red-throated diver food requirements equate to approximately 496 g/day (Ref. 6.105).

6.3.194. Based upon fish availabilities at Sizewell (Ref. 6.64), the prey of non-breeding red-throated divers in inshore areas of Outer Thames Estuary SPA is expected to consist of the most commonly occurring benthopelagic species, including sprat, herring, whiting and bass *Dicentrarchus labrax* (Ref. 6.64).

6.3.195. As non-breeding population, the red-throated divers associated with the SPA are not constrained by the foraging range from the colony, as is the case for the breeding seabird qualifying features of the SPA. Therefore, red-throated divers may range widely and take advantage of prey resources over a large area. This may make non-breeding red-throated divers relatively insensitive to localised changes in prey availability.

i) Sandlings SPA

i. Population estimates of SPA qualifying features

6.3.196. Breeding nightjar and woodlark are the two qualifying features of the Sandlings SPA, with the most recently available population estimates for the SPA indicating that numbers of both are currently lower than at the time of citation (**Table 6.20**). The most recent SPA population estimates represent 1.8% and 2.4% of the UK breeding populations of nightjar and woodlark, respectively (Ref. 6.107; Ref. 6.108).

Table 6.20: Population estimates for the qualifying features of the Sandlings SPA, as determined at citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Breeding	Nightjar	109 males (1992)	81 males (2004)
	Woodlark	154 bp (1997)	73 bp (2006)

[1] Count unit – males = breeding males; bp = breeding pairs.
Estimates derived from SPA Conservation Objectives supplementary (advicehttp://publications.naturalengland.org.uk/publication/6690828793675776).

ii. Distribution of SPA populations

6.3.197. The Sandlings SPA encompasses a total area of approximately 34 km^2 and comprises several discrete blocks of land, some of which are separated by distances of several kilometres (Ref. 6.109; **Figure 4.1**). Although the SPA is within 0.7km of the main development site at its closest point, the largest blocks of land which comprise the SPA are considerably further from the main development site, at over 9km.

6.3.198. The part of the SPA which is closest to the main development site overlaps substantially with the RSPB's North Warren and Aldringham Walks Reserve, for which data on the abundance of breeding nightjar and woodlark are available from 2010 to 2018. Over this period the number of nightjar territories on the Reserve increased from two in 2010 to five in 2018 (with an average of 1.4 territories per year from 2010 to 2014 and of 2.6 from 2014 to 2018), whilst for woodlark they increased from three in 2010 to seven in 2018 (with an average of 4.6 territories per year from 2010 to 2014 and of 6.8 from 2014 to 2018) (RSPB, *unpublished data*). Therefore, the discrete block of the SPA which is closest to the main development site seems likely to hold approximately 3% and 9% of the total SPA nightjar and woodlark populations, respectively.

iii. Occurrence of the qualifying features in the vicinity of the main development site

6.3.199. As detailed above (see Section (f) Minsmere-Walberswick SPA), surveys for breeding nightjar undertaken within, or close to, potentially suitable breeding habitat for the species failed to record any apparent breeding birds outside any SPAs (Ref. 6.45). Similarly, surveys for breeding woodlark undertaken across potentially suitable habitat (i.e. heathland and open coniferous woodland – Ref. 6.110) within and in close proximity of the main development site in 2016 produced no records of the species. Also, no woodlarks were recorded in standard breeding bird surveys undertaken within and in close

proximity of the main development site in 2015 but breeding bird surveys in 2010 recorded a single (likely) breeding territory to the south of Ash Wood (Ref. 6.45).

j) Stour and Orwell Estuaries SPA

i. Population estimates of SPA qualifying features

6.3.200. The most recently available population estimates for the SPA are lower than at citation for all but two of the qualifying features (dark-bellied brent goose and knot), with the decline in numbers particularly marked for non-breeding dunlin (**Table 6.21**).

6.3.201. The SPA also qualifies on the basis of the wintering waterbird assemblage but estimates of the overall abundance of this feature are not available.

Table 6.21: Population estimates for the qualifying features of the Stour and Orwell Estuaries SPA, as determined at (or near) the time of citation and from the most recently available data

Qualifying Feature		Citation Population Size[1] (Year(s) From Which Derived)	Recent Population Estimate[1] (Year(s) From Which Derived)
Breeding	Avocet	21 bp (1996-2000)	18.5 bp (no date)
Non-breeding	Black-tailed godwit	2,559 ind (1995/96-99/00)	2,148 ind (2010/11-14/15)
	Dark-bellied brent goose	2,627 in (1995/96-99/00)	2,937 ind (2010/11-14/15)
	Dunlin	19,114 ind (1995/96-99/00)	9,183 ind (2010/11-14/15)
	Grey plover	3,261 ind (1995/96-99/00)	2,501 ind (2010/11-14/15)
	Knot	5,970 ind (1995/96-99/00)	6,996 ind (2010/11-14/15)
	Pintail	741 ind (1995/96-99/00)	435 ind (2010/11-14/15)
	Redshank	3,687 ind (1995/96-99/00)	2,089 ind (2010/11-14/15)

[1] Count unit – bp = breeding pairs; ind = individuals
All estimates from Natural England's Designated Sites View (https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9009121&SiteName=stour+and+orwell&SiteNameDisplay=Stour+and+Orwell+Estuaries+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=8)

k) Stour and Orwell Estuaries Ramsar site

i. Qualification criteria

6.3.202. In relation to bird populations, The Stour and Orwell Ramsar site qualifies under Ramsar criteria 5 (i.e. *"A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds."*) and Ramsar criteria 6. Qualification under the criterion 5 is on the basis of the site supporting a waterfowl assemblage with a peak count of 51,285 individuals (based on the five year mean peak count for 1998/99-2002/03), whilst for criterion 6 it is on the basis of the populations of non-breeding black-tailed godwit, redshank, dark-bellied brent goose, dunlin and grey plover which occur on the site (Ref. 6.111).

6.3.203. Baseline data are as detailed for the Stour and Orwell Estuary SPA.

6.4 Marine mammals

a) The Humber Estuary SAC

i. Grey seal

6.4.1. Seal species within the UK are listed under international and national legislation for their protection. Both grey and harbour seal are listed under Annex II and Annex V of the Habitats Directive. Annex V requires that their exploitation or removal from the wild may be subject to management measures, and Annex II that member states of the European Union are to designate areas essential for their life and reproduction as SACs. The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2017 (as amended) provide the same level of protection for more than 12 nautical miles (nm) offshore.

Distribution and abundance

6.4.2. UK grey seal populations are assessed from the counts of pups born each year. Surveys are undertaken during the breeding season when females congregate on land to give birth. The most recent counts available are from the 2016 autumn breeding season surveys, that were released in 2018. The 2016 surveys resulted in an estimate of 65,000 pups (95% confidence interval = 57,800-71,800; Special Committee on Seals, Ref. 6.112). The pup counts can be used to determine actual population size through a mathematical model and have been projected forward to 2018. This model provides an estimated UK population for 2018 of 150,000 (95% confidence interval = 131,000-171,600; Ref. 6.112).

6.4.3. The most recent regional pup counts from the 2016 surveys for the North Sea colonies this was 14,600 (95% confidence interval = 12,700-16,900) (Ref. 6.112). The rate of pup production for the North Sea colonies have been increasing at an average rate of 10% per year from 2010-2016. In addition to the high numbers of grey seal along the east coast of the UK, there are also high numbers within the North Sea close to sandbanks (such as Dogger Bank) and along the corridors that connect offshore foraging areas to haul-out sites (Ref. 6.113).

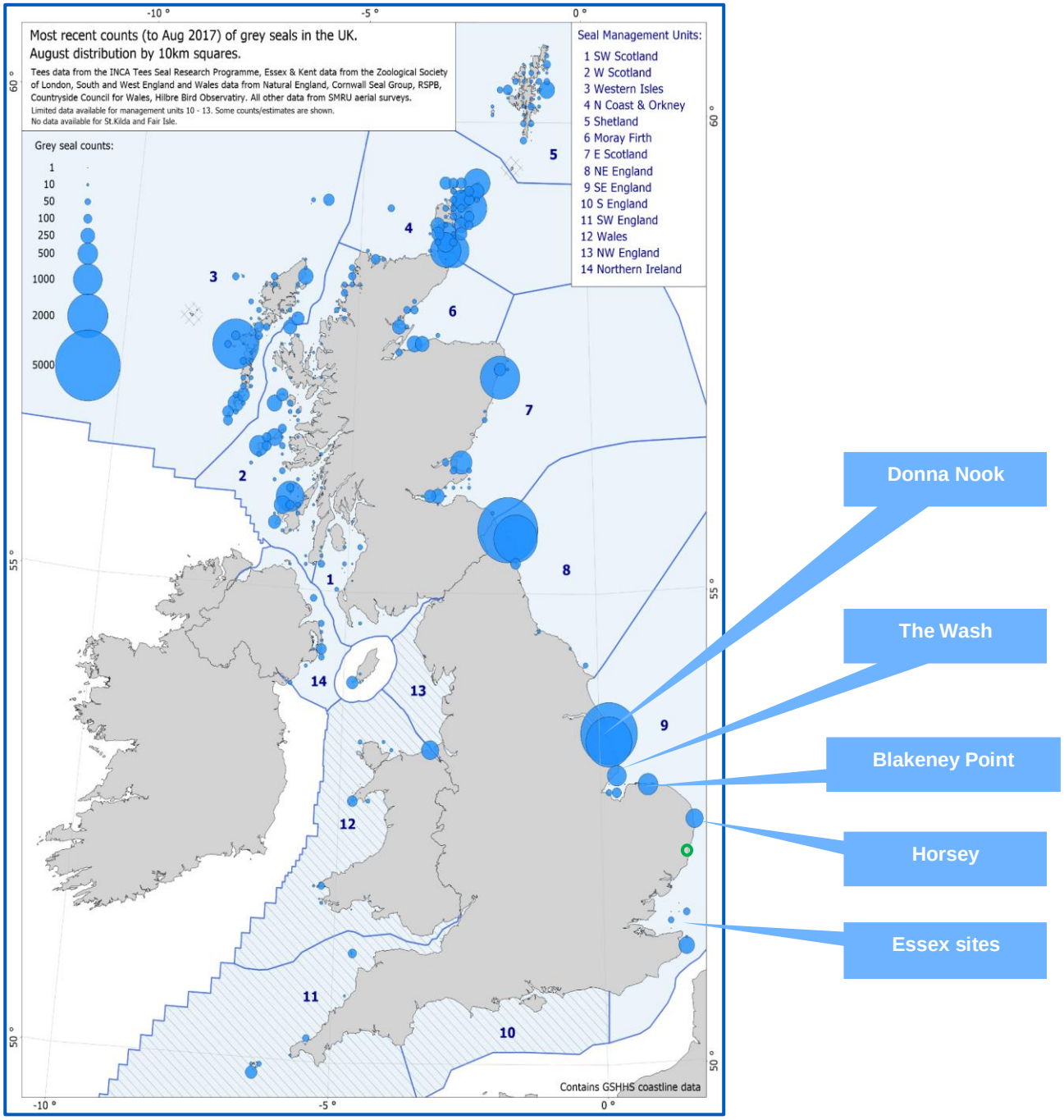
6.4.4. The most recent counts of grey seal in the August 2016 surveys estimated that the total count of grey seals in the UK was 45,119 (Ref. 6.112). The grey seal management unit, within which the Sizewell C main development site is located, is the South-East England Management Unit as shown on **Plate 6.14**, which has an estimated population of 8,716 (Ref. 6.112). This includes 6,526 seals at Donna Nook (which is the haul-out within the Humber Estuary SAC), 688 at The Wash, 502 at Blakeney Point, The Wash, 481 in Essex and Kent and 425 at Scroby Sands.

6.4.5. Marine mammal observations during recent surveys in the Greater Sizewell Bay have shown that grey seals are present in the vicinity of the Sizewell C main development site; near the Sizewell B station outfall and further offshore across and seaward of the Sizewell-Dunwich sandbank in the vicinity of the proposed intake and outfall infrastructure. Observations occurred on a reasonably regular basis and, in the winter and spring survey, seals were recorded on almost 40% of survey days, with one juvenile recorded in early March (Ref. 6.113).

6.4.6. Marine Scotland commissioned the Sea Mammal Research Unit to produce maps of grey seal distribution in UK waters (Ref. 4.5). These maps were produced by combining information about the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites. The resulting maps show estimates of mean seal usage (seals per 5km x 5km grid cell) within UK waters.

6.4.7. These usage maps indicate that grey seal mean total usage is low in and around the Sizewell C main development site, with a grey seal density of 0.038 per km^2 at the location of the Sizewell C main development site (for the grid cells intersecting with the Sizewell C main development site boundary), and of 0.030 per km^2 over the wider area (for the grid cells that intersect within a buffer distance of 25km from the Sizewell C main development site boundary) (Ref. 4.5).

Plate 6.14: Locations of the main grey seal breeding sites around the UK (taken from Ref. 6.112); the approximate location of the Sizewell C main development site is indicated by the green circle



Movements

6.4.8. Tracking of individual seals has shown that most foraging probably occurs within 100km of a haul-out site, with ranges of approximately 145km (Ref. 6.114), although they can feed up to several hundred kilometres offshore, with ranges of 1,088 to 6,400km recorded (Ref. 6.115). Individual grey seals based at a specific haul-out site often make repeated trips to the same region offshore but will occasionally move to a new haul-out site and begin foraging in a new region (Ref. 6.116). Studies of regular foraging and dispersal between winter breeding sites, and summer foraging and haul out sites indicates ranges of 1,000km (e.g. Ref. 6.117).

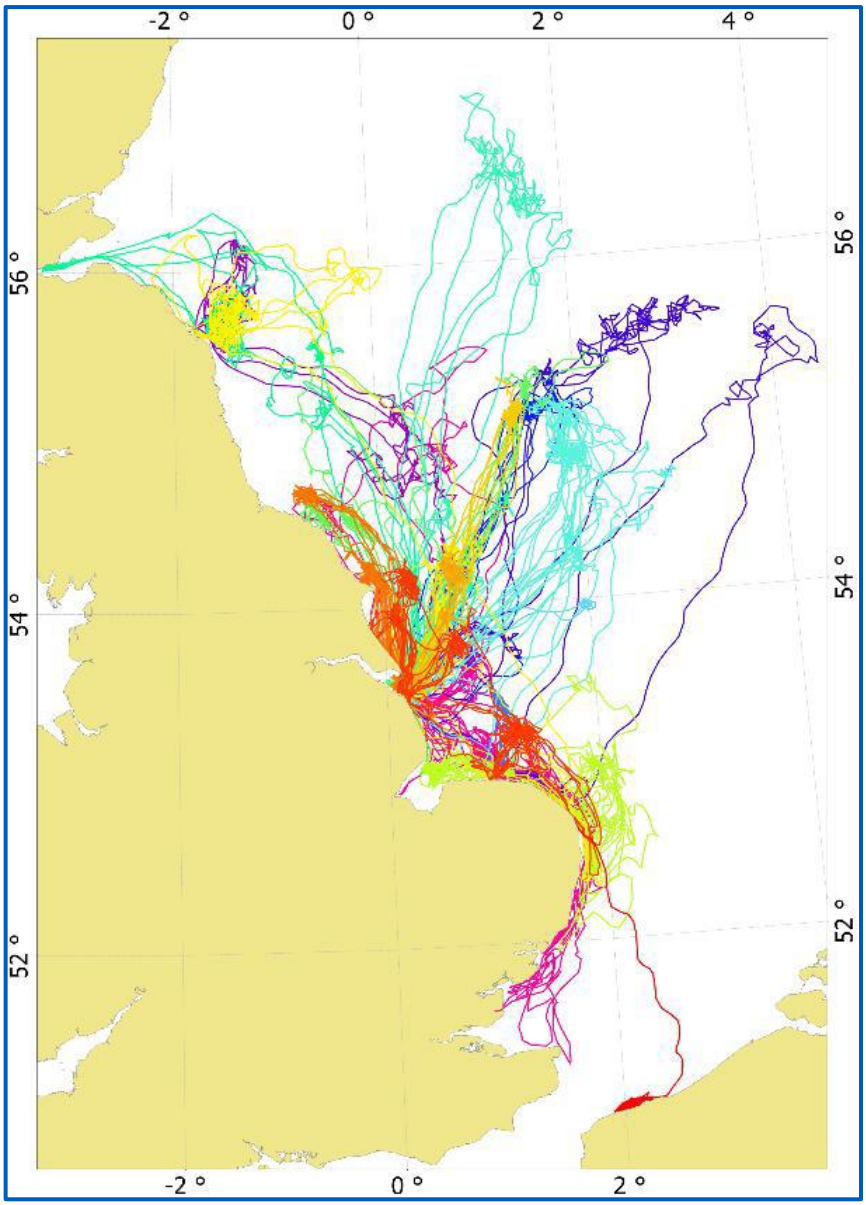
6.4.9. Tags were deployed on grey seal at Donna Nook (the haul-out site within the Humber Estuary SAC) (n=11) and Blakeney Point (n=10) in May 2015, at the end of their moult periods (Ref. 4.4). The tagged grey seals travelled between haul-out sites along the east coast of England, as well as to the north of France and up to the Firth of Forth and across Fladden Ground and Dogger Bank (Ref. 4.4). Of the 21 tagged individuals, 16 used multiple haul-outs sites; one hauling out in the Netherlands and one in northern France (this individual did not return within the tags duration) (Ref. 4.4). **Plate 6.15** shows the tagged seal movements along the east coast of England from the Donna Nook and Blakeney Point haul-out sites.

Haul-out sites

6.4.10. Grey seal come ashore to give birth, for their annual moult period and to rest between foraging trips. Grey seal will often haul-out on outlying islands and remote coastlines exposed to the open sea. Generally, they are sensitive to disturbance by humans and will haul-out in remote areas and prefer remote breeding sites. However, Donna Nook (the haul-out site within the Humber Estuary SAC) has a population of grey seals that have become acclimatised to the presence of humans and the associated disturbance, where there are over 70,000 visitors to the site during the breeding season and no impact on the breeding seals or pups (Ref. 6.112).

6.4.11. Compared with other times of the year, grey seals in the UK spend longer hauled out during their annual moult (between December and April) and during their breeding season (Ref. 6.112). In eastern England, pupping occurs mainly between early November and mid-December (Ref. 6.112). Pups are typically weaned 17 to 23 days after birth, when they moult their white natal coat and then remain on the breeding colony for up to two or three weeks before going to sea (Ref. 6.118).

Plate 6.15: Tagged grey seal movements along the east coast of England (Ref. 4.4)



6.4.12. The main breeding and haul-out sites for grey seal on the east coast of England are (with the (swimming) distance to the Sizewell C main development site shown in brackets) located at Horsey (63km north), Blakeney Point (119km north), The Wash (168km north), Donna Nook (194km north), and the Essex haul-out sites which include the Long Sand Inner (67km to the south-west), Margate (88km to the south-west) and Goodwin Sands (100km to the south-west) (**Plate 6.14**).

6.4.13. The number of grey seals recorded at the Essex haul-out sites has remained steady over recent years, with 393 individuals recorded in the 2010 count, to 449 within the 2014 count (Ref. 6.119), and 481 in the most recent 2016 count of the wider Thames estuary (Ref. 6.112).

Diet and prey species

6.4.14. Grey seals typically forage in the open sea and foraging trips can last anywhere between one and 30 days (Ref. 6.112).

6.4.15. Grey seal are generalist feeders and will prey upon a variety of species. The most common food sources for grey seal are sandeels (*Ammodytidae*), gadoid species (such as cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus* and ling *Molva molva*) as well as flatfish species (such as plaice *Pleuronectes platessa*, sole *Soleidae sp*., flounder *Platichthys flesus* and dab *Limanda limanda*), however this does vary from season and by location (Ref. 6.120). A study by Hammond and Wilson (2016 – Ref. 6.121, has shown that the diet of grey seals in the North Sea was dominated by sandeels (56%) with gadoid prey (particularly cod and saithe) comprising about 20% of the total diet.

6.4.16. Food requirements for grey seal depend on a number of factors, such as its size and fat content of the prey, but a general estimate is that a typical grey seal requires 4 to 7kg of prey a day, depending on the prey species (Ref. 6.112).

b) Southern North Sea SAC

i. Harbour porpoise

6.4.17. All cetaceans in UK waters are classed as European Protected Species (EPS) under Annex IV of the Habitats Directive (EU Directive 92/43/EEC) and, therefore, are internationally important. Harbour porpoise are additionally listed under Annex II of the Habitats Directive and are afforded protection through the designation of SACs. As for grey seal, the Offshore Habitats Regulations 2017 provide the same level of protection for more than 12nm offshore.

6.4.18. Member States report back to the EU every six years on the conservation status of marine EPS. In the UK, harbour porpoise has been assessed as having a 'favourable' conservation status (based on the last 2007 to 2012 reporting (Ref. 6.122)).

6.4.19. The Annex II species harbour porpoise is a primary reason for site selection of the Southern North Sea SAC.

Distribution and abundance

6.4.20. Harbour porpoise within the eastern north Atlantic are generally considered to be part of a continuous biological population that extends from the French coastline of the Bay of Biscay to northern Norway and Iceland (Ref. 6.123; Ref. 6.124, Ref. 6.125; Ref. 6.126). However, for conservation and management purposes, it is necessary to consider this population via smaller management units.

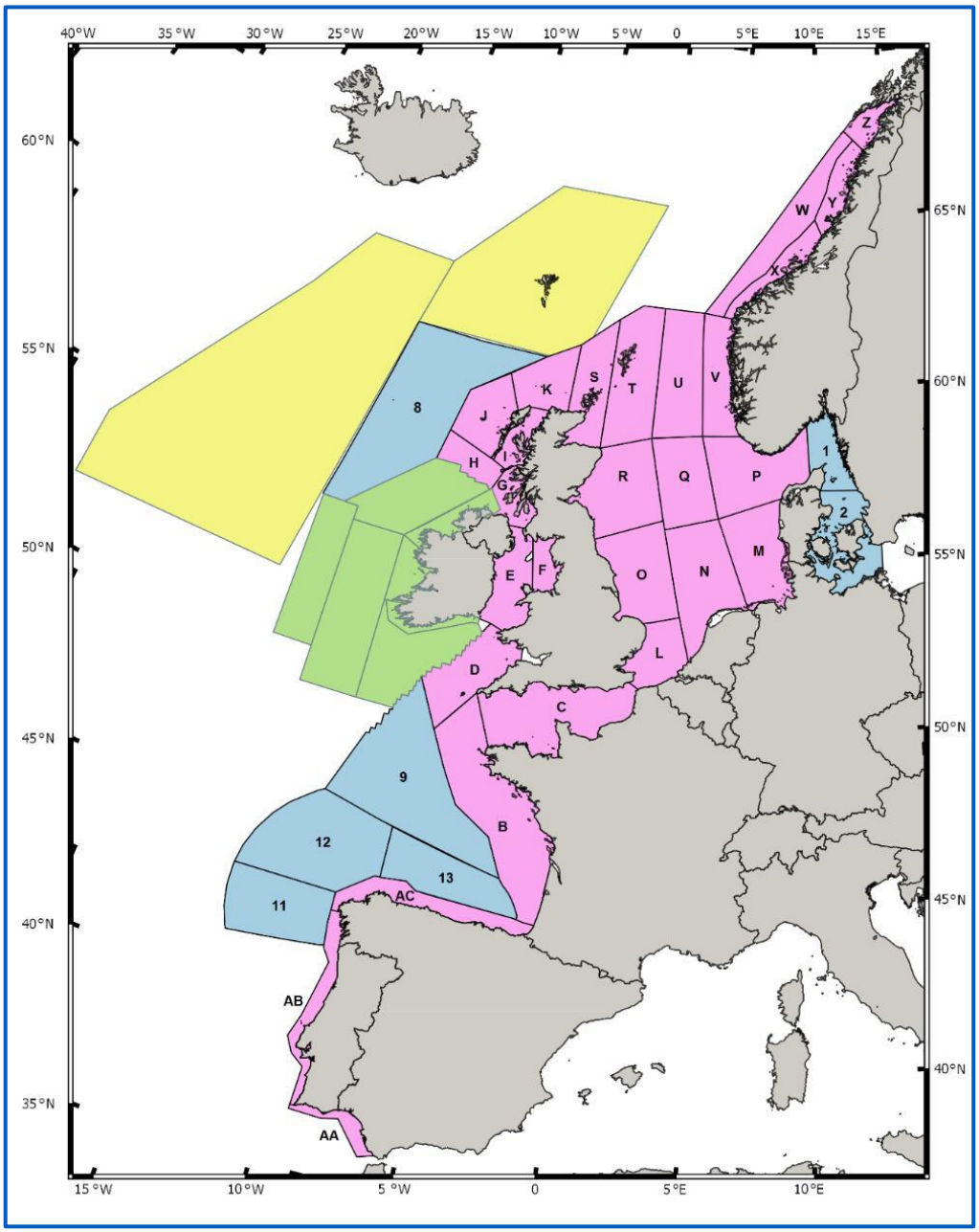
6.4.21. The Inter-Agency Marine Mammal Working Group defined three management units for harbour porpoise: North Sea; West Scotland; and the Celtic and Irish Sea; the Sizewell C main development site is within the North Sea Management Unit. The SCANS-III survey was undertaken in the summer of 2016 and surveyed all European Atlantic waters from the Strait of Gibraltar in the south to 62°N in the north and extending west to the 200nm limits of all EU Member States (Ref. 6.127). The SCANS-III estimate of harbour porpoise abundance in the North Sea Management Unit was 345,373 (coefficient of variation = 0.52; 95% confidence interval = 246,526 - 495,752) with a density estimate of 0.52 per km^2 (Ref. 6.127).

6.4.22. The Sizewell C main development site is located in SCANS-III survey block L (**Plate 6.16**), which has an area of 31,404 km^2 and 1,949.3km of effort. The estimated abundance of harbour porpoise in SCANS-III survey block L is 19,064 harbour porpoise (coefficient of variation = 0.38; 95% confidence interval = 6,933 – 35,703), with an estimated density of 0.607 harbour porpoise per km^2 (Ref. 6.127).

6.4.23. The Joint Cetacean Protocol Phase-III report (Ref. 6.128) indicates that for an area off the coast to the east of East Anglia, which includes the Sizewell C main development site (defined as the '*Norfolk Bank Development Area*' within the report, and totalling an area of 14,295 km^2), the abundance of harbour porpoise ranged from 5,300 (confidence interval = 2,600-15,600) in the spring to 13,700 (confidence interval = 7,000-26,200) in the winter, with numbers in summer and autumn being in between this range. The '*Norfolk Bank Development Area'* covers 2.4% of the North Sea Management Unit, but the abundance estimate of harbour porpoise in this area equates to 13.9% (confidence interval = 8.9-19.2%) of the North Sea Management Unit, indicating a high use of the area (Paxton *et al.,* 2016). **Plate 6.17** illustrates

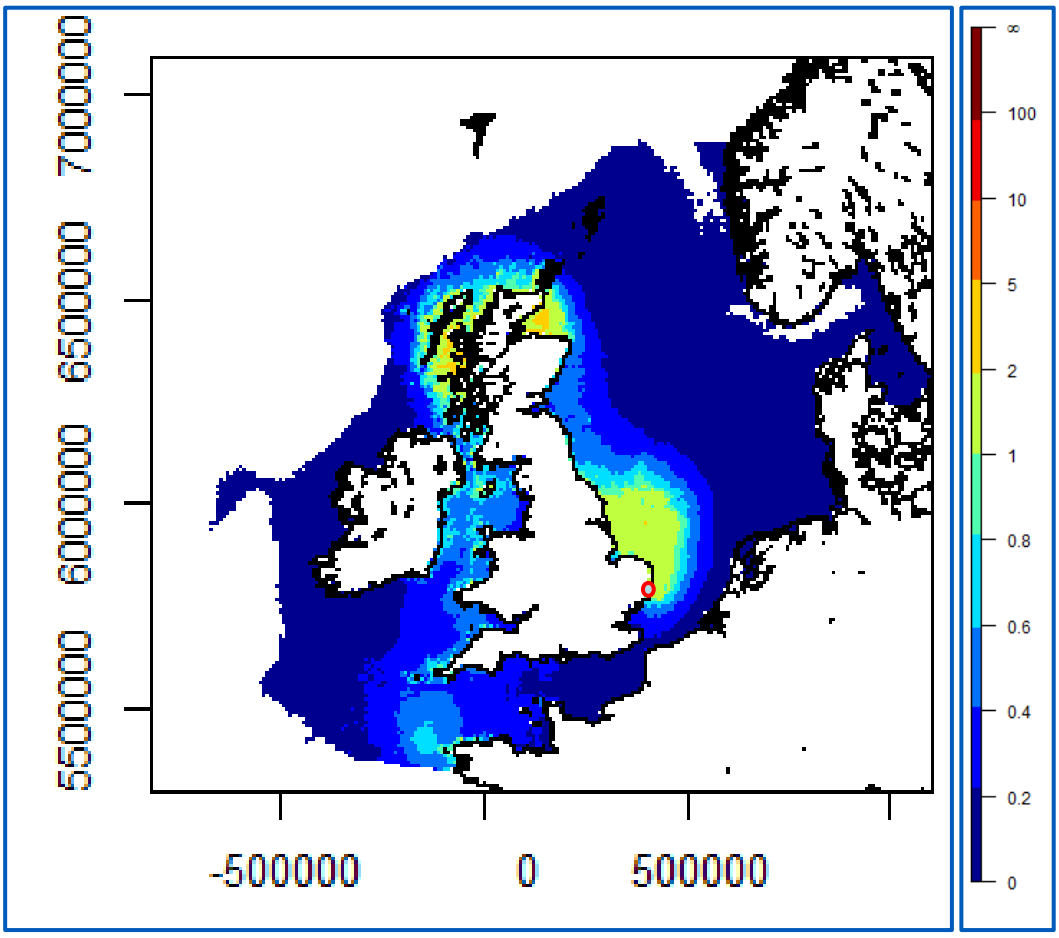
the distribution of harbour porpoise, based on modelled densities for winter 2010 from the Joint Cetacean Protocol Phase-III report.

Plate 6.16: Survey blocks covered by SCANS-III and adjacent surveys (Ref. 6.127)[14]



[14] SCANS-III = pink lettered blocks surveyed by air; blue numbered blocks were surveyed by ship. Blocks coloured green to the south, west and north of Ireland were surveyed by the Irish ObSERVE project. Blocks coloured yellow were surveyed by the Faroe Islands as part of the North Atlantic Sightings Survey in 2015.

Plate 6.17: Distribution of harbour porpoise based on predicted Joint Cetacean Protocol harbour porpoise densities (animals per km^2) for winter 2010 (Ref. 6.128); the approximate location of the Sizewell C main development site is indicated by the red dot



6.4.24. Heinänen and Skov (2015 - Ref. 6.129) provide the results of detailed analyses of 18 years of Joint Cetacean Protocol survey data. The model results for the North Sea Management Unit indicate that most important factors for the probability of harbour porpoise presence in the North Sea Management Unit is water depth and hydrodynamic variables (Ref. 6.129). For water depth, higher densities of harbour porpoise are consistently found in depths of 30-50m. During the summer months, surface salinity and eddy potential are the important hydrodynamic determinants of presence, while stability of the temperate is the most important for the density. During the winter months, eddy activity is still of importance, while current speed has an effect. The presence of vessels is an important factor in the abundance and presence of harbour porpoise in the North Sea Management Unit, with a lowering of abundance when exposed to over 80 vessels per day within a 5 km^2 area (Ref. 6.129).

6.4.25. The modelled areas of persistent high densities within the North Sea Management Unit, based on the Joint Cetacean Protocol data as described above (Ref. 6.129) show that during the summer months, there is an area of high harbour porpoise persistent density offshore of the Norfolk Coast, with a high harbour porpoise persistent density located directly off the coast and offshore of the Sizewell C main development site in the winter (Ref. 6.129) (**Plate 6.18**).

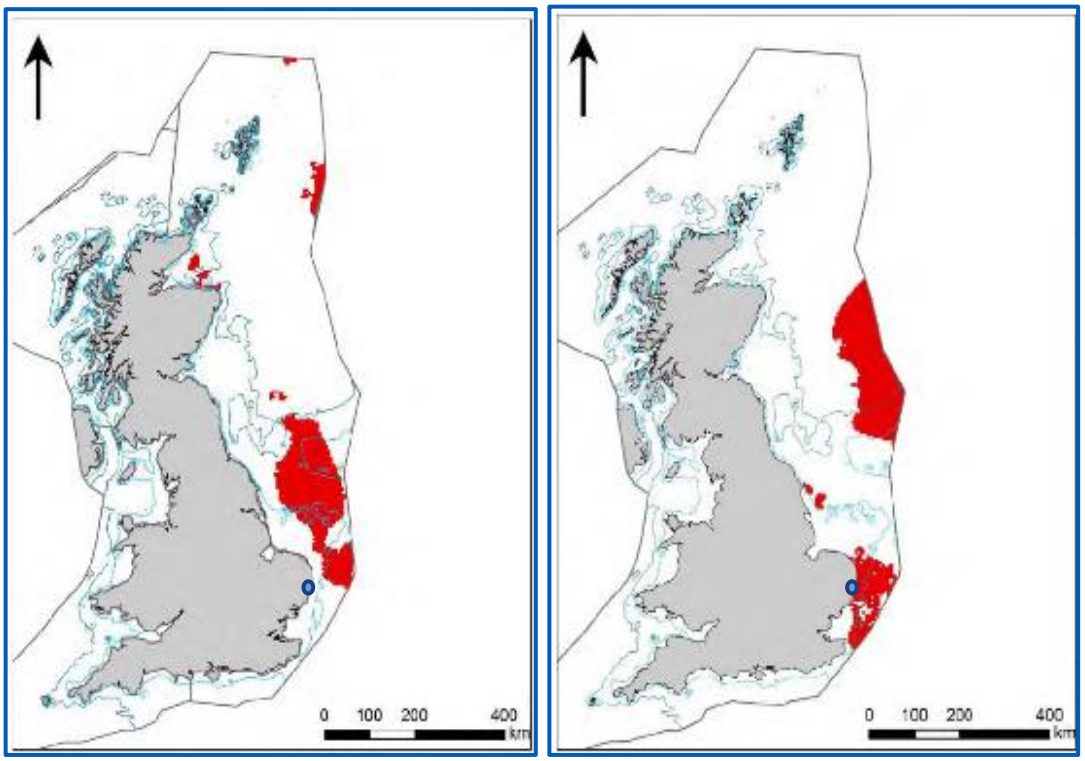
Marine mammal surveys

6.4.26. A number of Offshore Wind Farm projects are near to the Sizewell C main development site. These include the following (with the distance from closest point of the windfarm site to the Sizewell C main development site shown in brackets): Greater Gabbard Offshore Wind Farm (33 km), Galloper Wind Farm (34 km) and East Anglia TWO (31 km).

6.4.27. Site specific boat-based surveys for Greater Gabbard Offshore Wind Farm were undertaken for both seabirds and marine mammals from April 2004 to April 2006 (Ref. 6.130). A total of 166 harbour porpoise were recorded across 14 of the surveys (with none recorded in May or June 2004) (Ref. 6.130). The average encounter rate (which has not been adjusted for sea state) was reported as 0.04 per km (Ref. 6.130).

6.4.28. The Galloper Wind Farm boat-based surveys were undertaken from June 2008 to May 2011 for the wind farm site plus 4 km buffer, over 36 months. In total, 570 harbour porpoise were identified within that time, with peak sightings in April and May 2010 (n=156 and n=140 respectively) (Ref. 6.131). The reported encounter rate for the Galloper Wind Farm baseline surveys was highest in April and May 2010, with an encounter rate of 0.8 per km, however, the average rate was lower over the entire survey period, with a mean maximum encounter rate of 0.55 per km (Ref. 6.131).

Plate 6.18: Persistent high-density areas identified and selected in North West Scottish Waters Management Unit during the summer months; the red colours mark areas with where persistent high densities as defined by the upper 90th percentile have been identified (Ref. 6.129) and the approximate location of the Sizewell C Project is indicated by the blue dot



6.4.29. The East Anglia TWO aerial surveys, which covered the windfarm site and a 4km buffer, have so far been undertaken for the period of November 2015 to April 2016, September 2016 to October 2017 and May 2018. A total of 436 marine mammals were sighted within this period, with the majority being identified as either harbour porpoise or unidentified dolphin (n=352; 80.7%), with a further 15.5% being identified as harbour porpoise (n=69) (Ref. 6.132).

6.4.30. The Marine Aggregate Regional Environmental Assessment for the Outer Thames Region (MAREA) (Thames Estuary Dredging Association, 2010 - Ref. 6.133) investigated porpoise distribution within the outer Thames region. The Sizewell C main development site is located to the north of the study site. During the Thames Estuary Dredging Association surveys, the majority of porpoise sightings were recorded over the winter period. This increase in sightings suggests that there could be a seasonal increase in use of the outer Thames Estuary at this time, possibly in relation to increases in food abundance, such as spawning herring *Clupea harengus*.

6.4.31. Marine mammal sightings during recent winter geotechnical surveys in the Greater Sizewell Bay, support the higher levels of individuals within the offshore area, with sightings only on the edge and outside of the Sizewell-Dunwich sandbank to the southeast of the Sizewell C main development site. The surveys also suggest that harbour porpoise are not commonly present within the Greater Sizewell Bay, with sightings made on only 12% (5 out of 40) of the February to March survey days (Ref. 6.113).

6.4.32. An acoustic monitoring technique was used to study the presence of cetaceans within the Greater Sizewell Bay. Static acoustic loggers (C-PODs) were deployed over a period of 18 months, from September 2011 to March 2013, which were initially deployed at six locations, with further stations added at later dates. However, loss rates through this study were high due to local conditions and suspected human interference, some loggers also suffered from technical problems, the resultant data recovery rates impaired the options for data analysis, with a total of 37 months of data successfully collected from nine C-PODs (see Ref. 6.134 for more information).

6.4.33. Sufficient data was collected from these C-PODs to be able to provide some qualitative information on cetacean activity in the area. Harbour porpoise were detected on a total 64% of the monitoring days (414 days of a total of 745 days). Detections were consistently highest between October and March and lowest during the summer period, consistent with the known movements of harbour porpoise in the area. Detection rates were also higher during the night than the day, and the data indicated that harbour porpoise preferred offshore waters (see Ref. 6.134 for more information).

Diet and prey species

6.4.34. The distribution and occurrence of harbour porpoise is most likely to be related the availability and distribution of their prey species. For example, sandeels (*Ammodytidae*), which are known key prey for harbour porpoise, exhibit a strong association with particular surface sediments (Ref. 6.135).

6.4.35. The diet of the harbour porpoise consists of a wide variety of fish, including pelagic schooling fish, as well as demersal and benthic species, especially Gadoids, Clupeids and Ammodytes. Other prey species such as cephalopods, other molluscs, crustaceans and polychaetes have also been recorded. The diet varies geographically, seasonally and annually, reflecting changes in available food resources and differences in diet between sexes or age classes may also exist (Ref. 6.136; Ref. 6.137; Ref. 6.138; Ref. 6.139; Ref. 6.140; Ref. 6.141).

c) The Wash and North Norfolk Coast SAC

i. Harbour seal

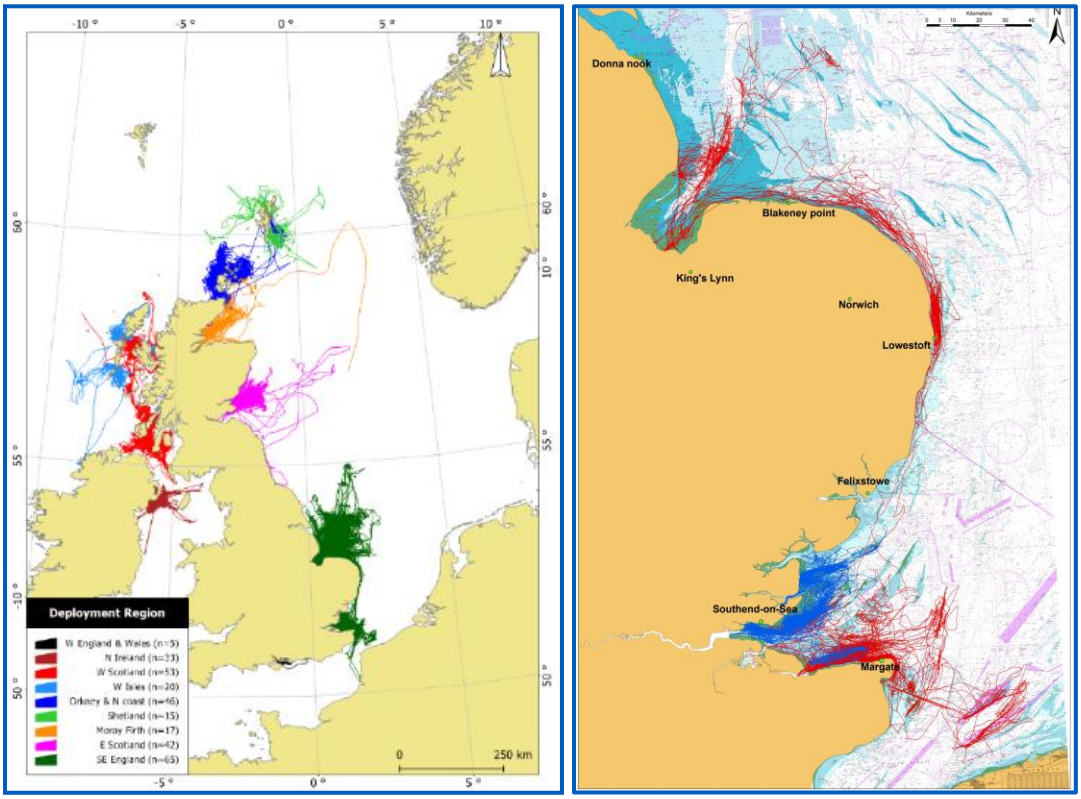
Distributions and abundance

6.4.36. Harbour seals are counted on land during their August moulting period, which gives a minimum population estimate. Combining the most recent counts available (2008-2016) gives a total count of 32,600 harbour seals in the UK (26,600 of which are in Scotland), and scaling this to reflect the number of seals missed by not being hauled-out, gives a total UK population estimate of 45,100 (95% CI = 37,000-60,400) in 2016 (Ref. 6.112).

6.4.37. The most recent harbour seal count (2011-2016) for the South-East of England Management Unit (which the proposed Sizewell C main development site is located within) is 4,965 (Ref. 6.11). This includes 3,200 seals at The Wash (the site within The Wash and North Norfolk Coast SAC), 694 in Essex and Kent, 399 at Blakeney Point, 290 at Donna Nook and 271 at Scroby Sands. **Plate 6.19**: shows the location of these harbour seal haul-out sites within the South-East of England Management Unit, and the most recent seal counts for each site.

6.4.38. The at-sea harbour seal mean total usage maps, produced by the Sea Mammal Research Unit (Ref. 4.5), show that the harbour seal usage is low in and around the Greater Sizewell Bay, with a harbour seal density of 0.039 per km^2 at the location of the proposed Sizewell C main development site (for the grid cells that intersect with the red line boundary), and of 0.011 per km^2 over the wider area (for the grid cells that intersect within a buffer distance of 25 km from the proposed Sizewell C main development site).

Plate 6.19: Telemetry tracks by deployment region for harbour seals aged one year or over between 2001 and 2012 [left] (Ref. 4.6); Harbour seal telemetry tracks from Marsh End Sand (blue) and Margate Sands (red) [right] (Ref. 4.7)



Movements

6.4.39. The Sea Mammal Research Unit, in collaboration with others, has deployed around 344 telemetry tags on harbour seals around the UK between 2001 and 2012 (Ref. 4.6). The tracks indicate that very few tagged harbour seals have been recorded in the area off Sizewell, with tracks moving in and out of the Wash and along the coast between the Wash and the Thames estuaries (**Plate 6.19**:).

6.4.40. A tagging study of harbour seals in the outer Thames Estuary also shows that there is connectivity between harbour seals that haul-out along the Kent coastlines with The Wash and North Norfolk Coast SAC population, with harbour seals passing along the coastline in proximity of the proposed Sizewell C main development site (**Plate 6.19**:; Ref. 4.7).

6.4.41. Barker *et al*. (2014 – Ref. 4.7) investigated the foraging areas of harbour seal that had been tagged within the Thames estuary. Kernal density analysis was used to identify those areas within the outer Thames estuary that could be

key foraging areas for harbour seal. The results show that while harbour seals show foraging activity across a large area, there are five key areas with greater levels of foraging activity (**Plate 6.20**:). The closest of these areas to the Sizewell C main development site is north-east Buxey Sand (area '1' in **Plate 6.20**:). This is approximately 70km from the Sizewell C main development site.

Haul-out sites

6.4.42. Harbour seals come ashore in sheltered waters, often on sandbanks and in estuaries, but also in rocky areas. Harbour seals haul out on land regularly in a pattern that is often related to the tidal cycle (Ref. 6.112).

6.4.43. Harbour seal give birth to their pups in June and July, having shed their white coat *in-utero*, and can swim almost immediately after birth (Ref. 6.112), and moult in August where they spend a higher proportion of their time on land than at other times (Ref. 6.112).

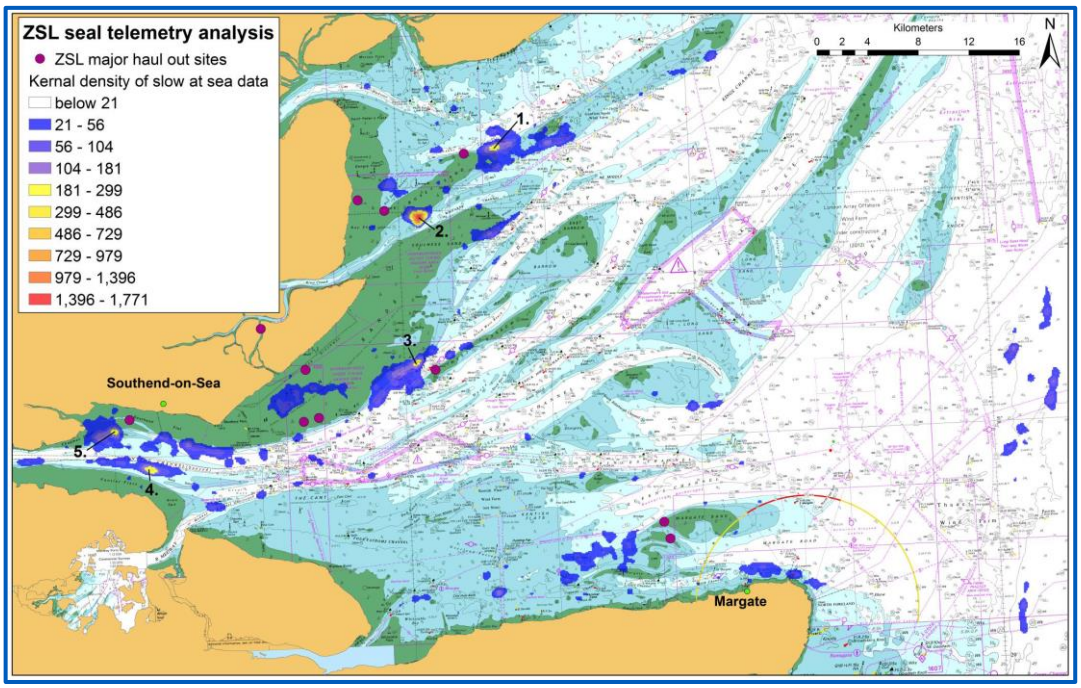
6.4.44. There principal harbour seal haul-out sites within the South-East England Management Unit (with the (swimming) distance to the Sizewell C main development site shown in brackets) are Scroby Sands (48km north), Blakeney Point (119km north), The Wash (168km north), Donna Nook (194km north) and the Essex haul-out sites including the Hamford Water sites (48 km south-west), Tillingham (77km south-west), Margate (88km south-west) and Goodwin Sands (100km south-west) (**Plate 6.21**).

6.4.45. The number of harbour seal at the Essex haul-out sites have been steadily increasing over recent years, from 137 individuals recorded in the 1996 to 1997 count, to 436 within the 2007 to 2011 count (Ref. 6.119), and 694 in the most recent 2016 count of the wider Thames estuary (Ref. 6.112).

Diet and prey species

6.4.46. Harbour seals generally make smaller foraging trips than grey seal, typically travelling 40 to 50km from their haul-out sites to foraging areas (Ref. 6.112). Tagging studies undertaken on harbour seal at The Wash have shown that this population will travel a larger distance for their foraging trips than for other harbour seal populations. Some individuals from The Wash travelled repeatedly over 200km to foraging areas, however there was a large variation in the distance travelled and the average was lower at 80km (Ref. 6.142).

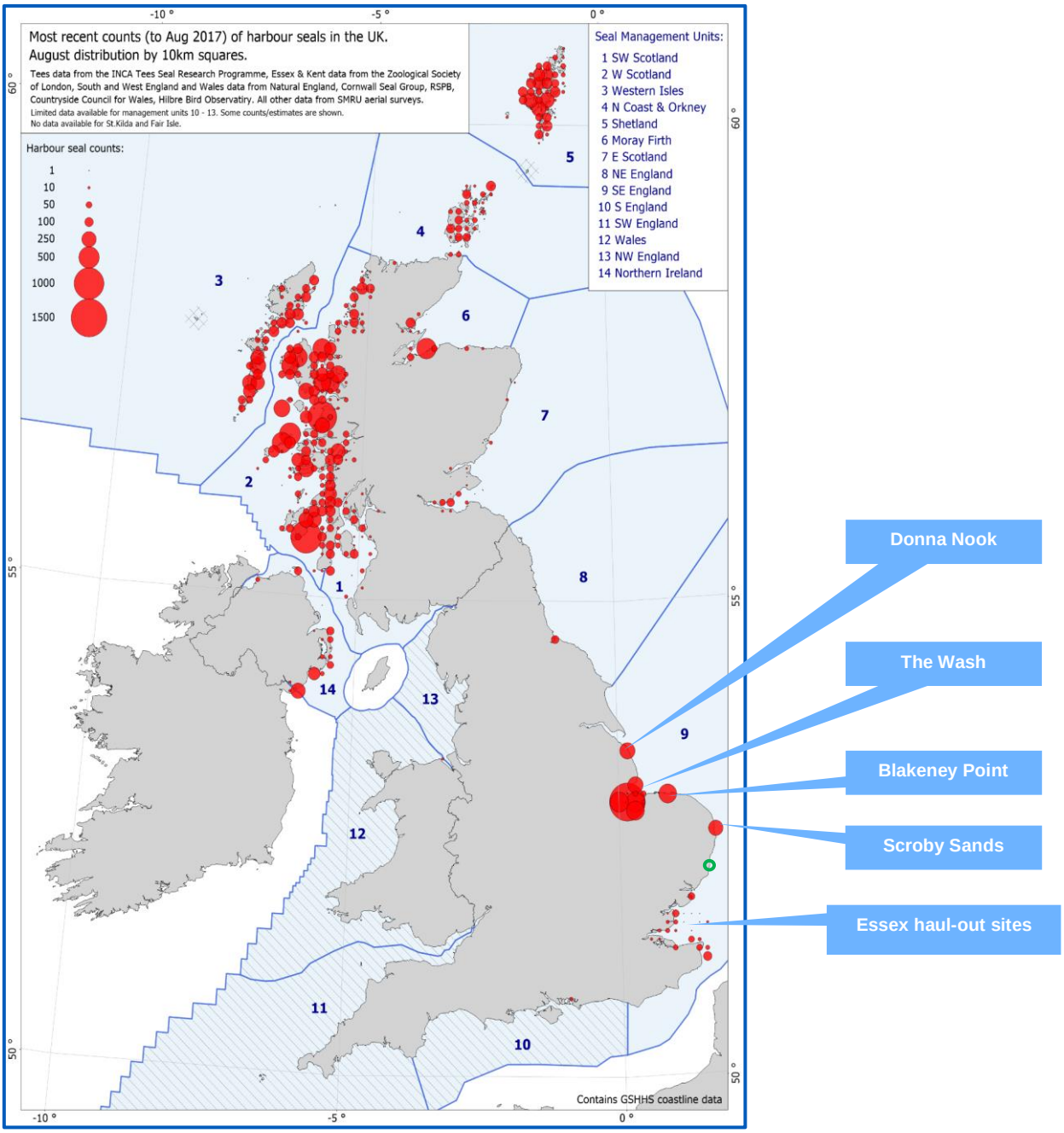
Plate 6.20: Major harbour seal foraging areas in the Thames Estuary, calculated when slow-at-sea kernel function was greater than 181km^2; the major foraging areas are - north east Buxey Sand (1), Whitaker Channel (2), West Swin Channel (3), north Yantlet Flats (4) and south Marsh End Sand (5), Ref. 4.7



6.4.47. Harbour seal take a wide variety of prey including sandeels, gadoids, herring and sprat *Sprattus sprattus*, flatfish and cephalopods. Diet varies seasonally and regionally; prey diversity and diet quality also showed some regional and seasonal variation (Ref. 6.118). It is estimated harbour seals eat 3-5kg per adult seal per day depending on the prey species (Ref. 6.112).

6.4.48. The Barker *et al*. (2014 – Ref. 4.7) study of harbour seal movements and foraging activity in the outer Thames Estuary found that the main prey found from the analysis of six harbour seal scats were; flounder, whiting, sprat and sandeel, further supporting evidence that harbour seal are generalist foragers and will prey upon a wide range of species, depending on what is readily available.

Plate 6.21: Location of the major harbour seal haul-out sites and the populations around the UK coasts (Ref. 6.112); the location of the Sizewell C Project is indicated by the green circle



d) Summary of reference populations and density estimates

6.4.49. **Table 6.22**: summarises the reference populations and density estimates that have been used to inform the Appropriate Assessment for harbour porpoise, grey seal and harbour seal.

Table 6.22: Reference populations and density estimates to inform the Appropriate Assessment for marine mammals

Species	Density Estimate (per km^2)	Reference Population
Harbour porpoise	0.607 per km^2 (SCANS-III Block L; Ref. 6.127)	345,373 (North Sea Management Unit population estimate based on SCANS-III; Ref. 6.127)
Grey seal	0.038 per km^2 (wider area estimates as the worst-case; calculated from Ref. 4.5)	8,716 (South-East England Management Unit; Ref. 6.112) 6,526 grey seal based on the latest available count at the Donna Nook haul-out site (Ref. 6.112)
Harbour seal	0.039 per km^2 (wider area estimate as the highest density; calculated from Ref. 4.5)	4,965 (South-East England Management Unit; Ref. 6.112) 3,609 harbour seal based on the latest available count at The Wash and Blakeney Point haul-out sites (Ref. 6.112)

6.5 Fish

6.5.1. This section provides baseline information on fish populations that are prey to piscivorous birds and marine mammals; effects on prey species could affect piscivorous birds and marine mammals supported by the European sites screened into this assessment.

6.5.2. This section also provides baseline information for the Humber Estuary SAC for which migratory fish species are a qualifying feature that could be affected by the Sizewell C Project.

a) Humber Estuary SAC

i. River and sea lamprey

6.5.3. River lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* are present within the Humber Estuary SAC as a qualifying feature but not a

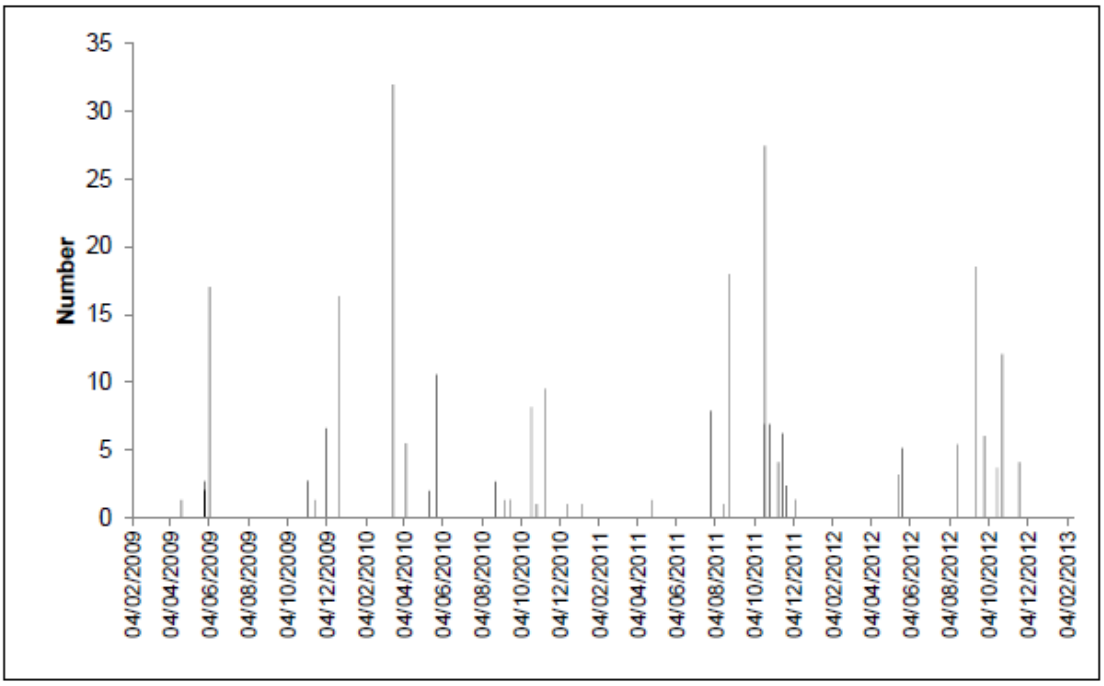
primary reason for site selection. The *Natura 2000* standard data form (Ref. 6.143) recorded the population of sea lamprey as between 251 – 500 individuals. There is no population record for river lamprey.

6.5.4. Full details of the data collected for river and sea lamprey is included in BEEMS Technical Report TR345 (Ref. 6.64) and is based on data collected during impingement sampling from the Sizewell B cooling water system and from a series of coastal fishing surveys.

6.5.5. River lamprey were present in 32% of the impingement samples, but the species was not abundant (only 269 individuals out of the approximately 1.5 million fish impinged during the 125 sampling operations). Apart from March 2010, when more than 30 river lampreys were caught in a single 24-hour sample, the majority of river lampreys were recorded between October and December, possibly reflecting the downward migration into the estuarine/coastal environment (**Plate 6.22**). No sea lampreys were impinged.

6.5.6. Lampreys were similarly rare in impingement sampling conducted for the Sizewell A power station between May 1981 and April 1982 (Ref. 6.144). Forty-one 24h samples were collected and only three sea lampreys were observed, and no river lampreys. The sea lampreys were caught on three separate occasions (two visits in June 2981, one visit in April 2982), and all were small less than or equal to 23g. A single (unidentified) lamprey was captured in June 2010 in the 2 m beam trawl, between Sizewell and Thorpeness. Considering the regular impingement of river lampreys in 2009-2012, but no recordings of sea lampreys, this specimen was likely a river lamprey, though information on their distribution in the estuarine/coastal environment is sparse (Ref. 6.145).

Plate 6.22: Numbers of river lamprey impinged during 125 x 24h sampling occasions at Sizewell B nuclear power station between February 2009 and February 2013 (Ref. 6.64)



b) Prey species for piscivorous birds and marine mammals

i. Introduction

6.5.7. This section provides baseline information on the fish populations that are prey to the qualifying piscivorous birds and marine mammals described above. It provides a summary of the fish populations found within the Greater Sizewell Bay area. Full details of the data collected and its analysis are included in BEEMS Technical Report TR345 (Ref. 6.64), which provides a comprehensive study of the fish fauna of the Greater Sizewell Bay area based on data collected during impingement sampling from the Sizewell B cooling water system and from a series of coastal fishing surveys. The datasets used within the report are as follows:

- Impingement sampling at Sizewell B between February 2009 and February 2013.
- Ten demersal fishing surveys carried out over a 4-year period; quarterly in 2008, once each in June 2009 and June 2010, and quarterly between June 2011 and March 2012. Sampling was conducted using two different fishing gears – a 2m beam trawl and a commercial otter trawl.
- A coastal pelagic fish survey carried out in March and June 2015.

- Additional information from sources such as sampling undertaken during the operation of the Sizewell A station, characterisation studies for other marine developments in the local area, inshore fishing surveys off the Suffolk coast and international stock assessments.

6.5.8. A total of 88 fish taxa were identified in the Greater Sizewell Bay area. Forty species were identified in the 2m beam trawl catches, 25 in the commercial otter trawl catches and 71 species were identified during impingement sampling. This is a likely reflection of the differences in sampling effort, with more sampling during the impingement programme increasing the likelihood of encountering less abundant taxa.

ii. Demersal community

6.5.9. Of the demersal species recorded, Dover sole *Solea solea* and whiting were most frequent in the impingement dataset, occurring in over 90% and 96% of the impingement samples, respectively. Gobies, dab *Limanda limanda* and flounder *Platichthys flesus* were also generally common and all three taxa were recorded in over 90% of the impingement samples. Other demersal species occurring in more than 80% of the impingement samples were Nilsson's pipefish *Sygnathus rostellatus*, lesser weever *Trachinus vipera* and bass *Dicentrarchus labrax*.

6.5.10. In the offshore samples, Dover sole was the most commonly occurring species overall, present in 68% of beam trawls and all the otter trawl samples. Whiting was found in a third of the beam trawls and 60% of the otter trawls. Gobies, dab and flounder were also generally common; dab were recorded in two thirds of otter trawls and 13% of beam trawls, gobies in nearly half of the beam trawls and flounder in 75% of the otter trawls. Thornback rays *Raja clavata*, were common in the otter trawls, being found in 75%, though they were rarely captured in the beam trawls.

6.5.11. Cephalopods were not common in either the offshore or onshore samples. Only a single species (the European common squid *Alloteuthis subulata*) was recorded in the coastal surveys; and it occurred in only 17 and 7 of the beam and otter trawl samples, respectively. Four species were impinged by Sizewell B, namely the little cuttlefish *Sepiola atlantica*, the European common squid, the cuttlefish *Sepia officinalis* and the common squid *Loligo vulgaris*, but only the little cuttlefish was present in more than 30% of the samples.

6.5.12. Of the demersal species in the impingement sampling, the four most abundant species were whiting (11% by abundance), bass (9%), sand gobies (4%) and Dover sole (2%). Both bass and the thin-lipped grey mullet *Liza ramada* were impinged in reasonably large numbers but were not a key feature of the coastal surveys. However, the abundance of bass is seasonal

with the majority of catches in the impingement dataset being made in the winter months.

6.5.13. In the offshore surveys, Dover sole dominated overall, accounting for 28% and 39% of all fish caught in the 2 m beam trawls in the original (2008 – 2010) and expanded (2011 - 2012) survey series and 48% and 25% in the otter trawl in the original and expanded series, respectively. Gobies were also highly abundant in the beam trawls (39% and 22% by abundance of the original and expanded survey series), but were not abundant in the otter trawl surveys, due to the large mesh size of the gear and small body size of the individuals. Whiting contributed 3% and 11% respectively, to the abundance of beam trawl samples in the original and extended survey areas. In the otter trawls, flounder, dab and thornback rays were also highly abundant.

6.5.14. Statistical analysis shows that there is very little evidence of consistent spatial patterns over time in the demersal fish community and that the species mix found at each site changed over time but not in a predictable way, suggesting that the fish of the Greater Sizewell Bay form one large homogenous community.

iii. Pelagic community

6.5.15. The sampling gear used to characterise the demersal fish community may catch pelagic fish, particularly during deployment and retrieval; however, that gear is not specifically designed for this purpose. During the demersal surveys, the following species were recorded:

- Atlantic herring *Clupea harengus.*
- European sprat Sprattus sprattus.
- anchovy Engraulis encrasicolus.
- mackerel Scomber scombrus.
- horse mackerel (scad) *Trachurus trachurus.*
- pilchard Sardina pilchardus.

6.5.16. All six species were recorded in the Sizewell B impingement monitoring; collectively, they accounted for approximately 65% of the total numbers of fish caught, suggesting pelagics are common in the Greater Sizewell Bay area. Sprat was the most abundant, at 49% of the total fish catch, then herring at 16%.

6.5.17. From the acoustic data, pelagic fish were more abundant in waters further north off Minsmere than around Sizewell itself, although good numbers were

found at Sizewell throughout the year. The fish appeared to aggregate in larger schools mainly at the edge of sandbanks during the winter and during the summer were more evenly distributed across the area, although highest densities were consistently found more offshore. Schools were denser and smaller during the summer and although variable between surveys and subareas, more than half of the pelagic fish biomass was found in the near surface waters (2-5m depth).

6.5.18. Analysis carried out for the East Anglia ONE offshore wind farm surveys of winter 2010/2011 (Ref. 6.146) suggests that while the species present in the Greater Sizewell Bay mirror those found in the wider offshore region, there may be differences in relative distribution, at least at certain times of year. Anchovy was much more dominant in the wider region than in the Sizewell-specific data, comprising 29% of the total catch (including non-target species) versus less than 1% of the Sizewell impingement catch, while at 14% offshore versus 49% in the Sizewell catch, sprat was much less prevalent. Pilchard was also more prevalent in the wider region, at least in November 2010. Only two pelagic species were caught in the February 2011 East Anglia ONE survey - sprat, which dominated the catch (more similarly to the Sizewell data), and anchovy.

6.5.19. On the basis of this evidence, herring and sprat are the most widespread pelagic fish species around the Greater Sizewell Bay.

iv. Prey and temperature

6.5.20. Important prey species for marine mammals and marine birds include sandeels, whiting, Atlantic herring and European sprat. Sandeel and herring have been found to occur in sea temperatures of up to 24°C (Ref. 6.147; Ref. 6.148); however, are most likely to be in areas with temperatures ranging from 8.5°C and 9.5°C and 9°C and 11°C respectively (Ref. 6.149; Ref. 6.150). Whiting are most likely found in sea temperatures of 6 to 9°C (Ref. 6.151, *cited in* Ref. 6.152) and sprat between 8°C and 14°C (Ref. 6.153).

6.5.21. Other marine mammal prey species include cod, saithe, haddock, plaice and Dover sole. Cod are predominately found in water temperatures of 7 to 15°C (Ref. 6.154) and have been found to avoid temperatures of above 15°C (Ref. 6.155). The preferred temperature range for haddock and saithe is 11.3°C to 16.1°C and 10.7°C to 16.1°C, respectively (Ref. 6.156). Juvenile plaice have been found to tolerate temperatures ranging up to 20°C (Ref. 6.157 *cited in* Ref. 6.158) and, in the Thames Estuary, 14.17°C is reported as the optimal temperature for growth of adult sole (Ref. 6.159 cited in Ref. 6.148).

6.5.22. As is evident from the survey data presented above, whiting, Atlantic herring and European sprat are common in Greater Sizewell Bay.

7 Information for Appropriate Assessment: Coastal, Freshwater and Terrestrial Habitats

7.1 Introduction

7.1.1. The information required for Appropriate Assessment of the predicted effects of the Sizewell C Project, alone and in-combination, on the SACs and Ramsar sites screened in for coastal, freshwater and terrestrial habitats is presented below. This chapter also considers potential effects on the great crested newts of Dew's Pond, but effects on birds, marine mammals and fish are assessed in the chapters that follow.

7.1.2. Predicted effects are considered for the construction, operation and decommissioning phases of the Sizewell C Project for each European site and relevant qualifying feature in turn (sections 7.4 to 7.9 of this report). Where appropriate (e.g. where a project element would remain operational, such as the two village bypass), the absence of effects in the decommissioning phase is referenced.

7.1.3. Sections 7.2 and 7.3 of this report provide context for the assessment by setting out the applicable generic conservation objectives for the SACs considered and the predicted effects associated with coastal process changes (due to the proposed coastal defences, BLF, cooling water system, FRR system and the CDO) across the wider study area.

7.1.4. The following table sets out the structure of this section to assist in navigation.

SECTION 7: COASTAL, FRESHWATER AND TERRESTRIAL HABITATS	
7.1	**Introduction**
7.2	**Generic conservation objectives**
7.3	**Potential overarching coastal process effects**
a)	Introduction
b)	Construction and operation of coastal defences
c)	Construction and operation of a BLF
d)	Construction and operation of the cooling water infrastructure
e)	Construction and operation of the FRR and CDO
7.4	**Assessment of effects: Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuaries Ramsar site**
a)	Summary of screening outcomes
b)	'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia)
i.	Alteration of coastal processes / sediment transport

SECTION 7: COASTAL, FRESHWATER AND TERRESTRIAL HABITATS	
ii.	Water quality effects – marine environment
iii.	Water quality effects – terrestrial environment
iv.	Alteration of local hydrology and hydrogeology
v.	Changes in air quality
c)	Ramsar criterion 2
i.	Coastal process, water quality, hydrology and hydrogeology and air quality effects
ii.	Disturbance due to an increase in recreational pressure
d)	Summary of alone effects for the European sites
e)	In-combination effects for the European site
i.	Introduction
ii.	Water quality effects – marine environment
iii.	Alteration of coastal processes / sediment transport
7.5	**Assessment of effects: Benacre to Easton Bavents Lagoons SAC**
a)	Summary of screening outcomes
b)	Coastal lagoons
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
c)	Summary of alone effects for the European site
d)	In-combination effects for the European site
i.	Water quality effects – marine environment
ii.	Alteration of coastal processes / sediment transport
7.6	**Assessment of effects: Dew's Ponds SAC**
a)	Summary of screening outcomes
b)	Great crested newt
i.	Alteration of local hydrology and hydrogeology
c)	Summary of alone effects for the European site
d)	In-combination effects for the European site
7.7	**Assessment of effects: Minsmere to Walberswick Heaths and Marshes SAC**
a)	Summary of screening outcomes
b)	European dry heaths
i.	Changes in air quality
ii.	Disturbance due to increase in recreational pressure
c)	Annual vegetation of drift lines and perennial vegetation of stony banks

SECTION 7: COASTAL, FRESHWATER AND TERRESTRIAL HABITATS	
i.	Alteration of coastal processes/sediment transport
ii.	Water quality effects – marine environment
iii.	Changes in air quality
iv.	Disturbance due to increase in recreational pressure
d)	Summary of alone effects for the European site
e)	In-combination effects for the European site
i.	Water quality effects – marine environment
ii.	Alteration of coastal processes / sediment transport
iii.	Disturbance due to an increase in recreational pressure
7.8	**Assessment of effects: Minsmere-Walberswick Ramsar site**
a)	Summary of screening outcomes
b)	Ramsar criterion 1 and criterion 2
i.	Alteration of coastal processes/sediment transport
ii.	Water quality effects – marine environment
iii.	Alteration of local hydrology and hydrogeology
iv.	Water quality effects – terrestrial environment
v.	Changes in air quality
vi.	Disturbance due to increase in recreational pressure
c)	Summary of alone effects for the European site
d)	In-combination effects for the European site
i.	Water quality effects – marine environment
i.	Alteration of coastal processes / sediment transport
ii.	Disturbance due to an increase in recreational pressure
7.9	**Assessment of effects: Orfordness to Shingle Street SAC**
a)	Summary of screening outcomes
b)	Coastal lagoons
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Changes in air quality
c)	Annual vegetation of drift lines and perennial vegetation of stony banks
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Changes in air quality
iv.	Disturbance due to increase in recreational pressure

SECTION 7: COASTAL, FRESHWATER AND TERRESTRIAL HABITATS	
d)	Summary of alone effects for the European site
e)	In-combination effects for the European site
i.	Water quality effects – marine environment
i.	Alteration of coastal processes / sediment transport

7.2 Generic conservation objectives

7.2.1. The following generic conservation objectives apply to all SACs considered within this section:

- With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'qualifying features'), and subject to natural change;
- Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring;
- the extent and distribution of qualifying natural habitats and habitats of qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of qualifying species; and
- the distribution of qualifying species within the site.

7.2.2. For Ramsar sites, as the provisions of the Habitats Regulations relating to HRAs extend to Ramsar sites, Natural England considers that the conservation advice packages for the overlapping European site designations (i.e. SACs and SPAs) to be, in most cases, sufficient to support the management of the Ramsar interests. Hence Defra and Natural England have not produced separate conservation advice packages for Ramsar sites.

7.2.3. For certain SACs and qualifying features, supplementary advice on the generic conservation objectives has been produced by Natural England.

7.3 Potential overarching coastal process effects

a) Introduction

7.3.1. Four elements of the Sizewell C Project could cause potential construction and operational phase effects to arise for the coastal processes of and sediment transport in the screened in European sites and qualifying features, as follows:

- coastal defences;
- BLF;
- cooling water intakes and outfalls; and
- FRR system and CDO.

7.3.2. These are described and considered in turn below.

b) Construction and operation of coastal defences

7.3.3. Two coastal defences would be constructed, comprising a fronting coastal defence (5m-elevation sacrificial berm) immediately behind the beach, and a main set-back defence protecting the main power station platform from flooding.

i. Construction and operation of the main defence

7.3.4. The main defence would be set back from the coast, meaning that it is unlikely to be exposed to coastal processes during its construction. It is not envisaged that the coastal defences would be decommissioned once in place, as they would have an important role in defending the operational power station and, ultimately, the decommissioned power station site.

ii. Construction of the sacrificial berm

7.3.5. The fronting berm would be constructed from materials delivered to the site and then landscaped and planted for erosion resistance. It would be sacrificial and not initially in the marine environment, although it could be partially eroded during storms. BEEMS Technical Report TR311 (Ref. 6.1) estimated the berm would have a life of several decades before it is depleted though ongoing erosion.

7.3.6. The delivery of materials and subsequent landscaping would be mainly completed from the land side with no marine effects. However, vehicles would need to access the beach to place and landscape sediment near to mean high water spring (MHWS) tide. The use of vehicles would cause local

compaction of beach sediments, temporarily increasing their resistance to erosion. The depth of compaction would be less than the natural variability in the beach elevation. Hence, the effect of construction of the sacrificial berm on coastal processes and sediment transport would be local and not significant. An adverse effect would not arise for the screened in European sites and qualifying features due to construction of the sacrificial berm, because they are too far away to be affected by the local changes predicted.

iii. Operation of the sacrificial berm

7.3.7. Operation of the sacrificial berm would change the beach profile above MHWS tide and increase the beach volume around that elevation. BEEMS Technical Report TR311 (Ref. 6.1) predicts that the larger back-beach volume would slow the rate of coastal erosion and relatively small volumes of additional sediment would occasionally be introduced into the coastal system during storms. The extra supply of sediment would have little effect on coastal processes and sediment transport because the volumes are small and would be effectively dispersed during each erosion event. Hence, there would be no effect on the screened in European sites and qualifying features from operation of the sacrificial berm, because they are too far away to be affected by the local changes.

c) Construction and operation of a Beach Landing Facility

7.3.8. The BLF would be constructed across the intertidal and nearshore subtidal zones to receive deliveries by sea throughout the construction and also the operational life of the power station. The BLF would be 176m long (from the main defence) and consist of an 85m-long piled platform (with an additional 11m of fenders and ramp) with the seaward 36.5m being seaward of MHWS. The seaward four pile pairs would be within the marine environment below MHWS tide. During operation, the deck would be removed, but the piles would be left in place.

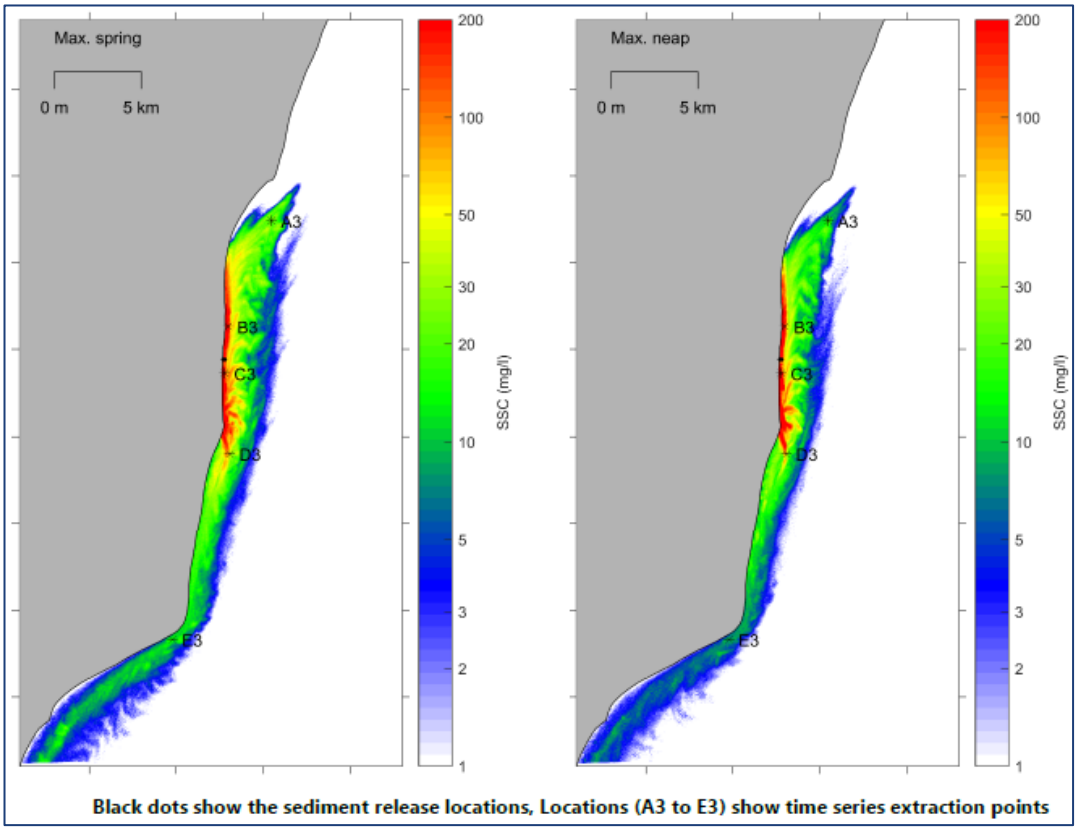
i. Capital dredging and piling

7.3.9. Nearshore capital dredging would be required to excavate the BLF and through the longshore bars to allow navigational access. The proposed dredging would use a plough dredger, which involves the mechanical agitation of the sea bed with the potential for development of a plume of suspended sediment. The total area dredged would be approximately 9,000m^2 with a dredge volume of 4,600m^3 released over a period of just over two days. Sediment would not be removed from the transport system, meaning that no supply is lost from the local sediment pathways (**Plate 7.1** and **Plate 7.2**).

7.3.10. BEEMS Technical Report TR480 (Ref. 7.1) using Delft3d to simulate the potential effect of nearshore dredging on SSC over a 15-day period. The model predicted that the plume created during dredging of the BLF approach channel would be confined to the nearshore and would extend north-south along the coast. The maximum SSC predicted at any time during the simulation would be greater than 100 mg/l above background extending along the coast for 5km to the north and south. Following the completion of dredging the suspended sediment is predicted to rapidly disperse, and concentrations would return close to background levels (less than 20 mg/l) within four days. Modelling of maintenance dredging of the BLF predicts a similar elongate form to the plume but with lower concentrations as a result of the much lower volume of sediment release.

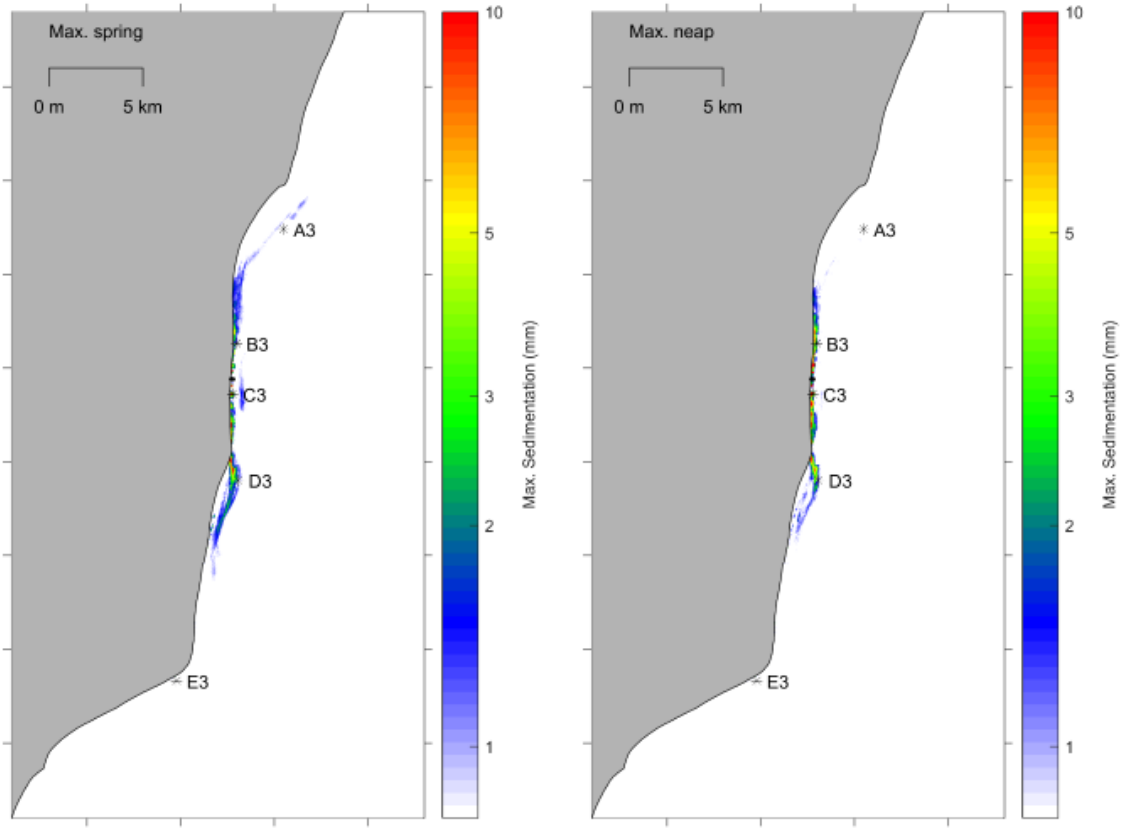
7.3.11. The plume sediment is predicted to deposit on the sea bed over a relatively small area close to the coast (Ref. 7.1). The maximum sediment deposition thickness is predicted to be approximately 20mm, with typical values less than 2mm. Bedload sediment remaining on the sea bed after dredging is predicted to deposit (up to 10mm) in shallow nearshore areas where tidal current velocities are not high enough to re-erode it. This sediment would be redistributed and mixed with beach sediment under wave activity. Deposits less than 2mm are predicted to occur only in local areas after maintenance dredging.

Plate 7.1: Maximum depth-averaged suspended sediment concentrations associated with capital dredging for the BLF on spring (left) and neap (right) tides



Black dots show the sediment release locations, Locations (A3 to E3) show time series extraction points

Plate 7.2: Maximum deposition associated with capital dredging for the BLF on spring (left) and neap (right) tides



Black dots show the sediment release locations, Locations (A3 to E3) show time series extraction points

7.3.12. The landward sections of the BLF jetty would be constructed by a piling machine operating from land but would likely require vehicles to drive over the intertidal and subtidal areas. These vehicles would cause local disturbance of the beach through compaction which would temporarily increase its resistance to erosion. The depth of compaction would be much less than the natural variability in the beach elevation.

7.3.13. The marine piling would be undertaken using a jack-up barge or similar. Piling may slightly increase SSC in the water column through release of drill arisings, but the potential volumes are so small (up to 18m^3 per pile) they would not be detectable above background conditions (Ref. 6.1).

7.3.14. Dredging and piling of the approach channel to the BLF would create a worst-case suspended sediment plume that would be relatively widespread along the coast but would be short-lived (up to four days before dispersion reduces it to background concentrations). Deposition from the plume would be local to the point of dredging with typical thicknesses less than 2mm. Hence, dredging of the construction of the BLF would not have an effect on the screened in European sites and qualifying features from a coastal process

perspective. Note that potential effects on marine mammals, birds and fish are considered in the following chapters.

ii. Operation of the Beach Landing Facility

7.3.15. During operation, the low density spacing of the piles means that the BLF jetty would allow passage of water and sediment across it, and the effect on currents and waves would be minimal. BEEMS Technical Report TR311 (Ref. 6.1) simulated the effect of the BLF piles on waves, currents and bed shear stress using the ARTEMIS and TELEMAC2D models. The models predicted that scour effects around the piles during a peak spring tidal current (no waves) would affect 186m^2 of sea bed and for a peak tidal current during a storm surge event would affect 852m^2. BEEMS Technical Report TR311 (Ref. 6.1) further predicted that during 0.2- and 20-year return period wave events, waves would act to backfill the scour pits with sediment.

7.3.16. For a scenario when the BLF is not in use (i.e. using existing bathymetry), the models predicted only slight interruption to tidal current flows. In deeper water, a small decrease in current velocities is predicted in the lee of the piles up to a maximum distance of 45m away. Closer to the coast the effects are predicted to be smaller, due to the lower current velocities. The predicted changes in wave energy are also small, with a maximum increase of 20% and a maximum decrease of 17%. The area over which the predicted change is greater than 5% is small (65m alongshore, 115m cross-shore, area of 1,130m^2). The BLF effect on combined wave and current bed shear stress is predicted to be small, with the highest changes (14%) occurring nearer to the coast where the piles are closer and interact with each other. The area of sea bed where the bed shear stress changes by more 5% is about 60m long and 110m wide (area of 937 m^2).

7.3.17. For a scenario when the BLF is in use (i.e. with a dredged area for navigational access) the bathymetry was lowered by up to 1.9m (outer longshore bar). The models predicted a local reduction in current velocities of 0.11 m/s within the confines of the dredging. Smaller changes are predicted up 360m away from the dredged area. The peak increase in wave energy is predicted to be approximately 150%, although this is for a small area of around 500m^2. The area of sea bed where the predicted change in wave energy is greater than 5% is about 22,500m^2 over 400m alongshore. Maximum predicted increases and decreases of combined wave and current bed shear stress are approximately 80% and 47%, respectively. The area of sea bed where the predicted change in bed shear stress is greater than 5% is about 20,290m^2 over about a 410m frontage.

7.3.18. Given the small areas predicted to be affected by the BLF piles with respect to tidal currents, waves and bed shear stress, the operation of the BLF would

not have an effect on the screened in European sites and qualifying features from a coastal process perspective.

d) Construction and operation of the cooling water infrastructure

7.3.19. The cooling water infrastructure in the marine environment would comprise six vertical shafts (four intakes, two outfalls) driven to connect the headworks to three tunnels (drilled from land) offshore of Sizewell-Dunwich Bank. The top of each headwork would be 4m above the sea bed and would have scour protection. Installation of headworks would require dredging of the topmost sand followed by drilling through the underlying bedrock.

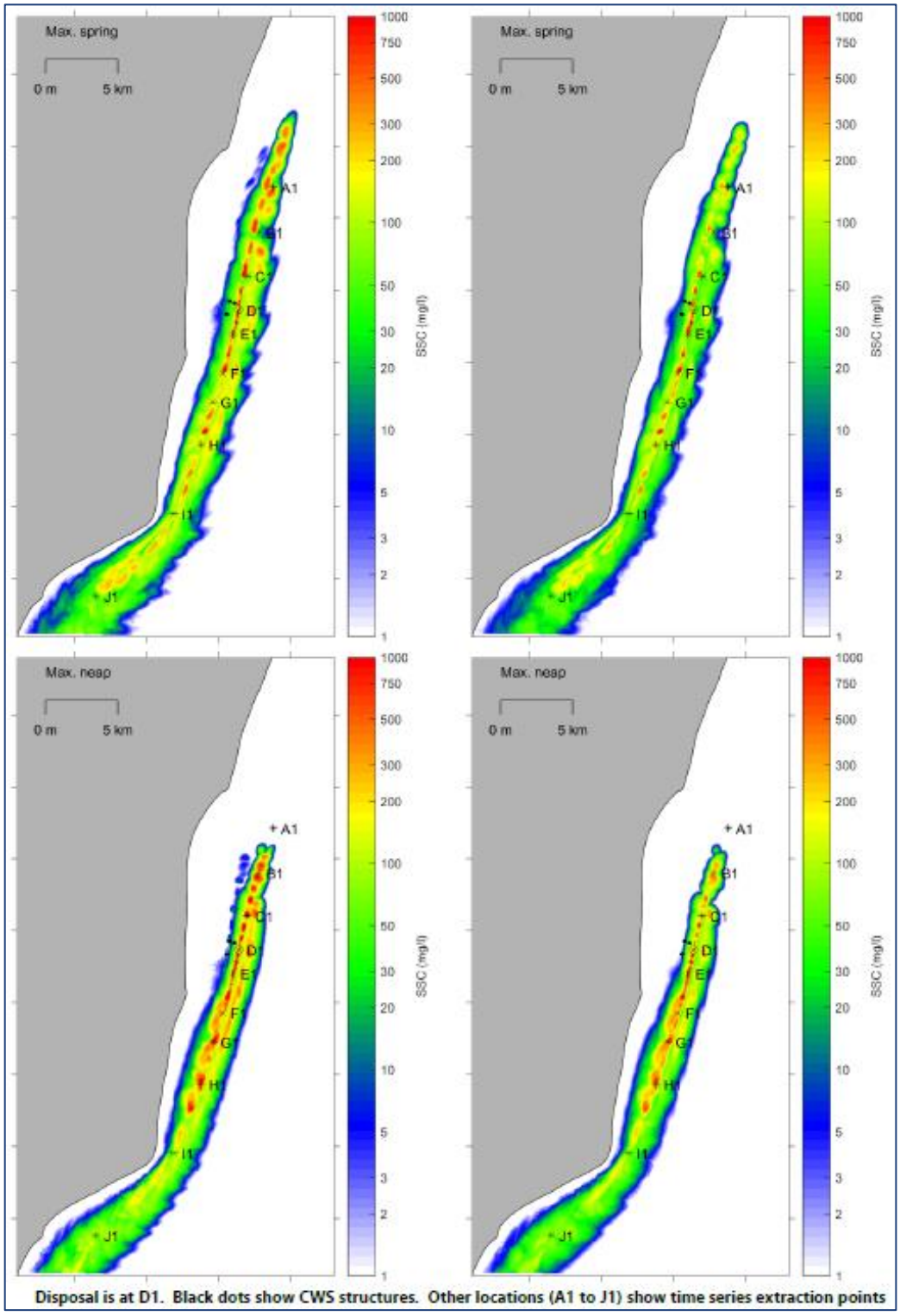
i. Dredging and drilling

7.3.20. A cutter suction dredge of approximately 93,100m^3 would be required for installation of the intakes (4 x 17,400m^3) and outfalls (2 x 11,750m^3). A local disposal of dredged surficial sediment has been assessed as a worst case, with dredge arisings discharged through a pipe within the application boundary approximately 500m from the dredge site. BEEMS Technical Report TR480 (Ref. 7.1) used Delft3D to simulate potential increases in SSC through consecutive dredging of all four intakes and both outfalls (about 8.5 hours in total) over a 15-day spring-neap period.

7.3.21. The sediment plumes arising from dredging either of the two outfall locations will not differ significantly, with most of the sediment plume resulting from disposal (which is assumed to be at a single location for all structures) and with only a small sediment disturbance at the dredger itself. Similarly, the sediment plume will not differ significantly between the dredging of each intake structure. The dredging of the most inshore outfall and the most southerly and inshore intake was simulated in the model.

7.3.22. Maximum depth-averaged SSC are predicted to be greater than 100 mg/l at any time during the simulation extending about 13km to the north, 22km to the south and several kilometres east-west during a spring tide (**Plate 7.3**). The plume is predicted to be offshore with no elevated concentrations at the coast. The plume is predicted to be relatively short lived with returns to levels lower than 20 mg/l within two days after the completion of the disposal operations on spring tides.

Plate 7.3: Maximum depth-averaged suspended sediment concentrations associated with dredging the most southerly and inshore intake (left) and the most inshore outfall (right) on spring and neap tides



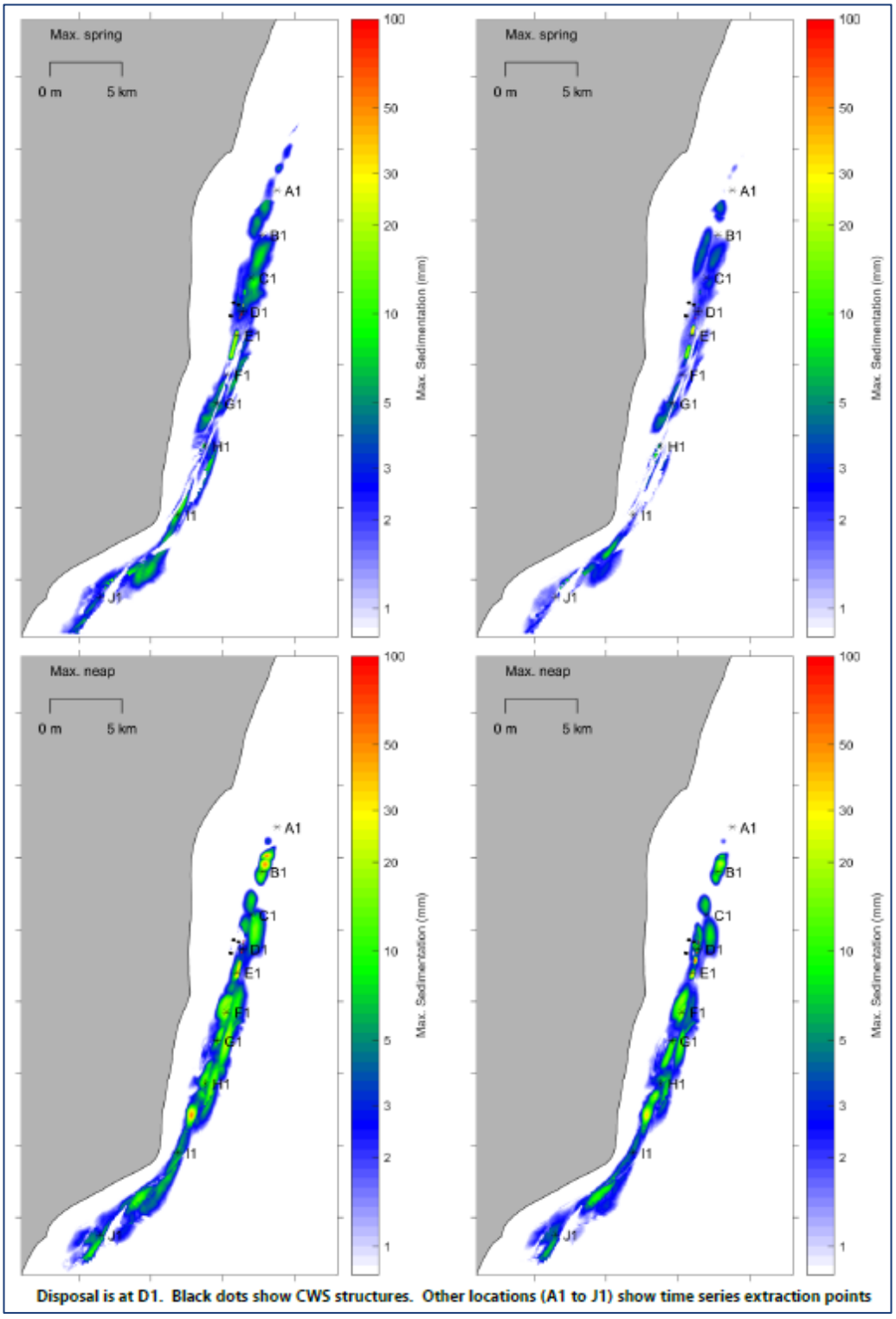
7.3.23. Deposits of more than 1000mm thickness only occur in two of the 50m x 50m model grid cells when the dredge is started on neap tides (i.e. over an area of 0.5ha). When the dredge is started on spring tides, the maximum thickness of deposit does not exceed 1000mm in any model grid cell. Deposition reduces to about 10mm about 1km away. Sediment (medium sand) that remains on the sea bed after dredging would be less than 3mm thick (**Plate 7.4**).

7.3.24. Once the dredging has been completed, drilling through bedrock would allow connection of the intake/outfall headworks to the tunnels. Modelling of the plume from the drill arisings predicted a narrow elongate plume with maximum SSC at any time during the simulation of less than 10 mg/l with temporary deposition of less than 1mm (Ref. 7.1). The plume is predicted to be offshore with no elevated concentrations at the coast. Following completion of the drilling, the bedrock plume would disperse with no plume remaining after 17 hours.

7.3.25. A mound of coarse sediment would be expected to settle close to the drill site. The mound footprint would depend on the release height of the drill arisings, which is not currently known. A release at the surface is predicted to result in a mound extending up to 60m from the drill location for the coarsest fractions (greater than 10mm), while the less coarse fractions (around 1mm) would settle within 200m (Ref. 7.1). The mound thickness is predicted to be centimetres to tens of centimetres.

7.3.26. Construction of the cooling water infrastructure would create a worst-case suspended sediment plume during disposal that would be elongate along the nearshore zone but would be short-lived (up to two days before dispersion reduces it to background concentrations). It would also occur remotely from the coast. Deposition from the plume would be local to the point of dredging with maximum thicknesses up to 10mm about 1km away from the point of disposal. Hence, with respect to coastal processes, construction of the cooling water infrastructure would have no effect on the screened in European sites and qualifying features.

Plate 7.4: Maximum deposition associated with dredging the most southerly and inshore intake (left) and the most inshore outfall (right) on spring and neap tides



Disposal is at D1. Black dots show CWS structures. Other locations (A1 to J1) show time series extraction points

ii. Operation of the cooling water infrastructure

7.3.27. The presence of the intake and outfall headworks has the potential to alter local hydrodynamic conditions to form scour holes around each structure. If no scour protection were installed at each intake, the predicted scour depth would be about 4.26m with scour holes being 14.8m long and 8.5m wide (Ref. 7.2). The area influenced (including the 320m^2 footprint of the structure itself) is predicted to be 1,554m^2 per structure (6,217m^2 for all four structures). The predicted scour volume would be 2,297m^3 per structure (9,189m^3 for all four structures, excluding the volume of the structures themselves).

7.3.28. For each outfall, the scour around each structure is predicted to be 4.67m deep, 16.3m long and 9.3m wide, with a footprint of 1,552m^2 (3,105m^2 for both). The scour volume is predicted to be 1,873m^3 per structure (3,746m^3 for both structures, excluding structure volume).

7.3.29. Scour could also occur due to the continuous discharge of cooling water from the outfalls. BEEMS Technical Report TR310 Edition 2 (Ref. 7.2) predicted a scour depth of 6.75m with a length of 53m extending away from the structure, and a maximum width of 24m. The scour is predicted to have a footprint of 1,013m^2 per structure (2,025m^2 for both).

7.3.30. Given the small and local areas of sea bed and volumes of sediment predicted to be affected by the intake and outfall headworks with respect to scour, from a coastal process perspective, the operation of cooling water infrastructure would have no effect on coastal processes in the screened in European sites and on the relevant qualifying features.

e) Construction and operation of the fish recovery and return and combined drainage outfalls

7.3.31. The FRR system and the CDO would be on the seaward slope of the outer longshore bar and landward of Sizewell-Dunwich Bank. Both the FRR and CDO outfall heads are assumed to comprise concrete blocks approximately 3m long, 3m wide and 4.5m high. Installation of the outfall heads would require dredging of the topmost sand before placement.

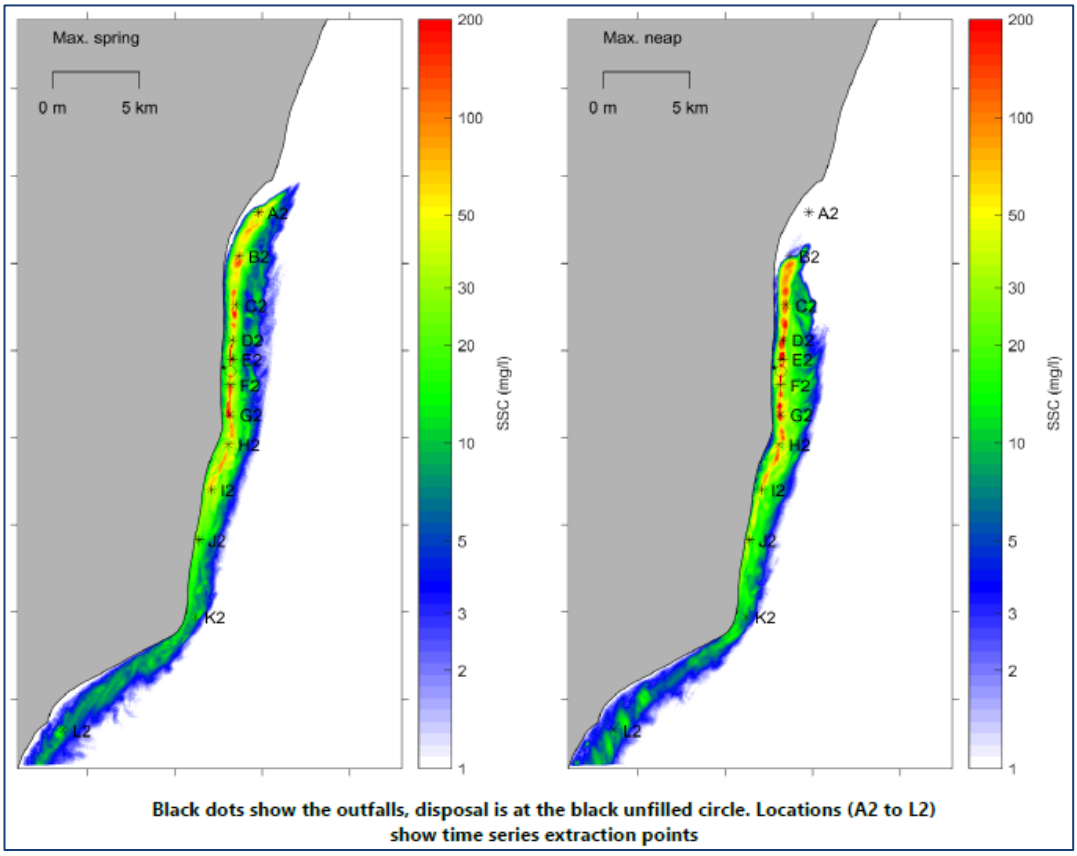
i. Dredging

7.3.32. BEEMS Technical Report TR480 (Ref. 7.1) used Delft3d to simulate the effect of FRR and CDO dredging (assuming 9.5 hours of dredging of the outfalls using a cutter suction dredger) on SSC over a 15-day spring-neap period. The excavated volumes per head would be 1,845m^3 (5,535m^3 for all three structures). Local disposal of dredged sediment was modelled with the

cutter suction dredger discharging the sediment through a pipe approximately 500m from the dredge site.

7.3.33. Maximum SSC would be associated mainly with disposal and are predicted to be greater than 100 mg/l up to 6.5km to the north and 5.5km to the south of the release location at any time during the simulation (**Plate 7.5**). The predictions are five times less than those for the cooling water infrastructure, but the predicted plume extends closer to the coast. Following completion of the dredge, the plume would quickly dissipate reducing concentrations to less than 20 mg/l within two days. Maximum deposition from the plume is predicted to be about 20mm at the disposal site reducing to less than 2mm up to 7km north and 8km south of the site.

Plate 7.5: Maximum depth-averaged suspended sediment concentrations associated with dredging the fish recovery and return and combined drainage outfalls on spring (left) and neap (right) tides

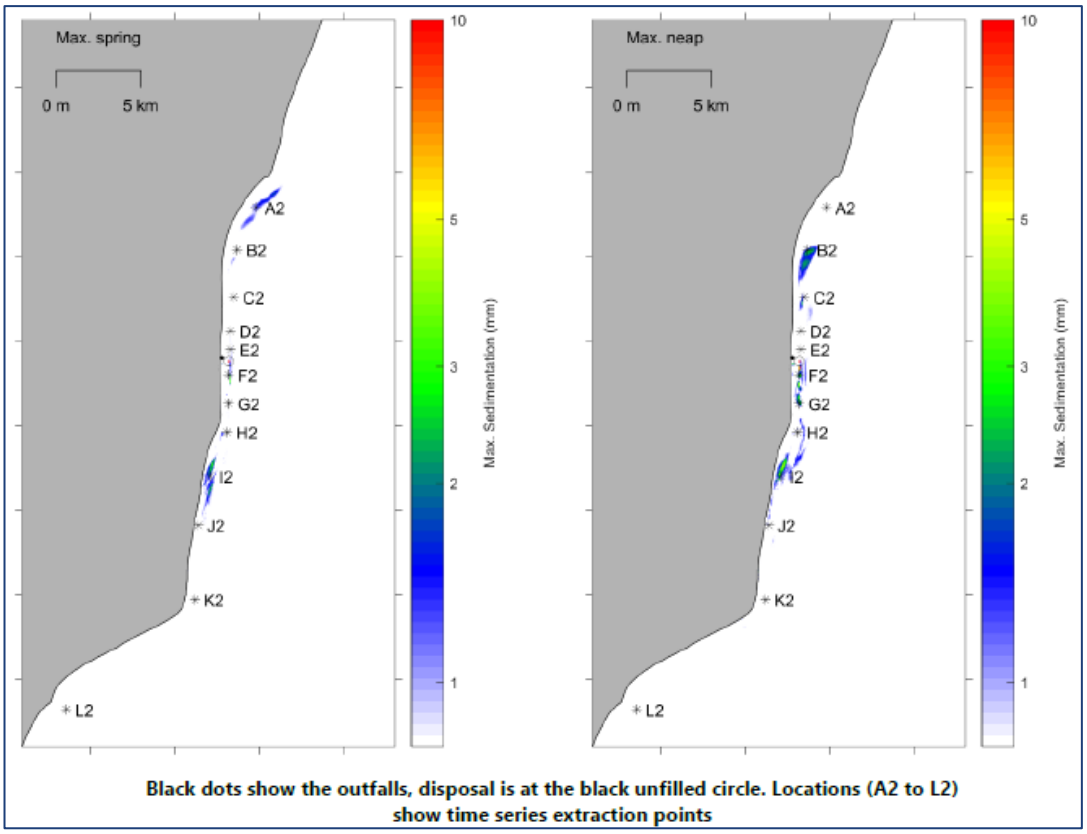


Black dots show the outfalls, disposal is at the black unfilled circle. Locations (A2 to L2) show time series extraction points

7.3.34. Dredging for construction of the FRR and CDO would create a worst-case suspended sediment plume that would be widespread along the coast but would be short-lived (up to two days before dispersion reduces it to background concentrations). Deposition from the plume would be local to the point of dredging with typical thicknesses up to 2mm (**Plate 7.6**). Hence, with

respect to coastal processes, dredging of the FRR and CDO would have no effect on the screened in European sites and qualifying interest features.

Plate 7.6: Maximum deposition associated with dredging the fish recovery and return and combined drainage outfalls on spring (left) and neap (right) tides



Black dots show the outfalls, disposal is at the black unfilled circle. Locations (A2 to L2) show time series extraction points

ii. Operation of the fish recovery and return and combined drainage outfalls

7.3.35. BEEMS Technical Report TR310 Edition 2 (Ref. 7.2) predicted scour depths of 2.07m at each outfall head, assuming no scour protection was installed. The scour holes are predicted to be 7.2m long (with the tidal flow) and 4.1m wide. The footprint affected (including the 9m^2 of the structure itself) would be 170m^2 per structure (510m^2 for all three). The scour volume is predicted to be 109m^3 per structure (328m^3 for all three, excluding the volume of the structures themselves). Scour could also occur due to the continuous discharge of cooling water from the outfalls. BEEMS Technical Report TR310 Edition 2 (Ref. 7.2) predicted a scour depth of 0.74m for the FRRs and 0.34m for the CDO.

7.3.36. Given the small and local areas predicted to be affected by the FRR and CDO outfall heads with respect to scour, from a coastal process perspective,

the operation of the FRR and CDO would have no effect on the screened in European sites and qualifying interest features.

7.4 Assessment of effects: Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuaries Ramsar site

a) Summary of screening outcomes

7.4.1. The following assessment relates to the screened in qualifying features and criteria for the Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuary Ramsar site, which include:

- Estuaries.
- Mudflats and sandflats not covered by seawater at low tides.
- Atlantic salt meadows.
- Ramsar criterion 2 - the site supports a number of nationally scarce plant species and British Red Data Book invertebrates.

7.4.2. The screened in effect pathways for these qualifying features due to the potential influence of the Sizewell C main development site are:

- alteration of coastal processes / sediment transport;
- water quality effects – marine environment;
- disturbance due to an increase in recreational pressure; and
- changes in air quality.

7.4.3. The screened in effect pathways for these qualifying features due to the potential influence of the Sizewell C associated development sites are:

- water quality effects – terrestrial environment;
- alteration of local hydrology and hydrogeology; and
- changes in air quality.

7.4.4. These effects are considered below for the construction, operation and decommissioning phases of the Sizewell C Project.

b) 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (*Glauco-Puccinellietalia*)

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

7.4.5. The construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport for the qualifying features of the Alde, Ore and Butley Estuaries SAC.

7.4.6. SSC created by dredging operations would reduce to background levels within four days after dredging ceases. Sediment deposited from the plume would be restricted to offshore areas and be too far away to interact with the Alde, Ore and Butley estuaries feature.

7.4.7. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would be no change to coastal processes and sediment transport of the 'estuaries', 'mudflats and sandflats' and 'Atlantic salt meadows' qualifying features.

ii. Water quality effects – marine environment

Operation

7.4.8. Marine and coastal habitats could be affected by changes in water quality during the operational phase due to discharge activities from the cooling water system. This is considered below with respect to the thermal, chemical and moribund biota discharges. However, during operation, treated sewage discharge is not expected to increase biological oxygen demand (BOD) levels above background levels and, therefore, dissolved oxygen levels would remain at a high-water quality status (Ref. 7.3).

7.4.9. No adverse effects are predicted during the construction or decommissioning phases.

Thermal discharge

7.4.10. The cooling water outfall would create a thermal plume due to the water being discharged at a higher temperature from the power station than the surrounding receiving water. The potential effects of the thermal plume would predominantly arise for sessile and sedentary benthic organisms that cannot avoid the plume. The thermal plume from Sizewell C was modelled by Cefas using the validated Sizewell General Estuarine Transport Model (GETM); full details of the model and detailed thermal plume maps are presented in

BEEMS Technical Report TR302 (Ref. 7.3), with a summary of the model provided within the BEEMS Technical Report TR306 (Ref. 7.4).

7.4.11. Unlike chemical contaminant water quality standards, which normally have a clear evidence link to ecological effects, thermal standards are not always evidence based due to a lack of reliable data (Ref. 6.148). In order to protect the most sensitive species, thermal standards have therefore been set on an indicative basis and, as such, act as trigger values for further investigation of potential ecological effects (i.e. if the thermal plume exceeds the threshold, further investigation should be undertaken).

7.4.12. The UK Technical Advisory Group (UKTAG) for the Water Framework Directive (WFD) recommend two threshold values as trigger levels for designated sites (Ref. 7.5):

- Increase above ambient - a temperature uplift of less than or equal to 2°C as the maximum allowed concentration at the edge of the mixing zone[15] (as a 100th percentile). The size of the predicted mixing zone is defined within BEEMS Technical Report TR302 (Ref. 7.3).
- Absolute temperature - the 98th percentile of less than or equal to 28°C.

7.4.13. In ecotoxicity studies maximum allowed concentrations are normally defined as 95th or 98th percentiles, but the designated site uplift threshold is specified as a 100th percentile, i.e. a maximum temperature value. This metric is very dependent on how the observations or model simulations are undertaken and the time period considered. Using the GETM model, the maximum temperature taken from instantaneous temperature fields, saved every hour for a one-year simulation, provides data on the predicted area that exceeds the 2°C excess temperature for at least 1 hour per year, i.e. for 1 hour in 8760 hours per annum. **Figure 7.1** and **Figure 7.2** show the predicted surface and seabed annual maximum excess temperature for the operation of Sizewell C (in conjunction with the operation of Sizewell B). At this temperature threshold, this metric is not considered to have any link to specific ecological effects, but it serves as a precautionary threshold to trigger further ecological investigation.

7.4.14. The absolute temperature standard for designated sites of less than or equal to 28ºC as a 98th percentile has a better evidence link, as it is known that the upper lethal temperature for many benthic organisms is in the range 30-33°C (Ref. 6.148). **Figure 7.3** shows the predicted extent of the 98th percentile thermal plume where the surface water temperature exceeds a 2°C and 3°C increase once Sizewell C is operational in conjunction with Sizewell B.

[15] The mixing zone, as used by UK regulators, is the area around a discharge within which a regulator permits a quality standard to be exceeded (Ref. 6.148).

Figure 7.4 shows the predicted extent of the 98th percentile thermal plume during the operation of Sizewell C alone.

7.4.15. Thermal discharges, for the main part, affect species that live within the water column. The thermal plume is buoyant, caused by the lower density of the warmer water causing the heated effluent to rise in an inverted cone towards the surface, thus limiting the likelihood of contact with the seabed. The seabed immediately beneath the plume, therefore, receives little warming effect. As the plume spreads, the temperature falls rapidly as a result of dilution and loss to the atmosphere. Therefore, where the plume does make contact with the seabed downstream, it is at a much-reduced temperature.

7.4.16. The area predicted to be exposed to temperatures of more than 28°C as a 98th percentile by the GETM model is predicted to be of a negligible extent for the operational discharge of Sizewell C alone, i.e. no exceedance of 28°C (98 percentile) at the surface and seabed. Exceedance of the 2°C MAC (as a 100th percentile), however, is predicted to cover an area of 16,775 ha at the surface and 12,244 ha at the seabed, as a result of the operational discharge of Sizewell C.

7.4.17. The assessment of effects from the thermal plume on habitats has been undertaken based on the addition of the Sizewell C discharge only, as the water temperature increase caused by the Sizewell B thermal plume forms part of the baseline, i.e. Sizewell B has been operational since 1995; therefore, habitats in contact with the Sizewell B plume are habituated to it. However, it is acknowledged that a small synergistic effect would arise at the interface between the Sizewell B and Sizewell C plume. Therefore, to ensure that all effects are captured, the extent of the thermal plume of Sizewell C in conjunction with Sizewell B has been used to carry out the screening assessment of SAC and Ramsar sites for habitat qualifying features.

7.4.18. As can be seen from **Figure 7.3**, the thermal plume is only predicted to intersect the mouth of the Alde-Ore estuary and only at increased temperatures in the 0°C to 1°C range as 98th percentiles. At these temperatures, the standard for significant impacts to occur on designated habitats that may cause adverse effects on site integrity would not be exceeded (Ref. 7.5).

7.4.19. From **Figure 7.5** we can see that the extent of the Sizewell C plume alone does not intersect with the European site and is located over 12km to the north of the site. Consequently, an effect on the water quality, and hence on the qualifying interest features of the SAC and Ramsar site, is not predicted.

Chemical discharge

7.4.20. Modelling for the chemical discharge was also undertaken using the validated GETM model of Sizewell, as presented in BEEMS Technical Reports TR301 and TR302 (Ref. 7.6; Ref. 7.3). This model was chosen to support the chemical modelling because of its ability to reproduce the natural variability due to meteorological and tidal conditions. **Figure 7.6** to **Figure 7.8** show the extent of the plume generated by each chemical modelled; **Table 7.1** provides the area (ha), at seabed and surface, exceeding the environmental quality standards (EQS) / predicted no-effect concentration (PNEC) for total residual oxidant, bromoform and hydrazine modelled plumes.

Table 7.1: Absolute areas exceeding the EQS/PNEC values at the surface and seabed from total residual oxidant, bromoform and hydrazine discharges (BEEMS Technical Report TR306)

Discharge	Surface (ha)	Seabed (ha)
Total residual oxidant – 132 m^3s^{-1} discharge scenario EQS = 10 µg/l as a 95%ile	336.65	2.13
Bromoform – PNEC of 5 µg/l as a 95%ile	52.14	0.67
Hydrazine - 69 ng discharge scenario (worst-case) PNEC = 4 ng/l (acute, as 95%ile)	13.79	0.22
Hydrazine - 34 ng discharge scenario PNEC = 4 ng/l (acute, as 95%ile)	17.38	0.00

7.4.21. Chlorination of the cooling water system is required to avoid biofouling. The total residual oxidant predicted to result from the combination of chlorine and organic material in the water were modelled using an empirical demand/decay formulation derived from experiments with Sizewell seawater coupled into the GETM Sizewell model (Ref. 7.7; **Figure 7.6**). A discharge of 132 m^3s^{-1} has been modelled for total residual oxidant for Sizewell C (Ref. 7.4). **Figure 7.6** shows the extent of the total residual oxidant plume areas at the relevant EQS, i.e. 10 μgl^{-1} as a 95th percentile maximum allowed concentration (Ref. 7.8). The area exceeding the EQS at the seabed is approximately 2ha and 337ha at the sea surface.

7.4.22. Due to the water chemistry at Sizewell, bromoform is the predominant chlorinated by-product. Since bromoform is a product of chlorination, the same modelling scenarios as for total residual oxidant were considered. There is no published EQS for bromoform so a calculated PNEC of 5 μgl^{-1} as a 95th percentile was used (Ref. 7.4). The amount of bromoform that is discharged mainly depends on the amount of chlorine that is added, but also on the amount of mixing at the outfall. **Figure 7.7** shows the extent of the

bromoform plume at Sizewell C. The bromoform plume that exceeds the PNEC is approximately 52ha at the sea surface and 0.2ha at the seabed.

7.4.23. Hydrazine is an oxygen scavenger used in power plants to inhibit corrosion in steam generation circuits. There is evidence that hydrazine is harmful to aquatic organisms at low concentrations, with a low to moderate persistence within the marine environment, depended upon its concentration and the receiving water quality. There is no established EQS for hydrazine so a chronic PNEC of 0.4 ngl^{-1} has been calculated for long-term discharges (calculated as the mean of the concentration values) and an acute PNEC of 4 ngl^{-1} for short term discharge (represented by the 95%ile). A hydrazine discharge of 69 ngl^{-1} in daily pulses of 2.32 hours starting at 12pm was used as the worst-case scenario. **Figure 7.8** shows the extent of the hydrazine plume at Sizewell C. The acute PNEC (i.e. 95th percentile) of the worst-case scenario discharge is exceeded at the surface by approximately 18ha and by less than 1ha at the seabed.

7.4.24. From **Figure 7.6** to **Figure 7.8** it can be seen that the extent of the chemical plumes would not interact with the qualifying features of the Alde, Ore and Butley Estuaries SAC. Therefore, an effect on water quality from the chemical plume on 'estuaries', 'mudflats and sandflats' and 'Atlantic salt meadows' qualifying features is not predicted.

Fish recovery and return: change to water quality from moribund biota

7.4.25. The total biomass of moribund biota predicted to be discharged from the FRR has been estimated based on the level of abstraction (pump rates) for the planned Sizewell C intakes and the information on seasonal distribution of species and length weight distribution of the species impinged for the existing Sizewell B station (Ref. 7.9; Ref. 7.10).

7.4.26. These values are based on rates of impingement at Sizewell B and extrapolated to Sizewell C; however, they do not account for Sizewell C mitigation (low velocity side entry headworks survival rates). Furthermore, the assessments consider discharges of dead and moribund biota form a single point source. This adds a further precautionary factor to the assessment as the two FRR units, located approximately 300m apart, would allow a greater level of initial dilution with discharges split between two spatially separated points sources. As such, they are highly precautionary assessments applied primarily to determine the worst-case potential for water quality issues (deoxygenation and nutrient enrichment).

7.4.27. The data show seasonal variation in the discharge of moribund fish. The highest biomass of moribund fish occurs in March with a mean biomass of 3442kg per day predicted to be discharged from the FRRs. Between April to

September, biomass discharge predictions are lower at a mean of 405.2kg per day.

(a) FRR system: nutrient inputs

7.4.28. The recycling of nutrients from decaying fish biomass has been more frequently considered for freshwater systems, e.g. decay of salmon carcasses in headwater streams. Several studies on salmonids indicate on a wet weight basis a phosphorus content of around 0.5% and nitrogen content of around 3.5% (Ref. 7.11; Ref. 7.12; and Ref. 7.13). The April to September period represents a time when sea temperatures and light levels at depth are increasing and phytoplankton growth is also increasing. At this time nutrients start to become less available and become a limiting factor for algal growth as provided in **Volume 2, Chapter 22, Appendix 22H** of the **ES** (Doc Ref. 6.3).

7.4.29. The predicted average daily nitrogen loading from operational inputs at Sizewell C is 32kg, which represents 0.2% of the daily exchange for the Greater Sizewell Bay. The additional inputs of nitrogen from decaying biomass represent an increase to a value of 0.3% of the daily exchange.

7.4.30. The predicted daily average operational phosphorus loading is low, at approximately 0.71 or kg 0.03% of the daily exchange for Sizewell Bay, and the biomass input from the FRR represents a relatively high addition to this.

7.4.31. Nevertheless, the additional inputs from the FRR result in combined operational phosphorus inputs of 0.25% of the daily exchange, which is still considered to be low. Phosphate is rarely a limiting nutrient within the Greater Sizewell Bay system and low-level increases would not be expected to perturb the system as provided in **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3).

7.4.32. A Combined Phytoplankton and Macroalgae model predicted that annual nutrients loadings due to operational nutrient discharges from Sizewell B and the proposed development would increase production within the Greater Sizewell Bay by 0.11% as provided in **Volume 2, Chapter 22, Appendix 22H** of the **ES** (Doc Ref. 6.3).

7.4.33. Much higher phosphorus loadings than this have been modelled for the construction inputs and a negligible influence on the phytoplankton carbon production is predicted. Moreover, this assessment represents a worst case as it assumes that the fish are not consumed by other species and that the tissue nutrient content makes a direct contribution to nutrient levels when, in fact, it would take several days for the tissue to decay and to release nutrients as provided in **Volume 2, Chapter 22, Appendix 21E** of the **ES** (Doc Ref. 6.3).

7.4.34. Because the assessment is conservative, assuming rapid release of nutrients from the total biomass, the nitrogen and phosphorus increase and potential contribution to phytoplankton growth is predicted to be of negligible significance. The input loading of phosphorus and nitrogen from biomass discharged from the FRR is predicted to have a negligible effect on water quality separately and in combination with the operational input. Hence an adverse effect on the integrity of the qualifying features of the Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuaries Ramsar site is not predicted as seen in **Volume 2, Chapter 21** of the **ES** (Doc Ref. 6.3).

(b) FRR system: un-ionised ammonia

7.4.35. The decay of biomass released from the FRR has the potential to cause an increase in un-ionised ammonia. The tissue ammonia content for fish and seasonal physicochemical conditions were incorporated into the un-ionised ammonia calculator as provided in **Volume 2, Chapter 22, Appendix 21E** of the **ES** (Doc Ref. 6.3). Un-ionised ammonia was calculated for summer, and winter when fish discharges and ambient conditions differ.

7.4.36. During the period of April to September, daily discharges of 405.2kg per day of dead or moribund biota would have the potential to cause un-ionised ammonia concentrations to exceed the EQS (21µg/l) over an area of 1.4ha (under average conditions) from the FRR discharge. To account for summer conditions, 95th percentile temperature, pH, and average salinity was considered. Under this scenario, the EQS would be exceeded over an area of 3.8ha from the FRR discharge point.

7.4.37. During winter (December-April), the release of dead and moribund biota is higher, and salinities may be lower during periods of heavy rainfall thus favouring un-ionised ammonia concentrations. However, temperature would also be low which reduces the un-ionised ammonia proportion.

7.4.38. To account for the most conservative scenario the highest daily discharge value (3,442kg per day in March) was applied using a 5th percentile salinity, average temperature for March and average annual pH. Under these conditions the exceedance of the EQS would occur over an area of 5.3ha as provided in **Volume 2, Chapter 22, Appendix 21E** of the **ES** (Doc. Ref. 6.3). The maximum spatial scale of the impacts differs seasonally but is low. Discharges would occur throughout the operational phase of the proposed development; therefore, the duration is high and the amount of change seasonally variable.

7.4.39. Biomass values are based on rates of impingement at Sizewell B and are extrapolated to account for abstraction volumes. They do not account for the Sizewell C intake head design that will mitigate fish entrapment and is predicted to abstract approximately 60% fewer fish per cumec than Sizewell

B, or any losses from the system through tidal/wave transport or consumption. Furthermore, the assessments consider discharges of dead and moribund biota form a single point source. This adds a further precautionary factor to the assessment as the two FRR units, located approximately 300m apart, would allow a greater level of initial dilution with discharges split between two spatially separated points sources. Results should, therefore, be considered as highly precautionary.

7.4.40. At an exceedance of the EQS at 5.3ha, the change in water quality will not overlap with the Alde, Ore and Butley Estuaries SAC and Ramsar site. Therefore, an adverse effect on the integrity of the qualifying features of SAC and Ramsar site with coastal habitats are not predicted.

(c) FRR system: biomass influence on dissolved oxygen levels

7.4.41. The decaying fish biomass is also likely to contribute to the BOD.

7.4.42. Based on the oxygen demand of organic matter inputs from fish cages coupled to the annual average daily biomass loading an estimate of BOD was made.

7.4.43. The average daily BOD contributed by decaying fish tissue is estimated to be 1,342 kg/day which is calculated to result in a reduction of dissolved oxygen of 447 kg/day. This potential oxygen requirement is equivalent to 0.2% of the daily exchange for Greater Sizewell Bay and deficits would also be met by daily reaeration at the sea surface as provided in **Volume 2, Chapter 21** of the **ES** (Doc Ref. 6.3).

7.4.44. This assessment assumes direct breakdown of material and no losses through predation. The estimate in reduction of oxygen concentration would only occur if the rate of oxygen use due to BOD is greater than the oxygen transfer across the water surface. Therefore, as the waters off Sizewell C are well mixed vertically, facilitating reaeration at the surface, background dissolved oxygen levels are high and the water exchange rate of the Greater Sizewell Bay is enough to limit the extent and duration of any oxygen reduction, the input loading of BOD from biomass discharged from the FRR is predicted to have a negligible effect on water quality. This would not adversely affect the integrity of the SAC and Ramsar site qualifying features or criterion.

iii. Water quality effects – terrestrial environment

Construction

7.4.45. During the screening process it was identified that the construction of the two village bypass, see section 2.2 b iii of this report, to include a bridge over the

River Alde, has the potential to have an adverse effect on water quality upstream of the Alde, Ore and Butley Estuaries SAC, which may then cause secondary effects on the estuaries, mudflats and sandflats and Atlantic salt meadows qualifying interest features.

7.4.46. The bypass would comprise a new, permanent, 2.4km single carriageway road, that would depart from the A12 to the south-west of Stratford St. Andrew before re-joining the A12 to the east of Farnham. The bypass would effectively create a new route around the south of Stratford St. Andrew and Farnham, thus bypassing the two villages. Once operational, the two village bypass is proposed to be a permanent bypass that would form a new section of the A12. The proposed route of the bypass would include the construction of a crossing over the River Alde. The crossing would be up to 7.5m in height above ground level to the road surface, and approximately 36m in length.

7.4.47. The construction of the crossing would be carried out in line with the Sizewell C Project's **Code of Construction Practice (CoCP)** (Doc Ref. 811). The **CoCP** (Doc Ref. 8.11) would be informed by relevant environmental legislative requirements and comply with current standards, construction and operational experience and the commitments of the EIA process; securing mitigation measures that are not secured by any other means. This would enforce the application of pollution prevention and control measures across the site, including a buffer area along all watercourses (where feasible) within which no storage of equipment or material would be allowed. In addition, excavated materials generally would not be stored in areas of high flood risk to avoid sediment loss during flooding. This mitigation would ensure that there is no significant impact on the water quality of the River Alde associated with the construction of the bridge.

7.4.48. It can be concluded that the construction of the two village bypass would not have an adverse effect on the 'estuaries', 'mudflats and sandflats', and 'Atlantic salt meadows' qualifying features of the Alde, Ore and Butley Estuaries SAC.

7.4.49. No terrestrial water quality effects on the SAC are predicted in the operational phase of the power station. Further, as the two village bypass is proposed to be a permanent bypass, no decommissioning effects would arise.

iv. Alteration of local hydrology and hydrogeology

Construction

7.4.50. During the screening stage it was identified that the construction of the crossing over the River Alde, which forms part of the two village bypass, could alter the local hydrology and hydrogeology of the river, which could have secondary impacts downstream on the estuaries, mudflats and

sandflats, and Atlantic salt meadows qualifying features of the Alde, Ore and Butley Estuaries SAC.

7.4.51. The crossing of the River Alde would comprise an overbridge for all traffic, up to 7.5m in height above ground level to the road surface. The crossing has been designed to preserve the natural integrity of the banks of the river, bed and bankside.

7.4.52. A buffer distance of at least 10m would be maintained during construction and operation of the crossing from the toe of the bank of the River Alde and adjoining ditches, where feasible, to protect the integrity of the banks as well as the associated ecological features. The design of the crossing is such that there would be no direct disturbance to the river.

7.4.53. Based on the design of the crossing and the embedded mitigation proposed, an effect on hydrological processes from its construction on the Alde, Ore and Butley Estuaries SAC 'estuaries' feature is not predicted.

Operation

7.4.54. As described above, the proposed crossing over the River Alde has been designed in such a way as to preserve the natural integrity of the banks of the river, bed and bankside. There would be no direct disturbance to the river from the operation of the crossing. Therefore, an effect on hydrological processes and, consequently, the 'estuaries', 'mudflats and sandflats' and 'Atlantic salt meadows' features of the SAC from the operation of the crossing is not predicted.

v. Changes in air quality

Construction and decommissioning

7.4.55. The construction phase is not considered to have any relevant pathways for on air quality effects on the receptor as the activities would occur beyond the screening distance where impacts would be expected. However for completeness the effects from road traffic emissions associated with the proposed development have been assessed.

7.4.56. The study area for the assessment of dust impacts during construction is based on the criteria detailed in the Institute of Air Quality Management guidance (Ref. 7.14). The Institute of Air Quality Management guidance states that ecological receptors within 50m of potential dust sources, 50m of the routes used by construction vehicles on the public highway and within 500m of construction site access require assessment; beyond these distances, dust effects from construction activities can be expected to be negligible.

7.4.57. Hence the Alde, Ore and Butley Estuaries SAC falls beyond the study area for the assessment of dust emissions and no further consideration of construction or decommissioning dust is necessary.

7.4.58. The air quality assessment as reported in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3), screens out construction phase traffic effects for this European site (i.e. predicted effects are not significant).

Operation

7.4.59. The assessed commissioning and operating scenarios for the main development site combustion plant comprise:

- Commissioning of EPR Unit 1 and Unit 2 diesel generators (annual average scenarios), including undertaking testing for a loss of off-site power event.
- Routine testing during operation (daily average and annual average scenarios).
- A loss of off-site power event (this represents emergency back-up operation only and, therefore, would only generate short-term (hourly) impacts).

7.4.60. The assessment of the potential effects of the combustion plant requires assessment of the Process Contribution (PC) (the modelled concentration of substances from the emission sources included in the assessment) in the context of the environmental standards for European sites (as set out in guidance from Defra and Environment Agency (Ref. 7.15)).

7.4.61. To screen out a PC for any substance (i.e. to confirm that no further assessment is needed), the PC must meet both of the following criteria:

- the short-term (daily) PC is less than 10% of the short-term environmental standard; and
- the long-term (annual) PC is less than 1% of the long-term environmental standard.

7.4.62. If the above requirements are not met, the predicted environmental concentration (PEC) (the PC plus the background concentration of the substance already present in the environment) needs to be compared to the environmental standard. The PEC does not need to be calculated for short-term targets; but if the short-term PC exceeds the screening criteria, further detailed assessment is required.

7.4.63. If the long-term PC is greater than 1% but the PEC is less than 70% of the long-term environmental standard, the emissions are considered to be insignificant and do not need to be assessed further. If the PEC is greater than 70% of the long-term environmental standard, further assessment is required.

7.4.64. The environmental standards presented in **Table 7.2**, which are reproduced from the Defra and Environment Agency guidance (Ref. 7.15), have been applied in this assessment.

Table 7.2: Environmental standards used in the screening process for European sites

Substance	Target (Mean)	Emission Period
Sulphur dioxide	10µg/m^3 where lichens or bryophytes are present (Critical Level)	Annual
	20µg/m^3 where lichens or bryophytes are not present (Critical Level)	Annual
Oxides of nitrogen (expressed as nitrogen dioxide)	30µg/m^3 (Critical Level)	Annual
	75µg/m^3 (Critical Level)	Daily
Nutrient nitrogen deposition	Depends on location (see **Table 5.2**) (Critical Load)	Annual
Acid deposition	Depends on location (see **Table 5.2**) (Critical Load)	Annual

7.4.65. For nutrient nitrogen deposition and acid deposition, the Air Pollution Information System (APIS) defines site-specific Critical Loads relevant to each European site. For the 'estuaries' and 'Atlantic salt meadows' qualifying features of the Alde, Ore and Butley Estuaries SAC, the relevant nitrogen Critical Load class (defined in APIS) is *'Pioneer, low-mid, mid-upper saltmarshes'*, with a Critical Load of 20 – 30 kg N/ha/yr (the most stringent (i.e. lower) Critical Load from the range provided has been used in the assessment).

7.4.66. APIS notes that estuaries and Atlantic salt meadows are not sensitive to acidification and, therefore, Critical Loads are not defined for acid deposition for these qualifying features.

7.4.67. The modelling of the combustion scenarios as reported in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3), predicts that for oxides of nitrogen (NOx) (long-term) and NOx (daily), the PC would be 0.2% and 6% of the Critical Level respectively and, therefore, not significant. For SO_2 (long-term), the PC would be <0.1% of the Critical Level and, therefore, not

significant. From this it can be concluded that the Critical Level would not be exceeded for the 'estuaries' and 'Atlantic salt meadows' qualifying features of the Alde, Ore and Butley Estuaries SAC. In addition, the Critical Load for nutrient nitrogen deposition would not be exceeded, with the maximum PC from the assessed scenarios predicted to be 0.04% of the Critical Load. On the basis of these predictions, it is concluded that there would not be an adverse effect on the integrity of these qualifying features due to changes in air quality during the operational phase.

7.4.68. APIS does not define a nutrient nitrogen deposition Critical Load for mudflats and sandflats not covered by seawater at low tide and, according to APIS, this qualifying feature is not sensitive to acidification. On this basis, it is concluded that (similarly) there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase of Sizewell C.

c) Ramsar criterion 2

i. Coastal process, water quality, hydrology and hydrogeology and air quality effects

7.4.69. The effects predicted on the Alde-Ore Estuary Ramsar site mirror those predicted for the Alde, Ore and Butley Estuaries SAC with respect to coastal process effects, marine and terrestrial water quality effects and effects on hydrology and hydrogeology.

7.4.70. Furthermore, the same Critical Levels and Critical Loads as reported for the Alde, Ore and Butley Estuaries SAC apply to the habitats of the Alde-Ore Estuary Ramsar site. Consequently, there would not be an adverse effect on the integrity of Ramsar criterion 2 due to changes in air quality during the operational phase.

7.4.71. Hence an adverse effect on the integrity of Ramsar criterion 2 is not predicted due to the Sizewell C Project in this context.

ii. Disturbance due to an increase in recreational pressure

7.4.72. The screening stage identified the potential for an adverse effect on the criterion 2 vegetated shingle to arise due to an increase in recreational pressure. This is assessed below.

Construction and decommissioning

7.4.73. There is the potential for an increase in visitor numbers or changes in the patterns of use of recreational areas (such as the Alde-Ore Estuary Ramsar site) due to the presence of the Sizewell C Project construction workers. For the purposes of assessment, it is assumed that 7,900 workers would be

present for the peak construction period of the Sizewell C Project. They are likely to be on-site for approximately 20% of the overall construction timeline (2.5 years of the 9 to 12 year construction period) and increase the pressure associated with recreational activity. Either side of peak construction the workforce would be lower and, therefore, would generate less demand for informal recreation.

7.4.74. In addition, the construction period could lead to the displacement of a number of existing recreational users through their avoidance of particular areas, e.g. Sizewell Beach, during the construction period. When considered together, these effects are expected to generate an additional 60,000 recreational visits per annum overall, of which 7,000 may be to Aldeburgh, where it is possible to access the Alde-Ore Estuary Ramsar site.

7.4.75. The habitat that may be affected by an increase in recreational pressure on the Ramsar site is vegetated shingle. This is a nationally rare and relatively fragile habitat which supports a highly specialised flora.

7.4.76. An increased number of visitors to an area could increase the physical trampling of vegetated shingle and an increase in dog-walking (from the displacement of existing users) could lead to a localised build-up of nutrients from dog faeces and urine. **Appendix E** of this report indicates that the car park locations that give access to the Ramsar site already receive an estimated 580,000 recreational visits per year, and that any increase due to recreational users displaced from Sizewell would be small (estimated to be an additional 29,000 recreational visits in this case per annum). In addition, this total increase in pressure would be diffuse and spread across a large number of potential car park access points.

7.4.77. For the reasons outlined above, it is concluded that an increase in recreational pressure on the Alde-Ore Estuary Ramsar site would not lead to an adverse effect on the vegetated shingle of the Alde-Ore Estuary Ramsar site.

Operation

7.4.78. The number of workers to be employed during normal operation of the power station is expected to be approximately 900 staff, with an additional 1,000 staff to be employed during planned refuelling and maintenance shutdowns. These are expected to take place every 18 months for each UK EPR™ unit.

7.4.79. The number of workers for the operation phase would represent a substantial reduction from the levels during construction. The assessment for recreational disturbance during construction concluded that adverse effects would not arise and, as less recreational visits would be generated, it can be concluded that recreational disturbance during the operation of the Sizewell

C Project would not have an adverse effect on the vegetated shingle of the Alde-Ore Estuary Ramsar site.

d) Summary of alone effects for the European sites

7.4.80. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of the Sizewell C Project would not adversely affect the integrity of the Alde, Ore and Butley Estuaries SAC in view of its relevant qualifying features and their conservation objectives or the Alde-Ore Estuary Ramsar site with regard to its qualifying criterion.

e) In-combination effects for the European site

7.4.81. **Table 7.3** lists those plans and projects that were screened in to the Appropriate Assessment that could have an in-combination effect with the Sizewell C Project on the Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuary Ramsar site.

i. Introduction

7.4.82. With reference to the Suffolk Shoreline Management Plan (SMP) and of relevance to this assessment, East Suffolk Council is working with the Environment Agency and other stakeholders to review the coastal management policy at Slaughden, to the south of Aldeburgh. The specific area involved is Policy Unit ORF 15.1, extending from the Martello Tower southwards through to Sudbourne Beach towards Orford Ness. East Suffolk Council has outlined the following three-phase approach to the policy review:

- Phase 1: high level review and assessment to provide baseline appreciation of aspects that are key to the identification of a viable policy, with a focus on implementation measures.
- Phase 2: further detailed assessments, including more detailed environmental appraisal and identification of constraints, to fully consider the proposed policy change, including formal engagement with any statutory consultees.
- Phase 3: upon completion of the necessary studies the proposals are to be subject to wider public consultation and review, and the policy changes agreed.

7.4.83. Phase 1 was completed in November 2017 and resulted in the identification of nine separate potential approaches to management which reflected three outcomes: breach, no breach and temporary breach.

Table 7.3: In-combination assessment of plans and projects with the potential to affect habitats within the Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuary Ramsar site

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Suffolk SMP7	Adjacent	Changes to water quality – marine Alteration of coastal processes	There is the potential for an in-combination effect to arise with the Sizewell C Project relating to changes in water quality and coastal processes. In-combination assessment is, therefore, provided (sections 7.4 e ii and iii of this report).	No

7.4.84. In Phase 2, undertaken in June 2018, preliminary assessments of the nine approaches under the Habitats Regulations and the WFD were carried out (Ref. 7.16). The following European sites where screened in to the Habitats Regulations Assessment: Orfordness-Shingle Street SAC; Alde, Ore and Butley Estuaries SAC; Alde-Ore Estuary SPA; and the Alde-Ore Estuary Ramsar site. The conclusions of this preliminary assessment determined that all of the proposed approaches have the potential to cause damage to the designated sites screened in and, as such, all approaches will require HRA to assess adverse effect on site integrity. In addition, the conclusions state that it should be recognised that the study area is part of a dynamic coastline; therefore, even without further intervention, changes to habitats and species in the future would be expected.

7.4.85. The coastal management approaches outlined within the preliminary assessment aim to either do nothing, maintain or improve the existing structures, create new embankments along the estuary channel, or maintain existing natural defences (resulting in temporary breaches). These four different approaches would not greatly change the current baseline for the Sizewell C Project. Doing nothing, maintaining or improving existing structures, and creating new embankments all aim to either maintain the existing baseline or improve upon it. Maintaining the existing natural defences with temporary breaches, similarly, would not greatly alter the existing baseline, given that the coastline near Slaughdon is already dynamic. The temporary breaches are predicted to be small and of occasional nature (Ref. 7.16).

ii. Water quality effects – marine environment

7.4.86. Based on the proposed management approaches outlined within the preliminary assessment (Ref. 7.16), none have the potential to cause an in-combination effect due to changes in water quality resulting from the construction, commissioning, operational and decommissioning activities of the Sizewell C Project. Therefore, it is predicted that an in-combination effect on water quality would not arise due to the Sizewell C Project and the outcomes of the Suffolk SMP.

iii. Alteration of coastal processes / sediment transport

7.4.87. As above, based on the management approaches outlined within the preliminary assessment (Ref. 7.16), and the location of the European sites about 10km south of the Sizewell C Project, the construction, commissioning, operational and decommissioning activities of the Project combined with the proposed management activities do not have the potential to cause an in-combination effect on and alter coastal processes / sediment transport. The changes to coastal processes / sediment transport due to the Sizewell C Project would be very small, local to the Project, and too far away to interact with the proposed management approaches. Therefore, it is predicted that an in-combination effect on coastal processes / sediment transport would not arise due to the Sizewell C Project and the outcomes of the SMP.

7.5 Assessment of effects: Benacre to Easton Bavents Lagoons SAC

a) Summary of screening outcomes

7.5.1. The following assessment relates to the coastal lagoons feature of the Benacre to Eastern Bavents Lagoons SAC.

7.5.2. The screened in effect pathways due to the influence of the main development site are:

- alteration of coastal processes / sediment transport; and
- water quality effects – marine environment.

7.5.3. These effects are considered below for each relevant phase of the Sizewell C Project.

7.5.4. There are no effect pathways from the associated development sites to the coastal lagoon feature.

b) Coastal lagoons

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

7.5.5. The construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport for the coastal lagoons qualifying interest feature of the Benacre to Easton Bavents Lagoons SAC.

7.5.6. SSC created by dredging operations would reduce to background levels within four days after dredging ceases. Sediment deposited from the plume would be restricted to offshore and be too far away to interact with the lagoons. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would be no change to coastal processes and sediment transport at the lagoons.

ii. Water quality effects – marine environment

Operation

Thermal and chemical discharges

7.5.7. A description of the predicted thermal and chemical discharge plumes is provided within section 7.3 of this report.

7.5.8. As can be seen from **Figures 7.3** and **7.4** and **Figures 7.6** to **7.8**, the coastal lagoons qualifying feature of the Benacre to Easton Bavents SAC lies outwith the extent of the thermal and chemical plumes respectively. Therefore, it can be concluded that there would be no effect on marine water quality from the thermal or chemical plume upon the qualifying features of the SAC.

7.5.9. No significant effects are predicted in the construction or decommissioning phases.

Fish recovery and return: change to water quality from moribund biota

7.5.10. The assessment reported for the Alde, Ore and Butley Estuaries SAC applies to the Benacre to Easton Bavents Lagoons SAC. It is concluded that there would not be an adverse effect on the integrity of the qualifying features of the Benacre to Easton Bavents Lagoons SAC due to changes in marine water quality from moribund biota discharged from the FRR system.

c) Summary of alone effects for the European site

7.5.11. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of the Sizewell C Project would not adversely affect the integrity of the Benacre to Easton Bavents SAC in view of its relevant qualifying feature and its conservation objectives.

d) In-combination effects for the European site

7.5.12. **Table 7.4** lists those plans and projects that were screened in to the Appropriate Assessment that could have an in-combination effect with the Sizewell C Project on the Benacre to Easton Bavents Lagoons SAC.

Table 7.4: In-combination assessment of plans and projects with the potential to affect habitats within the Benacre to Easton Bavents SAC

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
SMP7	Adjacent	Changes to water quality – marine Alteration of coastal processes	There is the potential for an in-combination effect to arise with the Sizewell C Project relating to changes in water quality and coastal processes. In-combination assessment is, therefore, provided (sections 7.5 d i and ii of this report).	No

i. Water quality effects – marine environment

7.5.13. During the screening process it was identified that the potential exists for an in-combination effect to occur due to potential changes in water quality arising from water discharge activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP proposals.

7.5.14. The predicted in-combination effects on the Benacre to Easton Bavents SAC are the same as those set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e ii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Benacre to Easton Bavents SAC due to changes to marine water quality.

ii. Alteration of coastal processes / sediment transport

7.5.15. During the screening process it was also identified that the potential exists for an in-combination effect to occur due to potential changes in coastal processes / sediment transport arising from dredging activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP coastal management options.

7.5.16. The predicted in-combination effects on the Benacre to Easton Bavents SAC are the same as those set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e iii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Benacre to Easton Bavents SAC due to changes to coastal processes / sediment transport.

7.6 Assessment of effects: Dew's Ponds SAC

a) Summary of screening outcomes

7.6.1. The following assessment relates to the great crested newt feature of the Dew's Pond SAC. There are no effect pathways predicted from the main development site to this feature of Dew's Ponds SAC.

7.6.2. The screened in effect pathway for the SAC's great crested newts due to the influence of the Sizewell C associated development is:

- alteration of local hydrology and hydrogeology.

7.6.3. This is considered below for each relevant phase of the Sizewell C Project.

b) Great crested newt

i. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

7.6.4. Dew's Ponds SAC is located within 2 km of the proposed Northern Park and Ride site located at Darsham. During the screening stage it was identified that there was the potential for the park and ride to alter the local hydrology and hydrogeology of the area on which Dew's Ponds SAC is dependent, which could affect the great crested newts qualifying feature.

7.6.5. The SAC is located within a different hydrological catchment to the park and ride; the park and ride is located within the Minsmere Old River Catchment whilst Dew's Ponds SAC is located in the Wenhaston water course. There is no hydrological connectivity of surface waters between the Northern Park and Ride site and the SAC. Additionally, no significant effects on the groundwater of the two catchments are predicted due to the proposed park and ride as detailed in **Volume 3, Chapter 12** of the **ES** (Doc Ref. 6.3).

7.6.6. Therefore, it can be concluded that an adverse effect on great crested newts would not arise from the construction, operation or decommissioning of the Northern Park and Ride due to potential changes in hydrology and hydrogeological conditions.

c) Summary of alone effects for the European site

7.6.7. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of the Sizewell C Project would not adversely affect the integrity of the Dew's Ponds SAC in view of its relevant qualifying feature and its conservation objectives.

d) In-combination effects for the European site

7.6.8. The screening exercise has identified no plans or projects that may have an in-combination effect with the Sizewell C Project on Dew's Ponds SAC.

7.7 Assessment of effects: Minsmere to Walberswick Heaths and Marshes SAC

a) Summary of screening outcomes

7.7.1. The following assessment relates to the screened in qualifying features for the Alde, Minsmere to Walberswick Heaths and Marshes SAC, which include:

- Annual vegetation of draft lines.

- European dry heaths.
- Perennial vegetation of stony banks.

7.7.2. The screened in effect pathways for these qualifying features due to the influence of the main development site are:

- alteration of coastal processes / sediment transport;
- water quality effects – marine environment;
- changes in air quality; and
- disturbance due to increase in recreational pressure.

7.7.3. These effects are considered below for each relevant phase of the Sizewell C Project.

7.7.4. There are no effect pathways from the associated development sites to the qualifying interest features screened in to the assessment.

b) European dry heaths

i. Changes in air quality

Construction and decommissioning

7.7.5. The key potential effects of the construction and decommissioning phases from changes in air quality are deposition of construction dust, and effects from road traffic emissions associated with the proposed development.

7.7.6. The Minsmere to Walberswick Heaths and Marshes SAC falls within the study area for the assessment of dust emissions and, therefore, further consideration of construction dust is necessary; dust would be generated primarily through the following activities:

- Demolition works and on-site crushing and screening of aggregate.
- Earthworks, including soil stripping, stockpiling and excavation.
- On-site concrete batching.
- The movement of HGVs and other vehicle movements on site

7.7.7. A dust deposition rate of 0.5 g/m^2/day has been agreed with consultees as the threshold level above which significant ecological effects due to deposited dust are predicted to occur.

7.7.8. The air quality assessment, seen in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3) predicts that the extent of any dust-related effect is likely to occur over a relatively small area, with deposition likely to occur close (tens of metres) to the point of origin. Dust generation would likely continue for the duration of the construction phase, but the impacts of dust are likely to be reversible. The qualifying feature is more than 2km from the main development site boundary and therefore dust from the construction activities is not considered likely to have an impact on this feature.

7.7.9. The primary mitigation measure proposed is the development of a dust management plan outlining a range of measures that would minimise dust generation and monitor the effectiveness of the proposed measures on dust deposition against the threshold limit of 0.5 g/m^2/day. On this basis, it can be concluded that adverse effects on the 'European dry heaths' feature from dust deposition are not likely.

7.7.10. Results of the road transport emissions modelling show that predicted concentrations of NO_x, maximum nutrient nitrogen deposition and maximum acid deposition are highest in the current baseline, represented by the 2018 reference case scenario when compared against the future baseline scenarios without the proposed development traffic. It is predicted that during construction of the proposed development, NO_x concentrations will be lower than the predicted current baseline, as seen in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3). The largest transport contribution to the nitrogen deposition Critical Load occurs for the 2028 "busiest day" scenario, over the reference case (future baseline without the proposed development), nevertheless both the reference case and "busiest day" scenarios are lower than the 2018 reference case. Similarly, the largest transport contribution to acid deposition occurs for the 2028 "busiest day" scenario, though lower than the 2018 reference case.

7.7.11. Locations where these values are highest are as a result of the European site being immediately adjacent to modelled roads. In these cases, it is important to acknowledge that this value is only representative of the portion of the European site immediately adjacent to the road.

7.7.12. It should be noted that the background levels of nutrient and acid deposition at the qualifying feature already exceed the Critical Load. Given the background rates of high chronic deposition, the contributions from road traffic are unlikely to result in significant changes in species composition or habitat condition. Consequently, it is very unlikely that the increases predicted would lead to significant changes in species composition or to noticeable damage to the constituent plants, including any lichens and bryophytes.

7.7.13. In light of the above, it is concluded that the conservation objectives of the SAC would not be compromised and an adverse effect on the integrity of the European site would not occur.

Operation

7.7.14. The methodology for the assessment is as described for the estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC (section 7.4 b v of this report). For the European dry heaths qualifying feature of the Minsmere to Walberswick Heaths and Marshes SAC, the relevant nitrogen Critical Load class (defined in APIS) is 'Dry heath', with a Critical Load of 10 – 20 kg N/ha/yr.

7.7.15. For acid deposition, the relevant acidity class (defined in APIS) is Dwarf Shrub Heath. The Critical Loads for acid deposition are presented in **Table 7.5.**

Table 7.5: Critical Loads for acid deposition (Dwarf Shrub Heath)

MinCLMinN	MinCLMaxN	MinCLMaxS
0.714	1.237	0.215

7.7.16. The annual average (long-term) PC for NOx during commissioning is predicted to be 45% of the Critical Level, and the PEC is predicted to be 71% of the Critical Level (i.e. the Critical Level is not exceeded) at the SAC.

7.7.17. The daily average (short-term) PC for NOx during routine testing is predicted to be 405% of the Critical Level, and the PEC is predicted to be 420% of the Critical Level.

7.7.18. During commissioning, dry heath habitat is predicted to experience increases in nitrogen deposition (PC) of more than 1% of the Critical Load (11.4%) and the PEC is predicted to exceed 70% of the Critical Load (142%). During routine testing, the predictions are lower (3.3% and 141% for PC and PEC respectively).

7.7.19. Acid deposition during commissioning is predicted to increase by more than 1% of the Critical Load (10.5%) and the PEC is predicted to exceed 70% of the Critical Load (99.4%). During routine testing, the predictions are lower (3.2% and 92.2% for PC and PEC respectively).

7.7.20. Defra and Environment Agency (Ref. 7.15) guidance indicates that given these predicted changes, further assessment of the potential effect on the SAC is required. This assessment is presented below and is based on the:

- modelled increases in NO_x (long- and short-term), SO_2, nutrient nitrogen and acid deposition;
- sensitivity of each habitat type to the predicted effects of the combustion activities (taking into account Critical Levels for vegetation and site-specific Critical Loads); and
- duration and frequency of the various assessed scenarios.

NOx Critical Levels

7.7.21. Given that Critical Levels are defined as concentrations of pollutants (at 100%) above which direct adverse effects may occur (Ref. 7.19), it is considered that the predicted concentrations of NOx (long-term) during commissioning would not have an adverse effect on this qualifying feature, as an exceedance is not predicted.

7.7.22. There are no commissioning scenarios which could lead to emissions from the diesel generators occurring over a 24-hour period and, therefore, potential effects in the context of the daily NOx Critical Level are only relevant for routine testing operations.

7.7.23. Daily NO_x during routine testing (i.e. the only scenario relevant for daily NO_x) is predicted to exceed the Critical Level (where the PC for daily NO_x is predicted to be 405% and the PEC is predicted to be 420% of the Critical Level). However, the modelling scenario for daily NO_x assumes that one diesel generator is operational throughout the year (in order to determine the worst-case impact from representative meteorological conditions). In reality, routine testing operations would only occur for 60 hours over the year per diesel generator (720 hours of operation on an annual basis for all generators combined). As there are 8,760 hours in a common year, generators would only operate for 8.2% of a full common year. The modelling results for this scenario, therefore, significantly over-estimate the predicted exceedance of the daily NO_x Critical Level, which would only occur for short periods. Furthermore, the modelling results predict that the ZOI of any exceedance of daily NO_x would be confined to a relatively small area (approximately 10ha, less than 1%) encompassing the southern end of the SAC - as illustrated in **Volume 2, Appendix 12C, Figure 12C10** where the qualifying feature is not present.

7.7.24. The daily mean for NO_x is of less importance than the annual mean, as vegetation exposed to levels of NO_x above the Critical Level are more likely to recover from a short duration exposure. A report from the Centre for Ecology and Hydrology (Ref. 7.20) states that:

"The United Nations and Economic Committee for Europe (UN/ECE) Working Group on Effects strongly recommended the use of the annual mean value, as the long-term effects of NOx are thought to be more significant than the short-term effects".

7.7.25. Given the highly conservative nature of the modelling scenario, the relatively small ZOI of exceedance of the daily NO_x Critical Level and the fact that longer term NO_x concentrations have greater potential to affect vegetation than short-term exceedances, it is concluded that there would not be an adverse effect on the integrity of the qualifying feature due to daily NO_x exceedance of the Critical Level during routine testing.

Nitrogen and acid deposition Critical Loads

7.7.26. The SAC is predicted to experience increases in nitrogen and acid deposition of more than 1% of the Critical Load and the PEC is predicted to exceed 70% of the Critical Load. However, it should be noted that the background levels of nutrient and acid deposition already exceed the Critical Load.

7.7.27. The predicted PCs associated with commissioning, routine testing and a loss of off-site power event would be short-term and temporary (especially during commissioning operations) and, given the background rates of high chronic deposition, the PCs are unlikely to result in significant changes in species composition or habitat condition. Furthermore, as described above the area of the SAC that would experience these highest predicted deposition rates are confined to the southern end of the SAC, where the qualifying feature is not present. Consequently, it is very unlikely that the increases predicted would lead to significant changes in species composition or to noticeable damage to the constituent plants, including any lichens and bryophytes.

7.7.28. In light of the above, it is concluded that the conservation objectives of the SAC would not be compromised and an adverse effect on the integrity of the European site would not occur.

ii. Disturbance due to increase in recreational pressure

Construction and decommissioning

7.7.29. There is the potential for an increase in visitor numbers or changes in patterns of use of recreational areas to occur due to the construction/ decommissioning workers and works associated with the Sizewell C Project.

7.7.30. As set out for the Alde, Ore and Butley Estuaries SAC (section 7.4 c ii of this report), an increased number of visitors to an area can increase the physical trampling of habitat types such as heath and vegetated shingle, leading to the loss of component plant species and the replacement of these habitat

types with bare un-vegetated substrate. An increase in dog-walking can also lead to a localised build-up of nutrients, due to dog faeces and urine, causing localised enrichment which will favour vigorous fast-growing plants. This could cause slower-growing plant species to be out-competed, thus leading to an overall loss in plant species diversity.

7.7.31. The **Plants and Habitats Synthesis Report** as provided in **Volume 2, Chapter 14, Appendix 14B1** concludes that any trampling effects are likely to be reversible in time, with vegetation recovering once the trampling pressure is removed. Nutrient enrichment from dog waste may take longer to reverse. The duration of additional tramping and enrichment from dog waste would be the greater of the period over which recreational users could be displaced or the construction period for the main development site. In certain cases, however, changed recreational usage behaviours could persist following the cessation of Sizewell C construction activities and could lead to this effect continuing.

7.7.32. The Minsmere to Walberswick Heaths and Marshes SAC is considered to be vulnerable to the trampling of shingle vegetation and the area is already likely to be impacted in the baseline condition. A substantial increase in trampling of vegetation and nutrient enrichment arising from recreational displacement would constitute an adverse effect, with the significance of the effect being dependent on the extent of habitat affected. The extent of any potential effect is likely to vary depending upon the location of access points. For example, an effect is more likely from car park locations that are close to sensitive habitats (such as at Walberswick and Dunwich, where these is direct access to the beach and its sensitive shingle and dune habitat).

7.7.33. The Recreational Evidence Base (**Appendix E** of this report) concludes that the Sizewell area receives approximately 500,000 recreational visits a year, with most visitors arriving by car. Of the respondents questioned as part of survey work for the Sizewell C Project, 29% indicated that they would avoid the Sizewell area during the construction of the main development site and seek other locations in which to undertake recreation.

7.7.34. This potential displacement of recreational users, including to the Minsmere to Walberswick Heaths and Marshes SAC, has to be considered in the context of the large number of recreational visits already made to the SAC. Data within the Plants and Habitats Synthesis Report as seen in **Volume 2, Chapter 14, Appendix 14B1**, indicates that the car-park locations that give access to the SAC already together receive an estimated 1,114,206 recreational visits per year, and that any increase due to recreation users displaced from the Sizewell area would be small (estimated to be approximately an additional 20,000 recreational visits per annum). In addition, this pressure would be diffuse and spread across a large number of potential car-park access points. It is estimated that perhaps 20% of the

predicted increase in visitor numbers would visit the main RSPB nature reserve (where dog walking is not permitted) and 80% of the predicted increase in visitor numbers would visit the outer areas of the reserve, where dog walking is permitted.

7.7.35. There is no automatic correlation between an increase in the number of recreational visits and the potential for the qualifying features of European sites to be detrimentally affected. It is envisaged that, overall, managed sites with a well-defined path network, such as the core area of the RSPB reserve, where people are easily observed, new recreational users are likely to keep to existing path networks and would be unlikely to lead to an increase in trampling. However, this is unlikely to be the case for less intensively managed sites. Where additional visitors are expected to visit peripheral 'outer' areas of the RSPB Minsmere reserve, it could be expected that this would lead to a corresponding increase in dog-walking activity and, as such, an increase in the potential for both trampling and nutrient enrichment. These areas do not, however, readily provide access to areas of habitat used by breeding / wintering bird interests.

7.7.36. The displacement of existing recreational users is likely to last for the duration of the construction phase, although as people establish new patterns of behaviour and access alternate sites, the changes could become permanent for a proportion of users. For the majority, once construction activities have ceased, a substantial proportion of displaced users are likely to reuse the Sizewell area and be joined by new users.

7.7.37. As set out earlier, mitigation measures have been established to minimise the requirement for both construction workers and existing recreational users from Sizewell to access the SAC for recreation. The Rights of Way and Access Strategy for the EDF Energy estate would be developed to minimise the displacement of people away from the Sizewell C area and to nearby European sites to minimise trampling of vegetation. In addition, the strategy outlines a monitoring programme for recreational displacement to identify local mitigation measures, to be agreed with local land managers, which could be introduced to further reduce recreational disturbance.

7.7.38. For the reasons outlined above, it is concluded that an adverse effect would not arise from an increase in recreational pressure on European dry heaths of the Minsmere to Walberswick Heaths and Marshes SAC.

Operation

7.7.39. As set out above, the number of workers employed during normal operation is expected to be approximately 900, with an additional 1,000 during planned refuelling and maintenance shutdowns (every 18 months for each UK EPR™

unit) and would represent a substantial reduction in the number of workers which would be required at peak times during construction.

7.7.40. Hence it can be concluded that the operation of Sizewell C would not have an adverse effect on European dry heaths due to recreational disturbance.

c) Annual vegetation of drift lines and perennial vegetation of stony banks

i. Alteration of coastal processes/sediment transport

Construction, operation and decommissioning

7.7.41. Based on the evidence presented in section 7.3 of this report (and supported by Ref. 6.1), the construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport for the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying interest features of the Minsmere to Walberswick Heaths and Marshes SAC.

7.7.42. SSC created by dredging operations would reduce to background levels within four days after dredging ceases. Sediment deposited from the plume would be restricted to offshore and be too far away to interact with the beaches. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would be no change to coastal processes and sediment transport along the regional coast.

ii. Water quality effects – marine environment

Construction and decommissioning

7.7.43. During the construction and decommissioning phases, the installation/decommissioning of infrastructure in the marine environment and vessel traffic represent potential pathways for contamination. Contamination could result from:

- resuspension of sediment bound contaminants, for example heavy metals and hydrocarbons, during dredging, drilling and pilling activities;
- accidental chemical release from vessels; and
- chemicals leaching from coatings on marine infrastructure.

7.7.44. In addition, a number of discharges to the marine environment would occur during the construction phase. Construction discharges would be directed via the CDO and include:

- site drainage, including surface water run-off;
- effluent from the treatment of sewage by the on-site treatment works and from the potable supply (black and grey water);
- water pumped from both groundwater and excavations during construction dewatering activities;
- wash water from cleaning concrete production equipment; and
- wastewater from horizontal cooling water system tunnelling operations.

7.7.45. A detailed assessment of the construction discharges is provided within the H1[16] Environmental Risk Assessment (Ref. 7.17), **Volume 2, Chapter 21, Appendix 21G** of the **ES** (Doc Ref. 6.3), the Water Quality Synthesis Report (Ref. 7.4) **Volume 2, Chapter 21, Appendix 21E** of the **ES** (Doc Ref. 6.3) and the **WFD Compliance Assessment Report** (Doc Ref. 8.14).

Potential for water quality effects due to construction phase discharges

7.7.46. During the initial dewatering activities through the construction phase, the volume of groundwater to be disposed of has been estimated to be 300,000 m^3 (Ref. 7.4).

7.7.47. Investigations into the existing contamination of the groundwater at the main development site showed the presence of a number of dissolved metals and dissolved inorganic tin. However, none were found to be above the EQSs (Ref. 7.4).

7.7.48. With regard to the groundwater discharge, measures to minimise the release of the priority hazardous substances cadmium and mercury are proposed. Specifically, levels are not to exceed a cumulative annual load of 5kg and 1kg (Ref. 7.18), for cadmium and mercury respectively. In response to this, the H1 Environmental Risk Assessment as provided in **Volume 2, Chapter 21, Appendix 21G** (Doc Ref. 6.3), shows that these annual loads would not be exceeded over the three-year construction period of discharges at the main development site (Ref. 7.4).

7.7.49. However, chromium and zinc failed the screening undertaken for the H1 Environmental Risk Assessment and, therefore, were modelled; as required by the Environment Agency. The modelling shows that the chromium plume is predicted to be below the EQS within 5.5ha of the CDO (less than 25 km) at the sea surface and would not reach the shoreline. At the seabed, the EQS is not predicted to be exceeded at any point. The modelling also shows that

[16] The Environment Agency's Environmental Risk Assessment framework for assessing changes to water quality from installations and waste operations with discharges to a water body.

zinc concentrations would be indiscernible from the background within 0.11ha of the CDO outfall (less than 3m).

7.7.50. Notably the qualifying features are found at, or above, MHWS, which would greatly limit the potential interaction between any changes in water quality and these features. Therefore, it is unlikely that there would be a significant effect on 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' of the Minsmere to Walberswick Heaths and Marshes SAC.

7.7.51. The H1 Environmental Risk Assessment and **WFD Compliance Assessment Report** (Doc Ref. 8.14) also detail the BOD, DO, ammonia and microbiology elements associated with the construction discharge. They show that all of these elements would be diluted to environmentally acceptable standards within metres of the discharge point (Ref. 7.17).

7.7.52. Dissolved inorganic nitrogen (DIN) discharges would result in a maximum of a 12.5% rise in background DIN levels in the summer period. However, when mixing with the wider southern North Sea is considered, there is no anticipated change in the water quality standard for DIN levels (Ref. 7.3).

7.7.53. Un-ionised ammonia is expected to be present in the groundwater and sewage discharges, however, dilution to 96% is expected to occur within 21m of the discharge location (see Ref. 7.3).

7.7.54. Modelling was undertaken to predict the distance from the CDO discharge point at which enough dilution of the sewage treatment discharge would occur to be within microbiological standard levels. The sewage discharge plume would buoyant and on the sea surface. The modelling shows that a concentration of *Enterococci* is likely to exceed the bathing water standard within a worst case of 460m of the discharge, without UV treatment.

7.7.55. In conclusion, an adverse effect on the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the SAC from changes to water quality during construction phase discharges and decommissioning is not predicted.

Potential for water quality effects during dredging and disposal activities

7.7.56. To allow for the safe passage of barges and tugs to the BLF, a navigational channel and grounding area are required. Dredging from the construction of the BLF would result in sediment settling on the seabed over a relatively small area close inshore (**Plate 7.1** and **Plate 7.2**). The thresholds used to model the plume extent are concentrations of more than 50 mg/l and 100 mg/l above background. The average mean suspended particulate matter value at Sizewell from April to August is 31 mg/l (an average monthly maximum 80 mg/l) and during September to March is 73 mg/l (an average monthly

maximum 180 mg/l) (Ref. 7.4). Following completion of the dredge the plume would quickly disperse. On spring tides, material in suspension is at concentrations of less than 20 mg/l above background within three days (Ref. 7.4).

7.7.57. Dredging and disposal from the construction of the cooling water intakes produce the largest plumes, with up to 9.3km^2 affected by increases in SSC of more than 50 mg/l and up to 3.7km^2 affected by increases in SSC of more than 100 mg/l (**Plate 7.3** and **Plate 7.4**). SSCs within the plume are predicted peak at more than 1,000 mg/l above background, covering a total area of 0.14km^2. These elevated concentrations, however, would be relatively short lived and return to background concentrations within a few days.

7.7.58. The modelling shows that there would be no effect from the sediment plume created as a result of the construction of the cooling water intakes on the SAC habitats. The sediment plume created during the construction of the BLF, through dredging, is expected to be short-lived and restricted to the period of the dredge itself. As a worst-case, would take three days for SSCs to return to background levels.

7.7.59. Taking into account the temporary nature of the effect, the prompt return to baseline once dredging has completed, and that the qualifying features are at or above MHWS, it can be concluded that there would not be an adverse effect on the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the SAC.

Potential for water quality effects due to commissioning phase discharges

7.7.60. Cold flush testing involves cleansing and flushing the various plant systems with demineralised water to remove surface deposits and residual debris from installation. Tests use demineralised water for preparing plant systems and testing of the primary and secondary circuits requires them to be filled and flushed several times each. The maximum daily discharge volume is 1500m^{3}d^{-1}, equivalent to the contents of the two 750m^3 tanks that serve this waste stream. Each tank would be emptied once a day, although not at the same time.

7.7.61. During cold flush testing the parameters of concern are hydrazine, ethanolamine and unionised ammonia. Prior to the release of hydrazine from the holding tanks, hydrazine would be treated to reduce the discharge concentration. The proposed treatment option has not yet been confirmed; however, it is anticipated that a discharge concentration of 30µgl^{-1} would be representative of the 95th percentile. The two other chemical contaminants, which would be used in circuit conditioning, are ethanolamine (at 4,000µgl^{-1}) and ammonia, principally in the unionised form (at 12,000µgl^{-1}) due to the higher pH (approximately 10) maintained in the circuits.

7.7.62. The **WFD Compliance Assessment Report** (Doc Ref. 8.14) describes the assessment methods and results for the parameters indicated above. Hydrazine failed to pass the H1 Environmental Risk Assessment screening, thus requiring additional assessment. To do this, BEEMS used the GETM model (Ref. 7.4) and the salinity of the discharge was modelled as freshwater with no thermal uplift. Modelling took the precautionary position of both reactors being commissioned simultaneously although, in reality, it is likely that each reactor would be commissioned separately with discharge of water via the CDO from cold flush testing.

7.7.63. To assess the spatial extent of the hydrazine plume and compare the resulting concentrations with the PNEC values (chronic and acute), the mean and 95th percentile of the hydrazine concentrations were extracted from the 31-day model run. The model results predict the concentrations are higher at the surface than at the seabed, showing the stratification of the hydrazine plume caused by the difference in salinity. The results are presented in **Table 7.6**.

Table 7.6: Areas of PNEC exceedance for hydrazine discharges during cold water testing

PNEC	Surface (ha)	Seabed (ha)
Chronic 0.4 ng/l (as a mean concentration)	53.60 (0.366%)	11.33 (0.077%)
Acute 4 ng/l (as a 95th percentile)	27.25 (0.186%)	10.99 (0.075%)

7.7.64. Canadian Federal Water Quality Guidelines for hydrazine indicate concentrations below 200 ngl^{-1} have a 'low probability of adverse effects for marine life' (Ref. 21). Given that the area of the hydrazine plume with a concentration greater than 200 ngl^{-1} is limited to the immediate vicinity around the CDO, effects on habitats on the WFD water body scale are not anticipated.

7.7.65. The model output for unionised ammonia shows there is no area of the plume in exceedance of the EQS apart from in the direct vicinity of the outfall (less than 5m). Given the very small areas impacted, the potential for WFD water body class deterioration of unionised ammonia is not anticipated.

7.7.66. The discharge of ethanolamine passed the screening carried out for the H1 Environmental Risk Assessment.

7.7.67. The outcomes of the H1 Environmental Risk Assessment for the discharge of commissioning water show no adverse effects upon the water quality of

the WFD water bodies. Therefore, we can conclude that the habitat qualifying features of the SAC will not be adversely affected either. Additionally, the qualifying features being assessed are found at, or above MHWS, thus limiting their interaction with the commissioning discharge plume. Therefore, it can be concluded that changes to water quality from commissioning discharges will not cause an adverse effect on the integrity of the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the SAC.

Operation

7.7.68. An effect pathway from the thermal or chemical plume to the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features at Minsmere to Walberswick is not present, as the drift line vegetation is located at or above MHWS. Therefore, it can be concluded that there would not be an adverse effect from the thermal and chemical plume upon the integrity of this qualifying feature.

7.7.69. With regard to changes to water quality from moribund biota, the assessment reported for the Alde, Ore and Butley Estuaries SAC applies to the Minsmere to Walberswick Heaths and Marshes SAC. Therefore, it is concluded that there would not be an adverse effect on the integrity of the qualifying features of the SAC due to changes in marine water quality from moribund biota discharged from the FRR system.

iii. Changes in air quality

Construction and decommissioning

7.7.70. The key potential effects of the construction and decommissioning phases from changes in air quality are as described for the European dry heaths feature of this SAC, including the deposition of construction dust, and effects from d road traffic emissions associated with the proposed development. Dust would be generated through construction activities, as described for the European dry heaths feature (section 7.7 b I of this report). The air quality assessment as provided in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3) predicts that the extent of any dust-related effect is likely to occur over a small area (likely to be less than 2ha), with deposition likely to occur close (tens of metres) from the point of origin. Dust generation would likely continue for the duration of the construction phase, but the impacts of dust are considered to be reversible. Dust generating activities would be mitigated, through application of a dust management plan including monitoring for compliance with the agreed threshold, as described for the European dry heaths feature of this SAC.

7.7.71. Furthermore, for the 'annual vegetation of drift lines' qualifying feature, this habitat is no longer present in Unit 113 of the Minsmere SSSI (i.e. the area adjacent to the main development site) (section 6.2 h i of this report). This means there is a very weak pathway for effect on this qualifying feature and, considered alongside the proposed mitigation, it can be concluded that effects on this qualifying feature are unlikely.

7.7.72. The construction traffic assessment as reported for European dry heaths as seen in section 7.7 b i of this report, also applies to this qualifying interest feature.

7.7.73. It should be noted that the background levels of nutrient and acid deposition at the qualifying feature already exceed the Critical Load. Given the background rates of high chronic deposition, the contributions from road traffic are unlikely to result in significant changes in species composition or habitat condition. Consequently, it is very unlikely that the increases predicted would lead to significant changes in species composition or to noticeable damage to the constituent plants, including any lichens and bryophytes.

7.7.74. It is concluded that there would not be an adverse effect on the integrity of the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the Minsmere to Walberswick Heaths and Marshes SAC due to air quality effects during the construction and decommissioning phases.

Operation

7.7.75. The methodology adopted for this assessment is as described for the estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC as seen in section 7.4 b v of this report. This assessment was undertaken for perennial vegetation of stony banks qualifying feature only; the annual vegetation of drift lines qualifying feature was screened out in terms of potential operational impacts due to changes in air quality on the basis that APIS confirms that this qualifying feature is not sensitive to nutrient nitrogen or acid deposition and the absence of a strong pathway, as the feature is assumed no longer present in this location (section 6.2 h i of this report).

7.7.76. For the perennial vegetation of stony banks qualifying feature of the Minsmere to Walberswick Heaths and Marshes SAC, the relevant nitrogen Critical Load class (defined in APIS) is 'coastal stable dune grasslands', with a Critical Load of 8 – 15kg N/ha/yr.

7.7.77. For acid deposition, the relevant acidity class (defined in APIS) is Acid Grassland. The Critical Loads for acid deposition are presented in **Table 7.7.**

Table 7.7: Critical loads for acid deposition (Acid Grassland)

MinCLMinN	MinCLMaxN	MinCLMaxS
0.223	0.568	0.215

NOx Critical Levels

7.7.78. The modelling predictions for NOx Critical Levels apply at the European site level and, therefore, the assessment reported for the European dry heaths qualifying feature of the Minsmere to Walberswick Heaths and Marshes SAC apply to the perennial vegetation of stony banks qualifying feature of the SAC, namely:

- The annual average (long-term) PC for NOx during commissioning is predicted to be 45% of the Critical Level, and the PEC is predicted to be 71% of the Critical Level at the SAC.
- The daily average (short-term) PC for NOx during routine testing is predicted to be 405% of the Critical Level, and the PEC is predicted to be 420% of the Critical Level.

7.7.79. The same assessment as reported for the European dry heaths qualifying feature applies here. It is considered that the predicted concentrations of NOx (long-term) during commissioning would not have an adverse effect on this qualifying feature, as an exceedance of the Critical Level is not predicted. The modelling results for the short-term scenario over-estimate the predicted exceedance of the daily NO_x Critical Level, which would only occur for short periods (around 8% of the year). Furthermore, the daily mean for NO_x is of less importance than the annual mean, as vegetation exposed to levels of NO_x above the Critical Level are more likely to recover from a short duration exposure. In conclusion, there would not be an adverse effect on the integrity of the qualifying feature due to long-term or daily NOx exceedance of the Critical Level during commissioning or routine testing.

Nitrogen and acid deposition Critical Loads

7.7.80. During commissioning, coastal stable dune habitat is predicted to experience increases in nitrogen deposition (PC) of more than 1% of the Critical Load (5.5%). The PEC is predicted to exceed 70% of the Critical Load (169%). During routine testing, the predictions are lower (1.6% and 165% for PC and PEC respectively).

7.7.81. Acid deposition during commissioning is predicted to increase by more than 1% of the Critical Load (5.3%) and the PEC is predicted to exceed 70% of the Critical Load (198.9%). During routine testing, the predictions are lower (1.8% and 195.4% for PC and PEC respectively).

7.7.82. The predicted PCs associated with commissioning, routine testing and a loss of off-site event would be short-term and temporary (especially during commissioning operations) and given the background rates of high chronic deposition, the PCs are unlikely to result in significant changes in species composition or habitat condition. Consequently, it is very unlikely that the increases predicted would lead to significant changes in species composition or to noticeable damage to the constituent plants.. Hence, there would not be an adverse effect on the integrity of the qualifying feature due to nutrient nitrogen or acid deposition.

7.7.83. In light of the above, it is concluded that the conservation objectives of the SAC relating to the qualifying feature would not be compromised and an adverse effect on the integrity of the European site would not occur.

iv. Disturbance due to increase in recreational pressure

Construction and decommissioning

7.7.84. The assessment carried out for 'European dry heaths' in section 7.7 b of this report also applies here.

7.7.85. For the reasons outlined above, it is concluded that an adverse effect from an increase in recreational pressure on 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the Minsmere to Walberswick Heaths and Marshes SAC would not arise.

Operation

7.7.86. As set out above, the number of workers employed during normal operation is expected to be approximately 900, with an additional 1,000 during planned refuelling and maintenance shutdowns (every 18 months for each UK EPR™ unit) and would represent a substantial reduction in the number of workers which would be required at peak times during construction.

7.7.87. Hence it can be concluded that the operation of Sizewell C would not have an adverse effect on 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features.

d) Summary of alone effects for the European site

7.7.88. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of Sizewell C would not adversely affect the integrity of the Minsmere to Walberswick Heaths and Marshes SAC in view of its conservation objectives.

e) In-combination effects for the European site

7.7.89. **Table 7.8** lists those plans and projects that were screened in to the Appropriate Assessment that could have an in-combination effect with the Sizewell C Project on the Minsmere to Walberswick Heaths and Marshes SAC.

i. Water quality effects – marine environment

7.7.90. During the screening process it was identified that the potential exists for an in-combination effect to occur due to potential changes in water quality from water discharge activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP proposals.

7.7.91. The potential in-combination effects on the Minsmere to Walberswick Heaths and Marshes SAC are the same as those set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Minsmere to Walberswick Heaths and Marshes SAC due to changes to marine water quality.

Table 7.8: In-combination assessment of plans and projects with the potential to affect habitats within the Minsmere to Walberswick Heaths and Marshes SAC

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Suffolk SMP	Adjacent	Changes on coastal processes and water quality – marine.	There is the potential for an in-combination effect with the Sizewell C Project relating to changes in water quality and coastal processes as provided in sections 7.7 e i and 7.7 e ii of this report.	No
DC/16/2104/OUT Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be reserved except for access).	0.9km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/16/1961/OUT An outline planning application for up to 187 dwellings to include car parking, open space provision with associated infrastructure and access.	1.3km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/16/1322/OUT Outline application - 100 new residential units (C3) with employment floorspace (B1) (approx. 1000m2) and family orientated public house / restaurant (A3/A4) (approx.770m^2)	0.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
DC/18/2325/FUL Residential development of 40 dwellings, together with associated access roads, garaging and car parking	1.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/16/3947/OUT Erection of 14 sheltered / extra care dwellings, together with residents lounge/meeting room and parking area	4.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/18/2621/FUL Erection of 44 no. new dwellings with associated new access road.	6.0km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/18/0702/FUL Residential development of 59 residential dwellings and associated landscaping and public open space, together with a new vehicular access from existing development and associated highway infrastructure	6.7km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/17/3981/OUT Outline Application (Some Matters Reserved) - Construction of up to 200	13.7km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational	No

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
dwellings including car parking, open space provision with associated infrastructure and access			pressure as provided in section 7.7 e iii of this report.	
DC/16/5410/OUT Outline Application (with all matters other than means of access reserved) for residential development of up to 160 dwellings with the provision of a new meadow, additional site wide open space and landscaping, land to enable an extension to the existing cemetery and vehicular accesses off Hill Farm Road	13.3km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
DC/19/1141/OUT Outline Application - Development of up to 220 dwellings with associated open space	12.0km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No
Site Allocations and Area Specific Policies Development Plan Document - East Suffolk Kelsale cum Carlton 1.86ha of land south of Ambleside, Main Road Kelsale cum Carlton, is identified for residential use for approximately 30 units although a	6.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.7 e iii of this report.	No

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
higher quantum of development may be appropriate subject to design and layout				
East Suffolk emerging Local Plan Benhall 1.76ha of land south of Forge Close between Main Road and Ayden, Benhall, as shown on the Policies Map, is identified for the development of approximately 50 dwellings	8.6km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
East Suffolk emerging Local Plan Darsham 7.33ha of land to the south of Darsham Station, as shown on the Policies Map, is identified for the development of approximately 120 dwellings and open space.	4.1km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
East Suffolk emerging Local Plan Darsham 1.11ha of land north of The Street, Darsham, as shown on the Policies Map, is identified for the development of approximately 25 dwellings	2.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
East Suffolk emerging Local Plan Westleton 0.73ha of land to the west of the B1125, Westleton, as shown on the Policies Map, is identified for the development of approximately 20 dwellings.	0.6km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
1.21ha of land at Cherry Lee, Darsham Road, as shown on the Policies Map, is identified for the development of approximately 15 dwellings	0.8km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.1. Mixed use development. 22.05ha. Approx. 215 dwellings, health care/retirement 2.3ha, sports 8.6ha, education facility	7.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.5. Land at Dairy Farm, Saxons Way, Halesworth (1.44ha) as identified on the Policies	7.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No

In-Combination Plan Or Project	Distance to Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Map is allocated for a residential development of approximately 40 dwellings and a community centre and pre-school setting.				
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.4. Land west of Lodge Road, Holton (0.70ha) as identified on the Policies Map is allocated for a residential development of approximately 15 dwellings.	6.6km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Wrentham Waveney Local Plan 7.8. Land north of Chapel Road, Wrentham. Residential. 4.82ha. Approx. 60 dwellings and open space	6.2km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.7 e iii of this report.	No

ii. Alteration of coastal processes / sediment transport

7.7.92. During the screening process it was also identified that the potential exists for an in-combination effect to occur due to potential changes in coastal processes / sediment transport arising from dredging activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP coastal management options.

7.7.93. The potential in-combination effects on the Minsmere to Walberswick Heaths and Marshes SAC are the same as those set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e iii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Minsmere to Walberswick Heaths and Marshes SAC due to changes to coastal processes / sediment transport.

iii. Disturbance due to an increase in recreational pressure

7.7.94. The Suffolk 'Recreational Disturbance Avoidance & Mitigation Strategy' (the 'RAMS Strategy') (Ref. 7.22) is a means by which sustainable housing growth can be delivered in the areas of Ipswich Borough, Babergh District, Mid Suffolk District and East Suffolk Councils. The RAMS Strategy facilitates new housing development whilst securing measures to avoid or mitigate potential additional recreational pressures on estuarine, coastal and heathland European Sites. The Strategy does not cover additional potential effects that may occur due to residential development (e.g. changes to air/water quality), nor any non-residential development. As such, whilst the Strategy is not directly applicable to the Sizewell C Project, SZC Co. is committed to the principles outlined within the Strategy and would adopt a similar approach to mitigate for any potential impacts. Such an approach would be secured via a monitoring and mitigation plan/agreement with relevant organisations/site managers to the European Site in question (e.g. the RSPB).

7.7.95. Where proposed or approved housing development pre-dates implementation of the RAMS Strategy, individual developers have committed to a suite of mitigation measures agreed with the relevant local planning authority to offset the potential for any impacts from increased recreational disturbance pressures on European Sites. Such measures include: a financial contribution per dwelling, information pack for designated sites, communications from the Suffolk Coast and Heaths Area of Outstanding Natural Beauty, signage at PRoW 'entrances' to designated sites, monitoring of visitor disturbance and on-site provision of green infrastructure.

7.7.96. It is considered that proposed housing developments which are covered by the RAMS Strategy, or by project-specific mitigation commitments, do not have the potential to cause an in-combination effect due to potential

increases in recreational pressure with the activities of the Sizewell C Project. Therefore, it is predicted that an in-combination effect due to recreational disturbance upon the Minsmere to Walberswick Heaths and Marshes SAC would not arise.

7.8 Assessment of effects: Minsmere-Walberswick Ramsar site

a) Summary of screening outcomes

7.8.1. The screened in effect pathways for the Ramsar site's screened in criteria (criterion 1 and 2) due to the influence of the main development site are:

- alteration of coastal processes / sediment transport;
- water quality effects – marine environment;
- water quality effects – terrestrial environment;
- alteration of local hydrology and hydrogeology;
- changes in air quality; and
- disturbance due to increase in recreational pressure.

7.8.2. There are no effect pathways from the Sizewell C Project associated development sites to the Ramsar criterion of the Minsmere-Walberswick Ramsar site screened in to the Appropriate Assessment.

7.8.3. The above main development site effects are considered below for each relevant phase of the Sizewell C Project.

b) Ramsar criterion 1 and criterion 2

i. Alteration of coastal processes/sediment transport

Construction, operation and decommissioning

7.8.4. Based on the evidence presented in section 7.3 of this report (and supported by Ref. 6.1), the construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport to or in the Minsmere-Walberswick Ramsar site.

7.8.5. SSC created by dredging operations would reduce to background levels within four days after dredging ceases as seen in section 7.3 c i of this report. Sediment deposited from the plume would be restricted to offshore and be too far away to interact with the wetlands. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would

be no change to coastal processes and sediment transport as seen in section 7.3 of this report.

ii. Water quality effects – marine environment

Construction and decommissioning

7.8.6. The effect pathways for changes to the water quality on this criterion and the agreed threshold above which significant ecological effects would occur are the same as described in section 7.7 c ii of this report. Therefore, it is concluded that there would not be an adverse effect on the integrity of the marine features of Ramsar criterion 1 and criterion 2 of the Minsmere-Walberswick Ramsar site due to water quality effects during the construction phase.

Operation

7.8.7. The assessment of effects from changes to marine water quality during operation is undertaken for criterion 1 only; criterion 2 (nationally-scarce plant species and British Red Data Book invertebrates) was screened out of operational impacts due to changes in marine water quality. The Minsmere-Walberswick Ramsar site is situated within, and adjacent to, the thermal discharge plume. **Figure 7.9** shows the extent of the predicted plume respective to the site.

7.8.8. The site is composed of a number of different habitats, such as dykes, reedbeds, grazing marsh, lagoons, and shingle. The majority of the habitats found within the Ramsar site that support the qualifying bird assemblage (criterion 2) are located above MHWS. These habitats support an important assemblage of rare breeding birds associated with marshland and reedbeds, but none of the habitats above MHWS would be affected by the thermal plume.

7.8.9. The criterion 1 coastal habitats found at the Ramsar site include coastal dunes and shingle. Both habitats are located either within the splash zone at the limits of the tide or above the tidal limit. Therefore, the level of interaction between the habitats and the thermal plume would be small. **Figure 7.9** shows that the predicted extent of the Sizewell C plume (alone) does not interact with the Ramsar site. The combined Sizewell B and Sizewell C plume (which would be less than that shown in **Figure 7.3**) is not expected to overlap with the habitat features of criterion 1.

7.8.10. Salinity monitoring of the coastal lagoon at Minsmere has shown that the pond is brackish in nature, indicating a source of saline water (Ref. 7.23). Seawater is thought to enter the lagoon slowly and most likely through the slow diffusion through the dune system between the lagoon and the coast.

Due to the slow diffusion of seawater through the sediment, any heat retained in the water from the thermal plume would slowly dissipate as the seawater percolates through the sediment to the lagoon. Therefore, an adverse effect on water quality within the lagoon from the Sizewell C thermal plume is also not predicted.

7.8.11. With regard to changes to water quality from moribund debris, the assessment reported for the Alde, Ore and Butley Estuaries SAC also applies to the Minsmere to Walberswick Heaths and Marshes SAC. Therefore, it is concluded that there would not be an adverse effect on the integrity of the qualifying features of the SAC due to changes in marine water quality from moribund biota discharged from the FRR system.

iii. Alteration of local hydrology and hydrogeology

Construction and decommissioning

7.8.12. The potential for the construction and decommissioning phase to result in changes to hydrological conditions (surface water and groundwater) results in a potential pathway for effect on criterion 1 and criterion 2 of the Ramsar site. For example, the range of plant species supported, and plant composition and distribution could be affected by a change in the hydrological regime.

7.8.13. The Plants and Habitats Synthesis Report as provided in **Volume 2, Chapter 14, Appendix 14B1** of the **ES** and **Volume 2, Chapters 14** and **19** of the **ES** (Doc Ref. 6.3) discuss the predicted effects of the construction phase on the surface water and groundwater regimes.

7.8.14. With respect to the surface water regime, the Minsmere Sluice is the main control structure governing the flow and water level regimes of the Minsmere New Cut, Leiston Drain and Scott's Hall Drains. The sluice is divided into two chambers, each with its own gravity-outlet culvert. The northern chamber receives flows from the Minsmere New Cut, while the southern chamber receives flows from Leiston Drain and Scott's Hall Drains.

7.8.15. There is the theoretical possibility that if the flows within the Leiston Drain are increased, as a result of the construction of the proposed development to the south, this would cause excessive back flooding of the Scott's Hall Drain. This back flooding could then result in increased inundation of habitats within part of the Ramsar site, preventing control of water levels.

7.8.16. The Leiston Drain drainage system provides a relatively small hydrological input to the study area and supplies approximately 14% of the total contributing catchment of the Minsmere Sluice. As part of the construction phase, the Sizewell Drain (a tributary of the Leiston Drain) would be diverted,

parallel to the base of the platform slope. At its northern extent, it would discharge to the Leiston Drain upstream of the proposed SSSI crossing. In addition, revised water level management may be required for the Sizewell Marshes SSSI adjacent to the construction site. This would require the inclusion of additional water level control structures and potentially the revised operation of other existing structures. The design of the structures would consider the interfaces with other drains and ditches and aim to ensure the existing water balance of the surrounding wetlands was maintained. The enhanced water level control within the Sizewell Marshes SSSI would allow for fine tuning of the management regime over time.

7.8.17. There is a potential risk that a greater volume of discharge down the Leiston Drain may be required to ensure the Sizewell Marshes SSSI water levels (which does not form part of the Ramsar site) behind the water management structures are maintained. If the increased discharge flows are sufficient to reduce available capacity in the southern chamber of the Minsmere Sluice, this could cause back flooding within the Scott's Hall Drain, potentially affecting the Minsmere to Walberswick Heaths and Marshes SSSI, part of which is included within the Ramsar site.

7.8.18. Primary mitigation measures are embedded in the design to manage surface water discharges from the proposed development adequately during the construction phases that could potentially affect the flow regime of the systems. These measures, combined with the proposed Sizewell Drain realignment, largely isolate the proposed development from the surrounding areas. The mitigation measures also ensure that any flows discharged to an existing surface water receptor would have passed through water quality treatment measures and would be discharged at greenfield rates.

7.8.19. The proposed water management structures would also allow for easy manipulation of the water levels and flows and thus levels/flows within the Leiston Drain could be reduced as and when required to allow for the Scott's Hall Drain to discharge efficiently when required. This coupled with the fact that the relatively small contribution from Leiston Drain to the overall flow at Minsmere Sluice, limited effects on the flow regime of the southern chamber of the Minsmere Sluice are anticipated and thus no significant effect is predicted for the Scott's Hall Drain and associated drainage network. It is, therefore, anticipated that the proposed development should create no significant effect on the flow regime or water quality of the existing surface water receptors and, therefore, no effect on the habitats within the Ramsar site.

7.8.20. With respect to groundwater, modelling predicts drawdown of less than 10 cm for a very localised part of the Ramsar site, just to the north of the main platform. The predicted affected area is less than 0.6ha, equating to 0.03% of the Ramsar site (total area of 2,019ha).

7.8.21. The modelling study predicts that the effect of drawdown of groundwater would be short-term and reversible (once the dewatering operations have concluded) and, therefore, it is unlikely that there would be any lasting effect on the habitats or species of the Ramsar site. In addition, the habitats present in this part of the Ramsar site as provided in **Volume 2, Chapter 14** of the **ES** (Doc Ref. 6.3), are not wetland habitats and are not considered sensitive to changes in groundwater level (i.e. the area predicted to be affected does not consist of fen meadow but consists broadly of lowland grassland and some lowland marsh and swamp).

7.8.22. In conclusion, given the minor predicted effect on groundwater, localised area of effect, temporary nature of the effect and the lack of sensitive habitats, it is predicted that there would not be an adverse effect on the integrity of the Ramsar site.

Operation

7.8.23. As described above, no effect is predicted beyond the construction phase. Consequently, it is concluded that there would not be an adverse effect on the integrity of the Ramsar site during the operational phase.

iv. Water quality effects – terrestrial environment

Construction and decommissioning

7.8.24. As described within the assessment for 'alteration of local hydrology and hydrogeology', mitigation measures are embedded in the design to manage surface water discharges.

7.8.25. Infrastructure would be in place to ensure all surface run-off and foul water is captured and treated and does not enter the Ramsar site. Run-off would be managed as part of the **Construction Drainage Strategy** which would include mitigation measures to manage surface water discharges as detailed in **Volume 2, Chapter 19** of the **ES** (Doc Ref. 6.3).

7.8.26. Ditches, bunds and swales would be constructed, as required, to prevent untreated surface water run-off from leaving the site. Oil/petrol interceptors would be incorporated into the drainage design. Where complete infiltration to ground is not feasible, water management zones are included in the design. These systems would be designed to discharge treated water to the surface water drainage network at greenfield run-off rates. Foul water would be pumped to a central treatment plant, prior to discharge to sea, preventing the contamination of surface waters with sewage effluent during construction.

7.8.27. In conclusion, given the proposed mitigation to manage surface water run-off during the construction and decommissioning phase, it is predicted that there

would not be an adverse effect on the integrity of the Ramsar site due to effect on water quality during this phase.

Operation

7.8.28. The principles of the strategy described for the construction phase are expected to apply during the operational phase (e.g. the use of swales etc.) and, therefore, it can be assumed that that there would not be an adverse effect on the integrity of the Ramsar site due to effects on water quality during this phase.

v. Changes in air quality

Construction and decommissioning

7.8.29. The assessment reported for the Minsmere to Walberswick Heaths and Marshes SAC also applies to the Minsmere-Walberswick Ramsar site. It is concluded that there would not be an adverse effect on the integrity of the Minsmere-Walberswick Ramsar due to air quality effects during the construction phase.

Operation

7.8.30. The methodology for this assessment is as described for the estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC.

7.8.31. For the purposes of the modelling, the habitats of the Minsmere-Walberswick Ramsar site are defined as coastal floodplain grazing marsh and reedbed. The relevant nitrogen Critical Load classes (defined in APIS) are 'fen, marsh and swamp (rush pasture - moist and wet oligotrophic grassland)' (with a Critical Load of 15 – 25kg N/ha/yr) and 'rich fens - fen, marsh and swamp (swamp, fen meadow and reedbeds)' (with a Critical Load of 15 – 30kg N/ha/yr).

7.8.32. For acid deposition, the relevant acidity classes (defined in APIS) are 'Acid Grassland' and 'Swamp, fen and reedbed'. The Critical Loads for acid deposition are the same for these two acidity classes and are presented in **Table 7.9**.

Table 7.9: Critical loads for acid deposition (Acid Grassland and Swamp, fen and reedbed)

MinCLMinN	MinCLMaxN	MinCLMaxS
0.223	0.568	0.215

NOx Critical Levels

7.8.33. The modelling predictions for NOx Critical Levels apply at the European site level and, therefore, the assessment reported for the Minsmere to Walberswick Heaths and Marshes SAC applies to the Minsmere-Walberswick Ramsar site, namely:

- The annual average (long-term) PC for NOx during commissioning is predicted to be 13.5µg/m3, or 45% of the Critical Level, and the PEC is predicted to be 71% of the Critical Level at the Ramsar site.
- The daily average (short-term) PC for NOx during routine testing is predicted to be 303.6 µg/m^3, or 405% of the Critical Level, and the PEC is predicted to be 420% of the Critical Level.

7.8.34. According to Defra and Environment Agency (2016) guidance (Ref. 7.15), given these predicted changes, further assessment of the potential effect on the Ramsar site is required.

7.8.35. The same assessment reported for the Minsmere to Walberswick Heaths and Marshes SAC applies here (section 7.7 b i of this report). In conclusion, there would not be an adverse effect on the integrity of the Ramsar criteria due to long-term or daily NOx exceedance of the Critical Level during commissioning or routine testing.

Nitrogen and acid deposition Critical Loads

7.8.36. During commissioning, fen, marsh and swamp (rush pasture - moist and wet oligotrophic grassland) habitat is predicted to experience increases in nitrogen deposition (PC) of more than 1% of the Critical Load (7.3%). The PEC is predicted to exceed 70% of the Critical Load (95%). During routine testing, the predictions are lower (2.1% and 89% for PC and PEC respectively). Rich fens - fen, marsh and swamp (swamp, fen meadow and reedbeds) are not predicted to experience an increase in nutrient nitrogen deposition of greater than 1%.

7.8.37. Acid deposition during commissioning is predicted to increase by more than 1% of the Critical Load (21.1%) and the PEC is predicted to exceed 70% of the Critical Load (214.8%) for fen, marsh and swamp (rush pasture - moist and wet oligotrophic grassland) habitat. During routine testing, the predictions are lower (7% and 200.7% for PC and PEC respectively). Rich fens - fen, marsh and swamp (swamp, fen meadow and reedbeds) are not predicted to experience an increase in acid deposition of greater than 1%.

7.8.38. The same assessment as reported for the Minsmere to Walberswick Heaths and Marshes SAC applies here as seen in section 7.7 b i of this report.

Hence, as above, there would not be an adverse effect on the integrity of the Ramsar criteria due to nutrient nitrogen or acid deposition.

7.8.39. Ramsar criterion 2 relates to nationally scarce plants and red data book invertebrates. There are no bespoke Critical Levels or Critical Loads for these features and, therefore, the modelling predictions and assessment for the Ramsar site as a whole have been taken as being applicable to both Ramsar site criteria. Whilst invertebrates would not be expected have the same degree of sensitivity to nutrient nitrogen and acid depiction as the habitats within the Ramsar site, in the absence of bespoke Critical Levels or Critical Loads, the approach adopted is reasonable given that the modelling and assessment has been undertaken on the mosaic of habitats that supported Ramsar criterion 2 features. Consequently, it is concluded that there would be no adverse effect on the integrity of the qualifying criteria of the Ramsar site.

vi. Disturbance due to increase in recreational pressure

Construction, operation and decommissioning

7.8.40. The assessment carried out for 'annual vegetation of drift lines' in section 7.7 b ii of this report also applies to the Ramsar criterion 1 and criterion 2 of the site.

7.8.41. Application of the Rights of Way and Access Strategy is intended to substantially reduce the potential displacement of people from the Sizewell C area to nearby European sites, such as the Minsmere-Walberswick Ramsar site, which would minimise any potential increase in the trampling of vegetation.

7.8.42. It is, therefore, concluded that an adverse effect on the integrity of the Minsmere-Walberswick Ramsar site would not arise due to an increase in recreational pressure on Ramsar criterion 1 and criterion 2.

c) Summary of alone effects for the European site

7.8.43. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities associated with Sizewell C would not adversely affect the integrity of the Minsmere-Walberswick Ramsar site in view of its relevant qualifying features and

d) In-combination effects for the European site

7.8.44. **Table 7.10** contains those plans and projects that were screened in to the Appropriate Assessment that could have an in-combination effect with the Sizewell C Project on the Minsmere-Walberswick Ramsar site.

i. Water quality effects – marine environment

7.8.45. During the screening process it was identified that the potential exists for an in-combination effect to occur due to potential changes in water quality arising from water discharge activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP proposals.

7.8.46. The in-combination effect on the Minsmere-Walberswick Ramsar site would be the same as that set out for the Alde, Ore and Butley Estuaries SAC, as described in section 7.4 e of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Minsmere-Walberswick Ramsar site due to changes in marine water quality.

Table 7.10: In-combination assessment of plans and projects with the potential to affect habitats within the Minsmere-Walberswick Ramsar site

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Suffolk SMP	Adjacent	Changes in coastal processes and water quality – marine.	There is the potential for an in-combination effect with the Sizewell C Project relating to changes in water quality and coastal processes as seen in sections 7.8 d i and 7.8 d ii of this report.	No
DC/16/2104/OUT Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be reserved except for access).	0.9km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.8 d iii of this report.	No
DC/16/1961/OUT An outline planning application for up to 187 dwellings to include car parking, open space provision with associated infrastructure and access.	1.3km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.8 d iii of this report.	No
DC/16/1322/OUT Outline Application - 100 new residential units (C3) with employment floorspace (B1) (approx. 1000m2) and family orientated public house / restaurant (A3/A4) (approx.770m2)	0.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as seen in section 7.8 d iii of this report.	No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
DC/18/2325/FUL Residential development of 40 dwellings, together with associated access roads, garaging and car parking	1.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
DC/16/3947/OUT Erection of 14 sheltered/extra care dwellings, together with residents lounge/meeting room and parking area	4.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
DC/18/2621/FUL Erection of 44 no. new dwellings with associated new access road.	6.0km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
DC/18/0702/FUL Residential development of 59 residential dwellings and associated landscaping and public open space, together with a new vehicular access from existing development and associated highway infrastructure	6.7km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
DC/17/3981/OUT Outline Application (Some Matters Reserved) - Construction of up to 200	13.7km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational	No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
dwellings including car parking, open space provision with associated infrastructure and access			pressure as provided in section 7.8 d iii of this report.	
DC/16/5410/OUT Outline Application (with all matters other than means of access reserved) for residential development of up to 160 dwellings with the provision of a new meadow, additional site wide open space and landscaping, land to enable an extension to the existing cemetery and vehicular accesses off Hill Farm Road	13.3km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
DC/19/1141/OUT Outline Application - Development of up to 220 dwellings with associated open space	12.0km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
Site Allocations and Area Specific Policies Development Plan Document - East Suffolk Kelsale cum Carlton 1.86ha of land south of Ambleside, Main Road Kelsale cum Carlton, is identified for residential use for approximately 30 units although a higher quantum of	6.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
development may be appropriate subject to design and layout				
East Suffolk emerging Local Plan Benhall 1.76ha of land south of Forge Close between Main Road and Ayden, Benhall, as shown on the Policies Map, is identified for the development of approximately 50 dwellings	8.6km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
East Suffolk emerging Local Plan Darsham 7.33ha of land to the south of Darsham Station, as shown on the Policies Map, is identified for the development of approximately 120 dwellings and open space.	4.1km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
East Suffolk emerging Local Plan Darsham 1.11ha of land north of The Street, Darsham, as shown on the Policies Map, is identified for the development of approximately 25 dwellings	2.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
East Suffolk emerging Local Plan Westleton	0.6km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational	No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
0.73ha of land to the west of the B1125, Westleton, as shown on the Policies Map, is identified for the development of approximately 20 dwellings.			pressure as provided in section 7.8 d iii of this report.	
1.21ha of land at Cherry Lee, Darsham Road, as shown on the Policies Map, is identified for the development of approximately 15 dwellings	0.8km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.1. Mixed use development. 22.05ha. Approx. 215 dwellings, health care/retirement 2.3ha, sports 8.6ha, education facility	6.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.5. Land at Dairy Farm, Saxons Way, Halesworth (1.44ha) as identified on the Policies Map is allocated for a residential development of approximately 40	6.5km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
dwellings and a community centre and pre-school setting.				
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.4. Land west of Lodge Road, Holton (0.70ha) as identified on the Policies Map is allocated for a residential development of approximately 15 dwellings.	4.4km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Wrentham Waveney Local Plan 7.8. Land north of Chapel Road, Wrentham. Residential. 4.82ha. Approx 60 dwellings and open space	6.2km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure as provided in section 7.8 d iii of this report.	No

ii. Alteration of coastal processes / sediment transport

7.8.47. During the screening process it was also identified that the potential exists for an in-combination effect to occur due to potential changes in coastal processes / sediment transport arising from dredging activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP coastal management options.

7.8.48. The in-combination effect on the Minsmere-Walberswick Ramsar site would be the same as that set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e iii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Minsmere-Walberswick Ramsar site due to changes to coastal processes / sediment transport.

iii. Disturbance due to an increase in recreational pressure

7.8.49. As discussed in section 7.7 e iii of this report, the Suffolk 'RAMS Strategy' (Ref. 7.22) facilitates new housing development whilst securing measures to avoid or mitigate potential additional recreational pressures on estuarine, coastal and heathland European sites. Where proposed or approved housing development pre-dates implementation of the RAMS Strategy, individual developers have committed to a suite of mitigation measures agreed with the relevant local planning authority to offset the potential for any impacts from increased recreational disturbance pressures on European sites.

7.8.50. As such, potential recreational pressure effects from the Sizewell C Project in-combination with proposed housing developments covered by the requirements of the RAMS Strategy, or by project-specific mitigation commitments, are not predicted to have an in-combination effect upon the Minsmere-Walberswick Ramsar site.

7.9 Assessment of effects: Orfordness to Shingle Street SAC

a) Summary of screening outcomes

7.9.1. The screened in effect pathways for the SAC's 'coastal lagoons', 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' due to the influence of the main development site are:

- alteration of coastal processes / sediment transport;
- water quality effects – marine environment;
- changes in air quality; and

- disturbance due to increase in recreational pressure.

7.9.2. These effects are considered below for each relevant phase of the Sizewell C Project.

7.9.3. There are no effect pathways from the Sizewell C Project associated development sites to the screened in qualifying features.

b) Coastal lagoons

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

7.9.4. The construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport for the coastal lagoons qualifying feature of the Orfordness to Shingle Street SAC.

7.9.5. SSC created by dredging operations would reduce to background levels within four days of dredging ceasing, as seen in section 7.3 c i of this report. Sediment deposited from the plume would be restricted to offshore and be too far away to interact with the lagoons.

7.9.6. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would be no change to the coastal processes affecting the lagoons, as seen in section 7.3 of this report.

ii. Water quality effects – marine environment

Construction and decommissioning

7.9.7. During the construction and decommissioning phases, the installation/ decommissioning of infrastructure in the marine environment and vessel traffic represent potential pathways for contamination. These pathways and the outcomes of the H1 Environmental Risk Assessment have been described for the Minsmere to Walberswick Heaths and Marshes SAC in section 7.7 c ii of this report.

7.9.8. Chromium and zinc were the only contaminants that failed the screening undertaken for the H1 Environmental Risk Assessment. The modelling shows that the chromium plume was predicted to be below the EQS within 5.5ha of the CDO at the sea surface. Orfordness to Shingle Street SAC is located approximately 8km to the south of the CDO; therefore, there is no pathway of effect from the discharge of chromium as a contaminant to the SAC. The modelling also shows that zinc concentrations would be indiscernible from background levels within 0.11ha of the CDO outfall.

7.9.9. In conclusion, an adverse effect on the coastal lagoon features of the SAC from changes to water quality during construction and decommissioning is not predicted.

Operation

7.9.10. Marine and coastal habitats could be affected by changes in water quality during the operational phase due to discharge activities from the cooling water system. Section 7.3 of this report provides a description of the thermal and chemical plume to be discharged from the system.

Thermal discharge

7.9.11. **Figure 7.10** shows the extent of the thermal plume that exceeds the 2°C and 3°C (98th percentile) in relation to Orfordness-Shingle Street SAC.

7.9.12. Although the lagoons occur landward of the highest astronomical tide (HAT), the salinity of the lagoons is maintained by percolation through the shingle and overtopping during high tides. The Advice on Operations provided by Natural England (2019 – Ref. 7.24) states that the coastal lagoons are sensitive to an increase in temperature and the risk of this pressure is dependent on its spatial/temporal scale and the intensity of the activity. The sensitivity of the coastal lagoons from an increase in temperature from power station cooling waters has been classified as low, with a long-term (one year or more) pressure benchmark of a 2°C uplift and a short-term benchmark of a 5°C increase in temperature (Ref. 7.24).

7.9.13. Whilst there is a predicted overlap in the 2°C (98th percentile) EQS thermal contour line and the SAC, the extent of this is limited to within the tidal range, i.e. up to MHWS. As the lagoons sit behind the shingle bank, the seawater would percolate slowly through the shingle before reaching the lagoons themselves. The slow percolation of water through the lagoon would result in dissipation of any retained heat by the time it reaches the lagoons, thus reducing the percolating seawater temperature to below the EQS.

7.9.14. Overtopping of the shingle bank with seawater during high tide would introduce elevated seawater temperatures for a short duration of time only, with seawater temperature well below the short-term 5°C benchmark. Consequently, an adverse effect on the water quality of the coastal lagoons of the SAC is not predicted.

Chemical discharge

7.9.15. From **Figure 7.6** to **Figure 7.8**, it can be seen that the extent of the chemical plumes are not predicted to interact with the coastal lagoons qualifying

feature of the Orfordness to Shingle Street SAC. Therefore, an adverse effect on water quality from the chemical plume is not predicted.

Fish recovery and return: change to water quality from moribund biota

7.9.16. The assessment reported for the Alde, Ore and Butley Estuaries SAC applies to Orfordness to Shingle Street SAC as provided in section 7.4 b ii. It is concluded that there would not be an adverse effect on the integrity of the qualifying features of the SAC due to changes in marine water quality from moribund biota discharged from the FRR system.

iii. Changes in air quality

Construction and decommissioning

7.9.17. The Orfordness to Shingle Street SAC falls beyond the study area for the assessment of dust emissions based on the Institute of Air Quality Management 2016 guidance and no further consideration of construction dust in the context of this SAC is necessary.

7.9.18. The air quality assessment as provided in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3) screens out construction phase traffic effects for this European site (i.e. predicted effects are not significant).

Operation

7.9.19. The methodology for the assessment is as described for the Estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC as seen in section 7.4 b v of this volume.

7.9.20. The coastal lagoon qualifying feature is located more than 10km from the source of the operational combustion activity and therefore has not been specifically modelled for air quality effects. However modelling of the combustion scenarios for the nearer features within the SAC has been used within the assessment of coastal lagoon feature and predicts that the PC would be insignificant against the assessment criteria for Critical Levels of NOx (long-term), NOx (short-term) and SO_2 (long-term). In addition, the PC would be insignificant against the assessment criterion for the Critical Load for nutrient nitrogen deposition. On the basis of these predictions, it is concluded that there would not be an adverse effect on the integrity of the coastal lagoons of the Orfordness to Shingle Street SAC due to changes in air quality during the operational phase.

c) Annual vegetation of drift lines and perennial vegetation of stony banks

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

7.9.21. The construction, operation and decommissioning of the Sizewell C Project would have no effect on coastal processes and sediment transport for the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' qualifying features of the Orfordness to Shingle Street SAC.

7.9.22. SSC created by dredging operations would reduce to background levels within four days after dredging ceases as seen in section7.3 c i of this report. Sediment deposited from the plume would be restricted to offshore and be too far away to interact with the beaches as provided in section 7.3 of this report. The changes in tidal currents, waves and sediment transport due to the operation of Sizewell C would be confined to the local area around the sources of disturbance and there would be no change to coastal processes and sediment transport along the regional coast.

ii. Water quality effects – marine environment

Construction and decommissioning

7.9.23. The pathways for potential changes to the water quality of this qualifying feature and the agreed threshold above which significant ecological effects would occur are the same as for coastal lagoons described in section 7.9 b ii of this report Therefore, it is concluded that there would not be an adverse effect on the integrity of the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' interest feature of Orfordness to Shingle Street SAC due to water quality effects during the construction and decommissioning phases.

Operation

7.9.24. There is no effect pathway from the thermal or chemical plume to the annual vegetation of drift lines, as it is located at or above MHWS. Perennial vegetation of stony banks was not screened in to the assessment as this habitat type lies above the MHWS. Therefore, it can be concluded that an adverse effect would not arise from the thermal and chemical plume upon the integrity of these features of the SAC.

7.9.25. With regard to changes to water quality from moribund debris, the assessment reported for the Alde, Ore and Butley Estuaries SAC applies to Orfordness to Shingle Street SAC as seen in section 7.4 b ii of this report. Therefore, it is concluded that there would not be an adverse effect on the

integrity of the qualifying features of the SAC due to changes in marine water quality from moribund biota discharged from the FRR system.

iii. Changes in air quality

Construction and decommissioning

7.9.26. The Orfordness to Shingle Street SAC falls beyond the study area for the assessment of dust emissions based on the IAQM 2016 guidance and no further consideration of construction or decommissioning dust in the context of this SAC is necessary.

7.9.27. The air quality assessment as detailed in **Volume 2, Chapter 12** of the **ES** (Doc. Ref. 6.3) screens out construction phase traffic effects for this European site (i.e. predicted effects are not significant).

Operation

7.9.28. The methodology for this assessment is as described for the estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC as seen in section 7.4 b v of this report. This assessment is undertaken for perennial vegetation of stony banks qualifying feature only; the annual vegetation of drift lines qualifying feature was screened out with regard to potential operational impacts due to changes in air quality on the basis that APIS confirms that this qualifying feature is not sensitive to nutrient nitrogen or acid deposition.

7.9.29. For the perennial vegetation of stony banks qualifying feature of the Orfordness to Shingle Street SAC, the relevant nitrogen Critical Load class (defined in APIS) is 'coastal stable dune grasslands', with a Critical Load of 8 – 15 kg N/ha/yr.

7.9.30. For acid deposition, the relevant acidity class (defined in APIS) is Acid Grassland. The Critical Loads for acid deposition are presented in **Table 7.11**.

Table 7.11: Critical loads for acid deposition (Acid Grassland)

MinCLMinN	MinCLMaxN	MinCLMaxS
0.223	4.353	4.120

7.9.31. The modelling of the combustion scenarios as detailed in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3) predicts that for NOx (long-term) and NOx (daily) the maximum PC would be 0.2% and 4% of the Critical Level respectively and, therefore, not significant. For SO_2 (long-term), the PC would be 0% of the Critical Level and, therefore, not significant. Hence it can be concluded that the Critical Level would not be exceeded for the perennial vegetation of

stony banks qualifying feature of the Orfordness to Shingle Street SAC. Critical Load. The maximum PC from the assessed scenarios would be insignificant against the assessment criterion for the Critical Load for nutrient nitrogen deposition, at 0.06% of the Critical Load. The predicted PC to acid deposition at the qualifying feature would also be insignificant against the assessment criterion at less than 1% of the Critical Load function.

7.9.32. On the basis of these predictions, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

iv. Disturbance due to increase in recreational pressure

Construction, decommissioning and operation

7.9.33. During construction, operation and decommissioning, the key potential impact pathways experienced by the plant and habitats of the Orfordness to Shingle Street SAC would be associated with disturbance effects on habitats (comprising trampling and other effects due to displacement of recreational users).

7.9.34. The main area where sensitive shingle vegetation is present, is along the Orfordness to Shingle Street shingle spit and the main access point to the shingle spit is by boat from Orford. Once on the spit, access is controlled by the National Trust, with access to sensitive shingle vegetation prevented by fencing and signage. It is possible to access the spit by walking from Aldeburgh (there is a car park at the southern end of the town), but it is envisaged that most people would access the town beach rather than undertake a longer return walk to access the shingle spit. In addition, clear fencing and signage from the National Trust indicate that access is prohibited from this direction.

7.9.35. For the reasons given above, it is concluded that there would not be an adverse effect on the integrity of the 'annual vegetation of drift lines' and 'perennial vegetation of stony banks' of the Orfordness to Shingle Street SAC due to recreational disturbance effects during the construction, decommissioning and operational phases.

d) Summary of alone effects for the European site

7.9.36. Based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of the Sizewell C Project would not adversely affect the integrity of Orfordness to Shingle Street SAC in view of its relevant qualifying features and conservation objectives.

e) In-combination effects for the European site

7.9.37. **Table 7.12** lists those plans and projects that were screened in to the Appropriate Assessment that could have an in-combination effect with the Sizewell C Project on Orfordness to Shingle Street SAC.

i. Water quality effects – marine environment

7.9.38. During the screening process it was identified that the potential exists for an in-combination effect to occur due to potential changes in water quality arising from water discharge activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP proposals.

7.9.39. The in-combination effect on the Orfordness to Shingle Street SAC would be the same as that set out for the Alde, Ore and Butley Estuaries SAC, as described in section 7.4 e ii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Orfordness to Shingle Street SAC due to changes in marine water quality.

ii. Alteration of coastal processes / sediment transport

7.9.40. During the screening process it was also identified that the potential exists for an in-combination effect to occur due to potential changes in coastal processes / sediment transport arising from dredging activities associated with the construction, operation and decommissioning of the Sizewell C Project and the Suffolk SMP coastal management options

7.9.41. The in-combination effect on the Orfordness to Shingle Street SAC would be the same as that set out for the Alde, Ore and Butley Estuaries SAC, described in section 7.4 e iii of this report. Therefore, it is concluded that the Suffolk SMP would not have an in-combination effect with the Sizewell C Project activities on the Orfordness to Shingle Street SAC due to changes to coastal processes / sediment transport.

Table 7.12: In-combination assessment of plans and projects with the potential to affect habitats within Orfordness to Shingle Street SAC

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Habitats	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Suffolk SMP7	9km	Changes to water quality – marine Alteration of coastal processes.	The potential for an in-combination effect with the Sizewell C Project relating to changes in water quality and coastal processes and discussed and discounted in section 7.9 e i and ii of this report.	No
Shingle Recycling from Sudbourne Beach to Slaughden Sea Defences.	8.8km	Changes to water quality – marine Alteration of coastal processes	The potential for an in-combination effect with the Sizewell C Project relating to changes in water quality and coastal processes and discussed and discounted in section 7.9 e i and ii of this report.	No

7.9.42. With regard to proposed shingle recycling from Sudbourne Beach to Slaughden sea defences, the Environment Agency state in its 'Summary Document to inform Appropriate Assessment of shingle recycling' (Ref. 7.25) that the only potential for an impact is on the feature 'annual vegetation of drift lines' for the Orfordness to Shingle Street SAC. However, any decrease in vegetation cover via this operation is deemed not to be significant in comparison to changes to the drift line vegetation caused by storms and storm surges. Therefore, no in-combination effects are predicted due to the proposed Sizewell C Project and shingle recycling operations at Sudbourne beach on the Orfordness to Shingle Street SAC.

8 Information for Appropriate Assessment: Birds

8.1 Introduction

8.1.1. The information required to inform an Appropriate Assessment of the effects of the Sizewell C Project on the European sites and qualifying interest features screened in for birds is presented below.

8.1.2. The following table sets out the structure of this section to assist in navigation.

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8.1	**Introduction**
8.2	**Generic conservation objectives**
8.3	**Assessment of effects: Alde-Ore Estuary SPA**
a)	Summary of screening outcomes, project alone
b)	Effects on breeding Sandwich tern, project alone
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ii.	Water quality effects – marine environment
iii.	Water quality effects – terrestrial environment
iv.	Alteration of local hydrology and hydro-geology
v.	Changes in air quality
vi.	Disturbance due to increase in recreational pressure
vii.	Physical interaction between species and project infrastructure
c)	Effects on breeding little tern, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Water quality effects – terrestrial environment
iv.	Alteration of local hydrology and hydro-geology
v.	Changes in air quality
vi.	Disturbance due to increase in recreational pressure
vii.	Physical interaction between species and project infrastructure
d)	Effects on breeding lesser black-backed gull, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Water quality effects – terrestrial environment
iv.	Alteration of local hydrology and hydrogeology
v.	Changes in air quality

SECTION 8: BIRDS	
vi.	Disturbance due to increase in recreational pressure
vii.	Physical interaction between species and project infrastructure
e)	Effects on breeding avocet, project alone
i.	Changes in air quality
ii.	Disturbance due to increase in recreational pressure
f)	Effects on breeding marsh harrier, project alone
i.	Changes in air quality
ii.	Disturbance due to increase in recreational pressure
g)	Effects on non-breeding avocet, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – terrestrial environment
iii.	Alteration of local hydrology and hydrogeology
iv.	Changes in air quality
v.	Disturbance due to increase in recreational pressure
h)	Effects on non-breeding redshank, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – terrestrial environment
iii.	Alteration of local hydrology and hydrogeology
iv.	Changes in air quality
v.	Disturbance due to increase in recreational pressure
i)	Effects on non-breeding ruff, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – terrestrial environment
iii.	Alteration of local hydrology and hydrogeology
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v.	Disturbance due to increase in recreational pressure
j)	Conclusion Alde-Ore Estuary SPA, project alone
k)	In-combination effects
8.4	**Assessment of effects: Alde-Ore Estuary Ramsar site**
a)	Summary of screening outcomes, project alone
b)	Effects on qualifying features screened in, project alone
c)	Conclusion Alde-Ore estuary Ramsar site, project alone
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SECTION 8: BIRDS	
8.5	**Assessment of effects: Benacre to Easton Bavents SPA**
a)	Summary of screening outcomes, project alone
b)	Effects on breeding bittern, project alone
i.	Disturbance due to increase in recreational pressure
c)	Effects on breeding little tern, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Disturbance due to increase in recreational pressure
iv.	Physical interaction between species and project infrastructure
d)	Effects on breeding marsh harrier, project alone
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e)	Conclusion Benacre to Easton Bavents SPA, project alone
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8.6	**Assessment of effects: Deben Estuary SPA**
a)	Summary of Screening outcomes, project alone
b)	SPA qualifying features, project alone
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c)	Conclusion Deben Estuary SPA, project alone
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8.7	**Assessment of effects: Deben Estuary Ramsar site**
a)	Summary of Screening outcomes, project alone
b)	Effects on qualifying features screened in, project alone
c)	In-combination assessment
8.8	**Assessment of effects: Minsmere–Walberswick SPA**
a)	Summary of screening outcomes
b)	Breeding avocet, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology
iii.	Changes in air quality
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
c)	Breeding bittern, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology

SECTION 8: BIRDS	
iii.	Changes in air quality
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
d)	Breeding marsh harrier, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology
iii.	Changes in air quality
iv.	Direct habitat loss and fragmentation
v.	Disturbance effects on species populations
vi.	Disturbance due to increase in recreational pressure
e)	Breeding little tern, project alone
i.	Alteration of coastal processes / sediment transport
ii.	Water quality effects – marine environment
iii.	Water quality effects – terrestrial environment
iv.	Alteration of local hydrology and hydrogeology
v.	Changes in air quality
vi.	Disturbance effects on species populations
vii.	Disturbance due to increase in recreational pressure
viii.	Physical interaction between species and project infrastructure
f)	Breeding gadwall, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology
iii.	Changes in air quality
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
g)	Breeding shoveler, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology
iii.	Changes in air quality
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
h)	Breeding teal, project alone
i.	Water quality effects – terrestrial environment
ii.	Alteration of local hydrology and hydrogeology

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iii.	Changes in air quality
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
i)	Breeding nightjar, project alone
i.	Changes in air quality
ii.	Direct habitat loss and fragmentation
iii.	Disturbance effects on species populations
iv.	Disturbance due increase in to recreational pressure
j)	Non-breeding hen harrier, project alone
i.	Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology
ii.	Changes in air quality
iii.	Direct habitat loss and fragmentation
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
k)	Non-breeding gadwall, project alone
i.	Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology
ii.	Changes in air quality
iii.	Direct habitat loss and fragmentation
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
l)	Non-breeding shoveler, project alone
i.	Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology
ii.	Changes in air quality
iii.	Direct habitat loss and fragmentation
iv.	Disturbance effects on species populations
v.	Disturbance due to increase in recreational pressure
m)	Non-breeding white-fronted goose, project alone
i.	Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology
ii.	Changes in air quality
iii.	Disturbance effects on species populations
iv.	Disturbance due to increase in recreational pressure

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n)	Conclusion for the Minsmere-Walberswick SPA, project alone
o)	In-combination effects
8.9	**Assessment of effects: Minsmere-Walberswick Ramsar site**
a)	Summary of screening outcomes, project alone
b)	Effects on qualifying features screened in, project alone
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8.10	**Assessment of effects: Outer Thames Estuary SPA**
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b)	Breeding little tern, project alone
i.	Water quality effects – marine environment
ii.	Disturbance effects on species populations
iii.	Physical interaction between species and project infrastructure
c)	Breeding common tern, project alone
i.	Water quality effects – marine environment
ii.	Disturbance effects on species populations
iii.	Physical interaction between species and project infrastructure
d)	Non-breeding red-throated diver, project alone
i.	Water quality effects – marine environment
ii.	Disturbance effects on species populations
iii.	Physical interaction between species and project infrastructure
e)	Conclusion for the Outer Thames Estuary SPA, project alone
f)	In-combination assessment
8.11	**Assessment of effects: Sandlings SPA**
a)	Summary of screening outcomes, project alone
b)	Breeding nightjar, project alone
i.	Changes in air quality
ii.	Direct habitat loss and fragmentation
iii.	Disturbance effects on species populations
iv.	Disturbance due to increase in recreational pressure
c)	Breeding woodlark, project alone
i.	Changes in air quality
ii.	Direct habitat loss and fragmentation
iii.	Disturbance effects on species populations

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iv.	Disturbance due to increase in recreational pressure
d)	Conclusion for Sandlings SPA, project alone
e)	In-combination assessment
8.12	**Assessment of effects: Stour and Orwell Estuaries SPA**
a)	Summary of screening outcomes, project alone
b)	SPA qualifying features, project alone
i.	Disturbance effects on species populations
c)	Conclusion for the Stour and Orwell Estuaries SPA, project alone
d)	In combination assessment
8.13	**Assessment of effects: Stour and Orwell Estuaries Ramsar site**
a)	Summary of screening outcomes
b)	Effects on qualifying features screened in, project alone
c)	In combination assessment

8.2 Generic conservation objectives

8.2.1. For SPAs, the following generic conservation objectives apply to all sites considered within this section:

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'qualifying features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- the extent and distribution of the habitats of the qualifying features;
- the structure and function of the habitats of the qualifying features;
- the supporting processes on which the habitats of the qualifying features rely;
- the population of each of the qualifying features; and
- the distribution of the qualifying features within the site.

8.2.2. The SPAs where these conservation objectives apply are:

- Alde-Ore Estuary SPA.

- Benacre to Easton Bavents SPA.
- Deben Estuary SPA
- Minsmere to Walberswick SPA.
- Outer Thames Estuary SPA.
- Sandlings SPA.
- Stour and Orwell Estuaries SPA.

8.2.3. For Ramsar sites, as the provisions of the Habitats Regulations relating to HRAs extend to Ramsar sites, Natural England considers that the conservation advice packages for the overlapping European site designations (i.e. SACs and SPAs) to be, in most cases, sufficient to support the management of the Ramsar interests. Hence Defra and Natural England have not produced separate conservation advice packages for Ramsar sites.

8.2.4. For certain SPAs and qualifying features, supplementary advice on the generic conservation objectives have been produced by Natural England which are also relevant to this assessment. Where applicable, these are referred to below, in the relevant sections where the effects of the Sizewell C Project on each qualifying feature are assessed.

8.3 Assessment of effects: Alde-Ore Estuary SPA

a) Summary of screening outcomes, project alone

8.3.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site.

- Alteration of coastal processes / sediment transport, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of little tern; Sandwich tern; lesser black-backed gull
  - Non-breeding populations of avocet; redshank; ruff
- Water quality effects – marine environment, during operation for the qualifying features:
  - Breeding populations of little tern; Sandwich tern; lesser black-backed gull

- Changes in air quality, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of avocet; marsh harrier; little tern; Sandwich tern; lesser black-backed gull
  - Non-breeding populations of avocet; redshank; ruff
- Disturbance due to increase in recreational pressure, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of avocet; marsh harrier; little tern; Sandwich tern; lesser black-backed gull
  - Non-breeding populations of avocet; redshank; ruff
- Physical interaction between species and project infrastructure, during operation for the qualifying features:
  - Breeding populations of little tern; Sandwich tern; lesser black-backed gull

8.3.2. The following potential effects were screened in for Appropriate Assessment in relation to the associated development sites:

- Water quality effects – terrestrial environment (two village bypass), during construction for the qualifying features:
  - Breeding populations of little tern; Sandwich tern; lesser black-backed gull
  - Non-breeding populations of avocet; redshank; ruff
- Alteration of local hydrology and hydro-geology, during construction, and operation (two village bypass) for the qualifying features:
  - Breeding populations of little tern; Sandwich tern; lesser black-backed gull
  - Non-breeding populations of avocet; redshank; ruff

b) Effects on breeding Sandwich tern, project alone

i. Alteration of coastal processes / sediment transport

8.3.3. As described in section 7.3 of this report, this effect refers to changes in coastal processes and sediment transport that may result from the construction, operation and decommissioning of marine infrastructure associated with the main development site, namely:

- construction and decommissioning of the discharge outfall;
- construction, operation and decommissioning of cooling water infrastructure (including the cooling water intake and outfall headworks on the seabed, and the outfall associated with the FRR);
- construction, operation and decommissioning of a BLF to receive deliveries of AILs by sea throughout the power station's operational life; and
- construction, operation and decommissioning (if applicable) of flood defence and coastal protection measures.

8.3.4. Modification of the local wave climate, current speeds and sediment transport processes by the presence of project infrastructure could reduce or enhance erosion and/or accretion along the coastline in the vicinity of Sizewell. If project infrastructure leads to significant change to coastal processes, then altered patterns of erosion/accretion could lead to a loss of coastal habitats (beach, shingle, dune) and potentially reduce flood defence resilience and increase the frequency of inundation of low-lying wetland habitats situated behind existing defences.

8.3.5. This could affect nesting, foraging and roosting habitats of Sandwich terns breeding within the Alde-Ore Estuary SPA given their reliance on coastal and intertidal habitats.

Construction, operation and decommissioning

8.3.6. Historically the coastline adjacent to the Sizewell power stations has been relatively stable with little change.

8.3.7. Modelling results indicate that the construction (decommissioning[17]) and operation of the main development site, including the construction/ decommissioning discharge outfall, cooling water infrastructure, FRR system, BLF and flood defence and coastal protection measures, would not significantly affect coastal processes. Any impacts on sediment transport would be confined to coastline within 200m of the BLF in each direction, with negligible changes outside this area.

8.3.8. The potential effects of increases in SSC associated with the construction, operation (including maintenance dredging) and decommissioning works are considered under water quality effects – marine environment as seen in section 8.3 b ii of this report.

[17] using construction as worst-case proxy for decommissioning.

8.3.9. The Alde-Ore Estuary SPA is situated approximately 5km south of the main development site. At this distance no effects are predicted on the coastal processes and sediment transport as a result of the construction or decommissioning of the main development site and, therefore, no changes in the extent of the supporting habitats of the qualifying features for which likely significant effects was identified on a precautionary basis.

8.3.10. Consequently, there is no likelihood of an adverse effect on the conservation objectives for breeding Sandwich tern to arise in these phases of the works.

ii. Water quality effects – marine environment

8.3.11. Changes in marine water quality as a result of the Sizewell C Project could potentially affect the availability of fish to the Alde-Ore Estuary SPA breeding Sandwich tern population, as well as to the other qualifying features of this SPA which forage within the marine environment. As specified above, for the Alde-Ore Estuary SPA, such potential effects have been screened in for the operational phase of the Sizewell C Project only.

8.3.12. This section assesses the potential effects on the SPA Sandwich tern population of the following operational discharges from the cooling water system:

- Thermal discharge – increases in water temperatures resulting from the cooling water discharges from the cooling water system outfalls being at higher temperatures than the surrounding receiving water.
- Chemical discharges, as follows:
  - total residual oxidant, which results from the combination of chlorine and organic material in the water (with chlorination of the cooling water system undertaken to avoid biofouling);
  - bromoform, which is the predominant chlorinated by-product resulting from chlorination of the cooling water system; and
  - Hydrazine, which is an oxygen scavenger used to inhibit corrosion in the steam generation circuits.

Operation

Thermal discharge

8.3.13. The thermal discharge from the cooling water system would create a thermal plume, which has been modelled by Cefas using the validated Sizewell GETM (with the full details of the model and detailed thermal plume maps presented in BEEMS Technical Report TR302 (Ref. 7.3), and summary information provided in the BEEMS Technical Report TR306 (Ref. 7.4).

8.3.14. As described in section 7.4 b ii of this report, thermal water quality standards are not always evidence based due to a lack of reliable data (BEEMS SAR008, 2011). Therefore, to protect the most sensitive species, thermal standards have been set on an indicative basis and, as such, act as trigger values for further investigation of potential ecological effects, with two threshold values recommended as trigger assessments for SPAs. That is:

- Increase above ambient - a temperature uplift of less than or equal to 2°C as the maximum allowed concentration at the edge of the mixing zone[18] (as a 100th percentile). The size of the predicted mixing zone is defined within BEEMS Technical Report TR302 (Ref. 7.3).
- Absolute temperature - the 98th percentile of less than or equal to 28°C.

8.3.15. Of these two thresholds, the evidence base is strongest for the latter, as it is known that the upper lethal temperature for many benthic organisms occurs between 30 – 33°C. In the case of the former, the 2°C uplift is not considered to have any specific ecological effects, so that it essentially serves as a precautionary threshold to trigger further ecological investigation (Ref. 8.1). These two thresholds provide markedly different outputs. For example, the overlap of the predicted thermal plume of the 2°C uplift at the sea surface (as a 100th percentile) for Sizewell C encompasses 168 km^2 (or 4.3%) of the area of the Outer Thames Estuary SPA, whereas that for the 28°C exceedance encompasses less than 0.01km^2 of this SPA at the sea surface (Ref. 8.1).

8.3.16. For the purposes of assessing the foraging area that is potentially 'lost' to birds foraging in the marine environment as a result of the thermal uplift, Cefas advise that it is more appropriate to base this on the 98th percentile, as opposed to the highly precautionary 100th percentile (Ref. 8.1).

8.3.17. In terms of the prey of Sandwich tern in the waters around Sizewell, pelagic species will be most important notably sprat and herring as provided in section 6.3a of this report (Ref. 7.10). Acoustic surveys of sprat at Sizewell have shown no apparent avoidance of the existing Sizewell B 2°C uplift chlorinated plume, whilst smelt (a locally common herring-like pelagic species) has shown avoidance at a temperature uplift of 4°C (Ref. 7.10, Ref. 6.148 and Ref. 8.1). On the basis of this evidence, it is considered that an avoidance threshold of a 3°C uplift would be sufficiently precautionary, with the 2°C uplift likely to be overly precautionary (Ref. 8.1).

8.3.18. In addition, it is appropriate to consider the thermal plumes associated with these different temperature uplifts for the period during which breeding Sandwich tern would be present at the SPA (as opposed to the full annual

[18] The mixing zone, as used by UK regulators, is the area around a discharge within which a regulator permits a quality standard to be exceeded (Ref. 6.148).

period), which is taken as April to August. Given this, the assessment for the Alde-Ore Estuary SPA Sandwich tern population focusses on the thermal plumes for both the 2°C and 3°C uplift thresholds as modelled from April to August. These are determined for the mean and maximum instantaneous plume sizes (as calculated at hourly intervals for the April to August period), as well as the 98th percentile, with the former providing higher resolution information on the extent of overlap with the SPA Sandwich tern foraging range (Ref. 8.1).

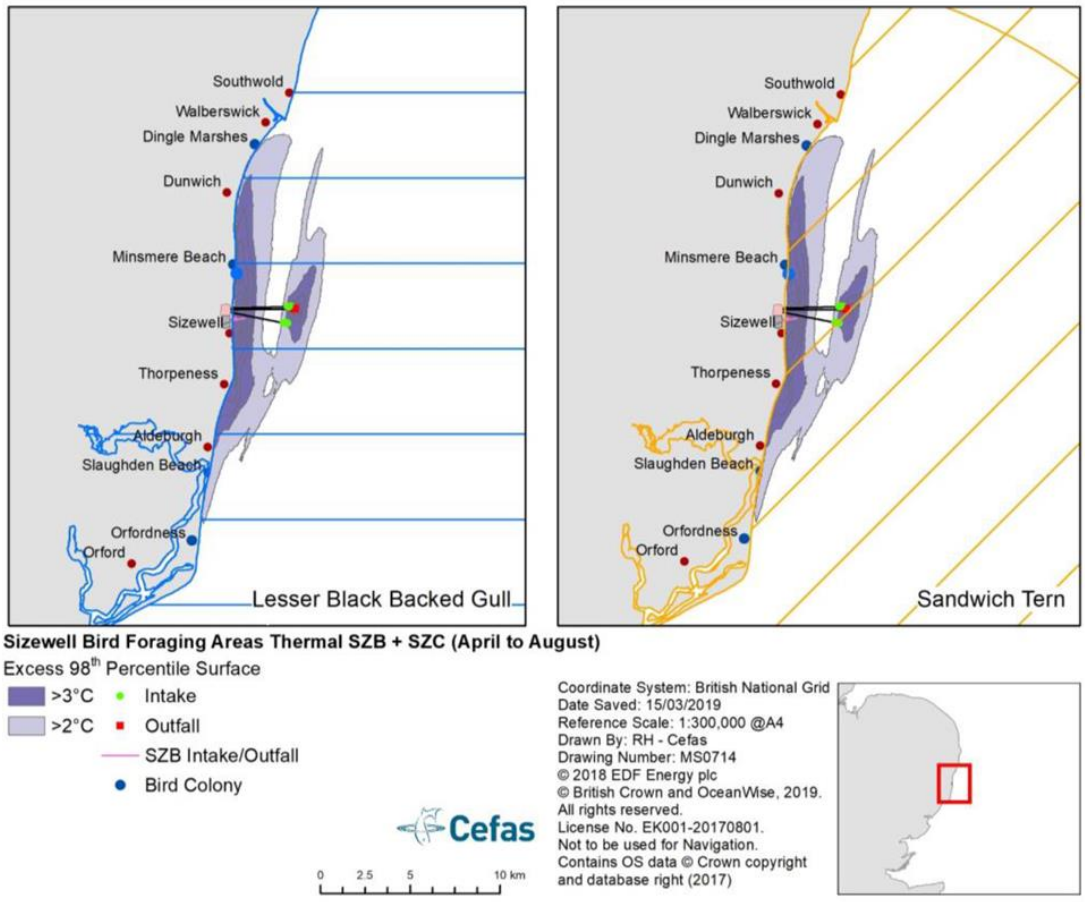
8.3.19. Importantly, the waters around Sizewell are already subject to thermal uplift as a consequence of the cooling water system discharges from the existing Sizewell B power station. Therefore, in undertaking the assessment of the potential effects of the Sizewell C thermal discharge, it is necessary to also consider and define the thermal plume for Sizewell B, as this represents part of the baseline conditions. The Sizewell B and Sizewell C thermal plumes are predicted to be separate at high uplift temperatures but at lower temperatures (e.g. 2°C and 3°C) the Sizewell C plume acts to increase the size and temperature of the Sizewell B plume at the surface and seabed (Ref. 7.6). Therefore, the assessment considers the extent and distribution (relative to the Sandwich tern foraging range) of the combined plumes (i.e. Sizewell B plus Sizewell C) in relation to those resulting from Sizewell B alone.

8.3.20. For the period from April to August, the areas encompassed at surface by the 98th percentiles for the existing 2°C and 3°C thermal plumes (for Sizewell B) extend to 18.6km^2 and 10.5 km^2, respectively (whilst the equivalent plumes for Sizewell C, when considered alone, extend across 9.8 km^2 and 2.8 km^2, respectively). Incorporating the Sizewell C thermal plumes together with the Sizewell B plumes increases these areas to 51.3km^2 for the 2°C uplift and 17.7km^2 for the 3°C uplift (**Plate 8.1**).

8.3.21. As detailed in section 6.3a of this report, Sandwich terns have not bred at the Alde-Ore Estuary SPA for a number of years. However, should breeding birds recolonise the SPA, it is reasonable to assume that the foraging area for the population would be defined by the mean maximum foraging range of this species. Thus, the majority of the foraging by the SPA population would be expected to occur within the offshore waters encompassed by a radius of 32km from the colony location, but with areas of concentrated foraging activity likely to be in those parts of the range which are closer to the colony as provided in section 6.3a of this report (Ref. 6.58). Based on the 98th percentile, the 2°C and 3°C thermal plumes lie entirely within this foraging range but represent only 2.7% (for the 2°C uplift) and 0.9% (for the 3°C uplift) of the assumed range when the combined effects of Sizewell B and Sizewell C are considered. This compares with 1.0% (for the 2°C uplift) and 0.6% (for the 3°C uplift) for the existing thermal plumes that result from Sizewell B.

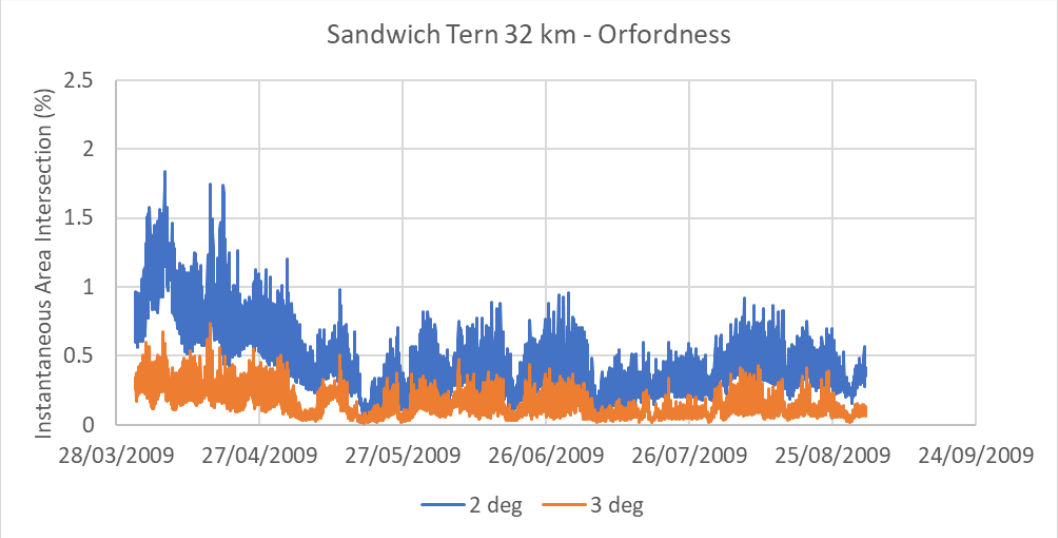
8.3.22. Given that areas of concentrated foraging activity are likely to occur closer to the colony, the area of overlap with the thermal plumes is also considered in relation to the area defined by a radius of 11.5km from the colony (equivalent to the mean foraging range for the species, as determined by Ref. 4.8). The 2°C and 3°C thermal plumes (defined by the 98th percentile) for the combined effects of Sizewell B and Sizewell C represent 6.8% (for the 2°C uplift) and 2.3% (for the 3°C uplift) of this smaller range, which compares with 3.0% (for the 2°C uplift) and 1.5% (for the 3°C uplift) for the existing thermal plumes that result from Sizewell B.

Plate 8.1: The 2°C and 3°C uplifts (as a 98th percentile) for sea surface temperatures for Sizewell B together with Sizewell C for April to August, in relation to the breeding colony locations and partially shown predicted foraging ranges for the Alde-Ore Estuary SPA lesser black-backed gull and Sandwich tern populations



8.3.23. The extent of overlap of the instantaneous plumes (as calculated at hourly intervals from April to August) with the SPA Sandwich tern foraging range is greatest in April (when the earliest birds arrive at the breeding colony) and lower in June and July, which coincides with chick-rearing when energetic demands on the adults are greatest and there is most need to maximise foraging efficiency (**Plate 8.2**). This is also the period during which foraging ranges are most constrained due to the need to provision the chicks at the colony (Ref. 8.2, Ref. 6.61).

Plate 8.2: Instantaneous area of overlap of the SPA Sandwich tern foraging range with the 2°C and 3°C uplifts for Sizewell B together with Sizewell C for April to August



8.3.24. Thus, for the combined effects of Sizewell B and Sizewell C, the 2°C uplift accounts for a maximum of 1.8% of the SPA Sandwich tern foraging range at any one point in time, and an average of 0.5% over the breeding period, representing more than a doubling in the extent of the overlap with the existing Sizewell B plume for the 2°C uplift (**Table 8.1)**. These percentages are considerably lower (at 0.7% and 0.2%, respectively) when considering the 3°C uplift. When considered in relation to the marine area encompassed by the mean foraging range of Sandwich tern (as a proxy for the area in which foraging activity is more concentrated – see above), the 2°C uplift for the combined effects of Sizewell B and Sizewell C accounts for a maximum of 8.0% and an average of 1.1% of this smaller range over the breeding period, whilst the equivalent 3°C uplift accounts for a maximum of 3.2% and an average of 0.3%. These percentage overlaps again represent an approximate doubling compared to the existing overlaps for the Sizewell B plumes (except for the maximum for the 3°C uplift, for which there is only a 40% increase).

Table 8.1: The maximum and mean instantaneous areas of thermal plumes at the sea surface for the 2°C and 3°C uplifts for Sizewell B alone and for Sizewell B together with Sizewell C for April to August with the percentage overlap with the predicted foraging range of the SPA Sandwich tern population

Temperature Uplift	Projects		Area (km^2)	Percentage (%) Of The SPA Sandwich Tern Foraging Range
2°C	Sizewell B alone	Mean	3.6	0.2
		Maximum	13.9	0.7
	Sizewell B plus C	Mean	8.5	0.5
		Maximum	34.6	1.8
3°C	Sizewell B alone	Mean	1.6	0.1
		Maximum	8.1	0.4
	Sizewell B plus C	Mean	2.8	0.2
		Maximum	13.8	0.7

8.3.25. The project-specific survey data relating to the foraging activity of Sandwich terns within the vicinity of the Alde-Ore Estuary SPA and the Sizewell coast are of limited value, given the absence of actively breeding birds at the SPA during the times of these surveys, together with fact that shore-based surveys will only record those birds foraging in relatively close proximity of the coast. However, it was apparent from the surveys undertaken that birds actively foraged in areas which are encompassed by the existing 2°C thermal plume associated with Sizewell B (**Plate 6.3** and **Plate 6.4**).

8.3.26. Based on the above, the thermal plume for the 2°C uplift for Sizewell B combined with Sizewell C represents a small percentage only of the likely foraging range of the SPA breeding Sandwich tern population, with the contribution of Sizewell C causing a small absolute increase to the existing baseline (resulting from Sizewell B). Furthermore, for the reasons given above, it is considered that the 2°C uplift is likely to represent an overly precautionary threshold and the extent of overlap is smaller still for the 3°C uplift, which is considered to be sufficiently precautionary. The 2°C and 3°C thermal plumes from Sizewell B and Sizewell C occur relatively close to shore (**Plate 8.1**), which could mean that any potential effects of the temperature uplift on Sandwich tern prey species disproportionately affect those parts of the range where foraging activity is greatest (because range usage increases near the shore and close to the colony – Ref. 6.58). Considering the thermal plumes in relation to the marine area that lies within the mean foraging range of Sandwich tern from the colony (as a proxy for the area in which foraging

activity is more concentrated) resulted in higher extents of overlap. However, the overlap values all remained within 10%, and were low for the 3°C uplift (with the 98th percentile and average instantaneous plume encompassing 2.3% and 0.3% of this smaller range, respectively).

8.3.27. Given this, no adverse effects on the Alde-Ore Estuary SPA Sandwich tern population are predicted as a consequence of thermal discharges during the operational period.

Chemical discharges

8.3.28. Modelling of the chemical discharges was also undertaken using the GETM as validated for Sizewell (Ref. 7.6 and Ref. 7.3), and, as for thermal discharges, it is necessary to consider the effect of Sizewell C within the context of the existing discharges from Sizewell B.

8.3.29. For total residual oxidant, the plumes resulting from Sizewell B and Sizewell C are spatially distinct at ecologically relevant concentrations, in contrast to the situation for thermal discharges (Ref. 7.4). Basing the assessment on the EQS value of 10µg/l as a 95th percentile, the total residual oxidant plume for Sizewell C at the sea surface encompasses 3.38km^2 within the SPA Sandwich tern foraging range, representing 0.1% of this range (**Plate 8.3**). This compares to an area of 3.89km^2 for the existing Sizewell B total residual oxidant plume, which represents 0.2% of the SPA Sandwich tern foraging range. When considered in relation to the marine area encompassed by the mean foraging range of Sandwich tern (as a proxy for the area in which foraging activity is more concentrated – see above), the percentage overlap with the plume for Sizewell C represents less than 0.01% of this smaller foraging range (whilst that for the plume for Sizewell B represents 0.4%).

8.3.30. For Bromoform, the resulting plumes from Sizewell B and Sizewell C are also spatially distinct, with the plume for Sizewell C invariably smaller than that for Sizewell B at values above 1µg/l (as a 95th percentile) due to the lower initial discharge concentration and greater water depth at the Sizewell C outfall location (Ref. 7.4). The EQS that has been used for bromoform is defined by the PNEC of 5µg/l (as a 95th percentile). At levels exceeding this value the bromoform plume for Sizewell C at the sea surface encompasses 0.52km^2 within the SPA Sandwich tern foraging range, representing 0.02% of this range (

8.3.31. **Plate** 8.4). This compares to an area of 3.06km^2 for the existing Sizewell B bromoform plume, which represents 0.1% of the SPA Sandwich tern foraging range. When considered in relation to the marine area encompassed by the mean foraging range of Sandwich tern, the percentage overlap with the plume for Sizewell C represents less than 0.01% of this smaller foraging range (whilst that for the plume for Sizewell B represents 0.4%).

Plate 8.3: Total residual oxidant concentration at the sea surface (µg/l as a 95th percentile) for Sizewell B and Sizewell C in relation to the breeding colony locations and predicted foraging ranges of breeding little tern (for the Alde-Ore Estuary, Minsmere-Walberswick and Outer Thames Estuary SPAs), common tern (for the Outer Thames estuary SPA), lesser black-backed gull (for the Alde-Ore Estuary SPA) and Sandwich tern (for the Alde-Ore Estuary SPA)

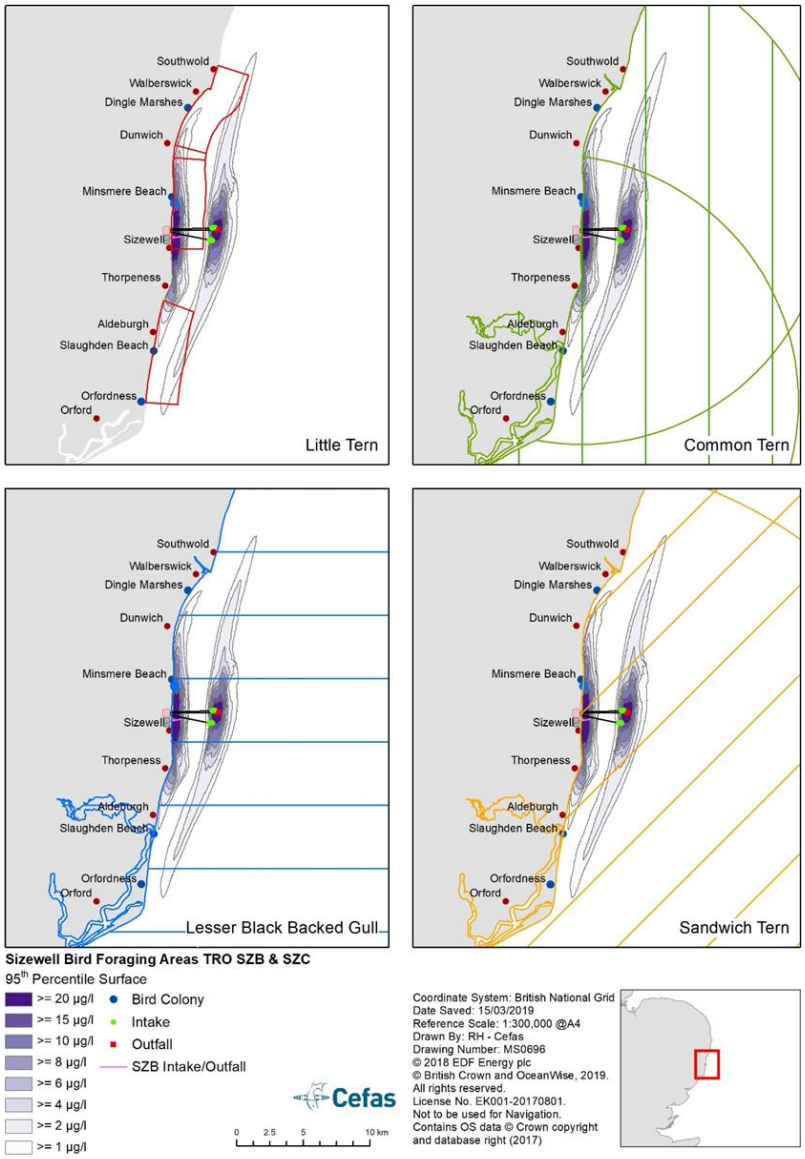
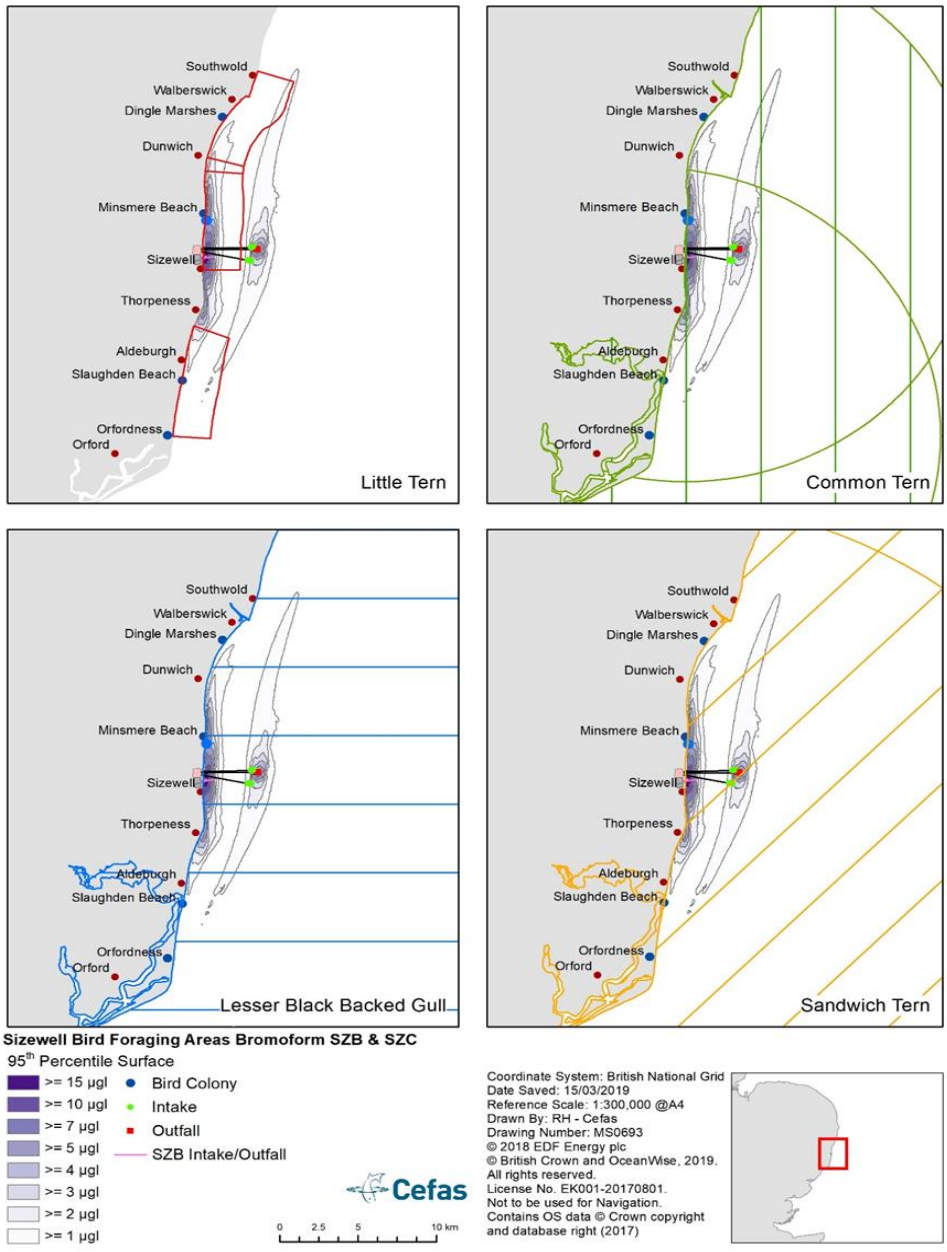


Plate 8.4: Bromoform concentration at the sea surface (µg/l as a 95th percentile) for Sizewell B and Sizewell C in relation to the breeding colony locations and predicted foraging ranges of breeding little tern (for the Alde-Ore Estuary, Minsmere-Walberswick and Outer Thames Estuary SPAs), common tern (for the Outer Thames estuary SPA), lesser black-backed gull (for the Alde-Ore Estuary SPA) and Sandwich tern (for the Alde-Ore Estuary SPA)



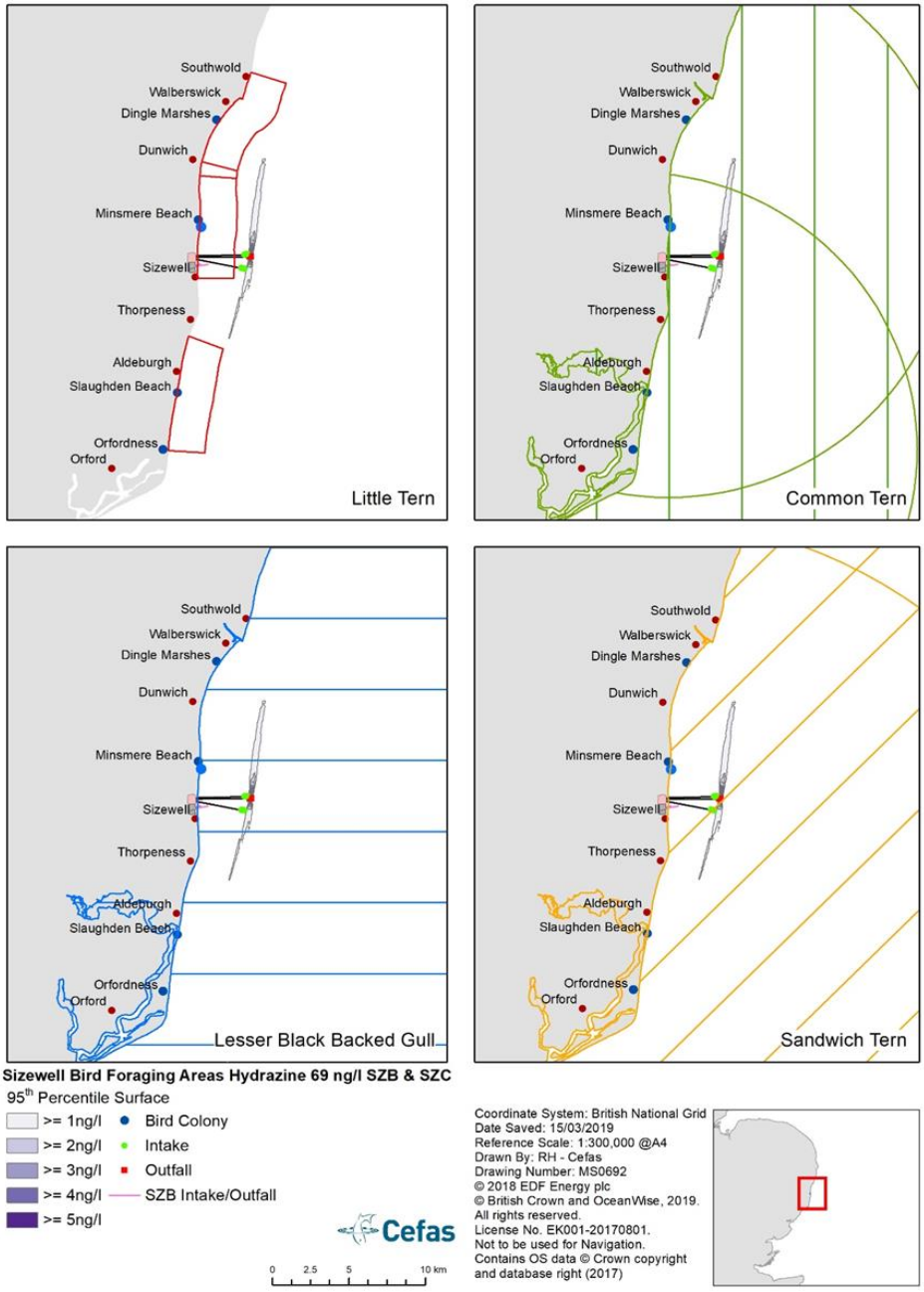
8.3.32. As detailed above section 7.4 b ii of this report, hydrazine is potentially harmful to aquatic organisms at low concentrations. There is no established EQS value for hydrazine so a chronic PNEC of 0.4 ngl-1 has been calculated for long-term discharges (using the mean of the concentration values) and an acute PNEC of 4 ngl-1 for short term discharge (as a 95th percentile), both of which are considered to be highly precautionary thresholds (Ref. 8.1). A hydrazine discharge of 69 ngl-1 in daily pulses of 2.32 hours starting at 12pm was used as the worst-case scenario.

8.3.33. Based upon the above, the hydrazine plume for Sizewell C at the sea surface encompasses 1.58km^2 and 0.14km^2 for the chronic and acute PNEC values, respectively. These plumes are fully encompassed by the SPA Sandwich tern foraging range and represent 0.08% and less than 0.01% of this range, respectively (**Plate 8.5**). There is no overlap of the hydrazine plumes with the marine area encompassed by the mean foraging range of Sandwich tern.

8.3.34. The project-specific survey data relating to the foraging activity of Sandwich terns within the vicinity of the Alde-Ore Estuary SPA and the Sizewell coast demonstrate that foraging occurs within areas encompassed by the existing total residual oxidant plume (for values exceeding 10µg/l as a 95th percentile) and bromoform plume (for values exceeding 5µg/l as a 95th percentile) associated with Sizewell B, as is also noted above in relation to the Sizewell B thermal plume (**Plate 6.3** and **Plate 6.4**).

8.3.35. Based on the above considerations, the chemical discharges from the Sizewell C Project will occur across a small part of the predicted foraging range of the Alde-Ore Estuary SPA breeding Sandwich tern population at concentrations that are considered to have the potential to affect the abundance of Sandwich tern prey. The total area affected by chemical discharges is predicted to encompass less than 0.2% of the predicted foraging range. It is also apparent from existing survey data that foraging Sandwich tern are not excluded from areas affected by such discharges. Therefore, no adverse effects on the SPA Sandwich tern population are predicted as a consequence of chemical discharges during the operational period.

Plate 8.5: Hydrazine concentration at the sea surface (ng/l as a 95th percentile) after release of 69 ng/l from Sizewell C in relation to the breeding colony locations and predicted foraging ranges of breeding little tern (for the Alde-Ore Estuary, Minsmere-Walberswick and Outer Thames Estuary SPAs), common tern (for the Outer Thames estuary SPA), lesser black-backed gull (for the Alde-Ore Estuary SPA) and Sandwich tern (for the Alde-Ore Estuary SPA)



iii. Water quality effects – terrestrial environment

Construction and decommissioning

8.3.36. As set out in section 7.4 b iii of this report, the proposed crossing over the River Alde, upstream of the SPA, as part of the two village bypass, has the potential to have an adverse effect on water quality which may have adverse effects on the habitats of the SPA qualifying species during construction. It is assumed that once built, the two village bypass would form part of the strategic road network would not be decommissioned.

8.3.37. Subject to the mitigation described in section 7.4 b iii of this report, the construction of the Alde crossing would not have an adverse effect on the water quality of the river. No adverse effects on the qualifying habits of the Alde, Ore and Butley Estuaries SAC (estuaries, mudflats and sandflats, and Atlantic salt meadows) are therefore predicted.

8.3.38. Water quality effects – terrestrial environment, have not been screened in for likely significant effects in relation to the SAC qualifying habitats of the Orfordness to Shingle Street SAC as provided in section 7.9a of this report, which underpins part of the Alde-Ore Estuary SPA.

8.3.39. Therefore, there would not be adverse effects on the any of the SAC qualifying habitats within the Alde-Ore estuary SPA as a result of changes in water quality – terrestrial environment. As these habitats also underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature, including breeding Sandwich tern, during the construction or operational phase.

iv. Alteration of local hydrology and hydro-geology

Construction and operation

8.3.40. As covered in section 7.4 b iv of this report, the proposed crossing over the River Alde could alter the local hydrology and hydrogeology of the river, which could have secondary impacts downstream on the habitats of the SPA qualifying features during construction and operation.

8.3.41. The crossing, however, has been designed to ensure that there would be no direct disturbance to the river and to preserve the natural integrity of the river banks, during both construction and operation. No adverse effects on hydrology and hydro-geology on the qualifying habits of the Alde, Ore and Butley Estuaries SAC (estuaries, mudflats and sandflats, and Atlantic salt meadows) are therefore predicted during construction or operation.

8.3.42. Alteration of hydrology and hydro-geology has not been screened in for likely significant effects in relation to the SAC qualifying habitats of the Orfordness to Shingle Street SAC as seen in section 7.9a of this report.

8.3.43. As these habitats underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature, including breeding Sandwich tern, during the construction or operational phase.

v. Changes in air quality

8.3.44. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.3.45. During construction and decommissioning, changes in air quality could result from road traffic emissions associated with the proposed development.

8.3.46. The Alde-Ore Estuary SPA lies beyond the study area for the assessment of dust emissions (50m of potential dust sources, 50m of the routes used by construction vehicles on the public highway and within 500m of the construction site access; Ref. 7.14). Beyond these distances the dust effects from construction (and decommissioning) activities are considered to be negligible and no further consideration of construction dust is necessary.

8.3.47. The air quality assessment as provided in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3) screens out construction phase traffic effects for this European site (i.e. predicted effects are not significant).

8.3.48. Consequently, it is concluded that there would not be an adverse effect on the integrity of any qualifying feature of the Alde-Ore Estuary SPA, including breeding Sandwich tern, due to air quality effects during the construction and decommissioning phases.

Operation

8.3.49. The assessment included in sections 7.4 and 7.9 of this report, for those SACs which overlap with the Alde-Ore Estuary SPA describes the proposed commissioning and operating scenarios for the combustion plant, the assessment methodology (including reference to site-specific Critical Loads for European sites from the APIS) and the environmental standards which have been applied (**Table 7.2**).

8.3.50. The Alde-Ore Estuary SPA overlaps with the following SACs and qualifying habitat features:

- estuaries, mudflats and sandflats not covered by seawater at low tide, and Atlantic salt meadows within the Alde, Ore and Butley Estuaries SAC; and,
- coastal lagoons, annual vegetation of drift lines, and perennial vegetation of stony banks of the Orfordness to Shingle Street SAC.

8.3.51. For the estuaries qualifying feature of the Alde, Ore and Butley Estuaries SAC, the modelling of the combustion scenarios predicts that the Critical Levels for NOx (long-term), NOx (short-term) and SO_2 (long-term) would not be exceeded; in addition, the Critical Load for nutrient nitrogen deposition would not be exceeded. APIS notes that Estuaries are not sensitive to acidification and, therefore, Critical Loads are not defined for acid deposition for this qualifying feature. On this basis, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

8.3.52. For the mudflats and sandflats not covered by seawater at low tide qualifying feature of the Alde, Ore and Butley Estuaries SAC, APIS does not define a nutrient nitrogen deposition Critical Load and – according to APIS - this qualifying feature is not sensitive to acidification. On this basis, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

8.3.53. For the Atlantic salt meadows (*Glauco-Puccinellietalia*) qualifying feature of the Alde, Ore and Butley Estuaries SAC, modelling of the combustion scenarios predicts that the Critical Levels for NOx (long-term), NOx (short-term) and SO_2 (long-term) would not be exceeded. In addition, the Critical Load for nutrient nitrogen deposition would not be exceeded. APIS notes that this qualifying feature is not sensitive to acidification and, therefore, Critical Loads are not defined for acid deposition. On this basis, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

8.3.54. The coastal lagoon qualifying feature of the Orfordness to Shingle Street SAC is located more than 10km from the source of the operational combustion activity. Nevertheless, the modelling of the combustion scenarios predicts that the Critical Levels for NOx (long-term), NOx (short-term) and SO_2 (long-term) would not be exceeded for the coastal lagoons qualifying feature of the Orfordness to Shingle Street SAC. In addition, the Critical Load for nutrient nitrogen deposition would not be exceeded. On this basis, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

8.3.55. The annual vegetation of drift lines qualifying feature of the Orfordness to Shingle Street SAC is not sensitive to air quality effects from combustion activities and was not screened in for this effect.

8.3.56. The modelling of the combustion scenarios predicts that the Critical Levels for NOx (long-term), NOx (short-term) and SO_2 (long-term) would not be exceeded for the perennial vegetation of stony banks qualifying feature of the Orfordness to Shingle Street SAC. In addition, the Critical Load for nutrient nitrogen deposition would not be exceeded. On this basis, it is concluded that there would not be an adverse effect on the integrity of this qualifying feature due to changes in air quality during the operational phase.

8.3.57. The air quality assessment has concluded no adverse effect of air quality (combustion activity) effects on the integrity of SAC qualifying habitats within the Alde-Ore Estuary SPA during operation of the main development site. No changes to these habitats, in terms of vegetation composition and structure, would be expected in relation to this effect. As these habitats also underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature, including breeding Sandwich tern, due to changes in air quality during the operational phase.

vi. Disturbance due to increase in recreational pressure

8.3.58. Increased recreational pressure may affect birds directly through increased direct disturbance to birds and indirectly via the effects of recreation on the habitats on which birds depend.

8.3.59. Anthropogenic disturbance may affect birds by temporarily or permanently displacing them from a disturbed area, resulting in effective habitat loss. Depending on the importance of the affected area to a species, this may affect the local population size, for example if birds are displaced regularly or permanently from formerly preferred feeding/nesting areas. Disturbance may affect energy budgets – meaning that birds need to spend more time feeding to meet their energy needs (and during breeding the energy requirements of dependent offspring); and cause physiological stress. Disturbed birds may face an increased predation risk and displacing breeding adults from nests can increase the risk of breeding failure. Noise disturbance may interfere with communication between birds through their calls and song. More detail on available scientific evidence about the effects of anthropogenic disturbance on birds and habitats is reviewed in the Recreational Evidence Base as seen in **Appendix E** of this report.

Construction and decommissioning

Overview of recreational assessment for the Alde-Ore Estuary SPA

8.3.60. The following assessment of the direct effects of an increase in recreational pressure is distilled from the Recreational Evidence Base as seen in **Appendix E** of this report which includes further details. During the construction of the main development site (where construction is used as a worst-case proxy for decommissioning), recreational users of the Sizewell C area may be displaced elsewhere, including to locations within and close to nearby European Sites.

8.3.61. Project-specific visitor surveys were carried out in August and November 2014, involving a questionnaire-based survey and observations at seven survey points within 2km of Sizewell. Survey locations and the questionnaire were discussed in advance with stakeholders. At the request of RSPB, further user surveys took place at the Minsmere RSPB reserve in 2015. During surveys, respondents were asked whether the construction of Sizewell C would impact on their recreational activity in the area and, if so, where they might relocate to should they be affected[19]. This information was used to estimate the potential increase in visits to locations adjacent to or within the SPAs, SACs and Ramsar sites under consideration. The assessment also took account of predictions about the potential recreational use of the surrounding area by construction workers from Sizewell C.

8.3.62. The Alde-Ore Estuary SPA covers a large area with relatively few direct access points: at Aldeburgh, Iken, Orford, Sailors path, the Snape and Butley as seen in **Appendix E** of this report, **Figures 002,007-009 and Table 4.1**. The key intertidal habitats used by the wintering wetland bird species of the Alde-Ore Estuary SPA are remote from or inaccessible via access locations at Snape Maltings, Iken and Sailor's Path. Access to Orfordness and Havergate Island is restricted and is controlled by the National Trust / RSPB. Two car parks to the west of the Butley Estuary give access to the RSPB Boyton Marshes reserve and the Suffolk Coast Path. Increased use of the path, which runs adjacent to the Butley and the Ore and alongside saltmarsh and intertidal mudflats, has the potential to increase disturbance to SPA qualifying species using these areas.

8.3.63. The Alde-Ore estuary was identified as a potential alternative location to Sizewell by a total of 30 respondents to the visitor survey (5.8% of 514 respondents). The estimated number of additional visits associated with the Sizewell C Project to the various access locations referred to above are shown in **Table 8.2**.

[19] The responses obtained are considered to be also relevant to the decommissioning phase (as far as this is foreseeable).

Table 8.2: Estimated additional visits to locations in the study area as a result of displacement of existing users from the Sizewell area and the construction workforce - Alde-Ore Estuary SPA

Location And Estimated Number Of Annual Visits	% Of Survey Visitors Who Gave As Alternative Location	Based On % Of Displaced Visitors[1]			Based On 500,000 Visits To Sizewell Area[2]		
		Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits	Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits
Alde-Ore Estuary SPA							
Aldeburgh – 150,000	2.92%	9292	25.5	6.2	19,512	53.4	13
Butley – 10,000	0.19%	19	0.05	0.2	950	2.6	9.5
Iken – 60,000	0.58%	348	1.0	0.6	2900	7.9	4.8
Orford – 150,000	0.78%	1170	3.2	0.8	3900	10.7	2.6
Sailors Path – 60,000	0.39%	234	0.6	0.4	1950	5.3	3.2
Snape – 150,000	0.97%	1455	4.0	1.0	4850	13.3	3.2

1. 'Realistic' approach: involves determining the percentage of survey respondents who said that they would be displaced to each named location and then calculating the number of additional visits that would be generated by multiplying the estimated number of annual visits at each of the locations by the percentage of displaced users.
2. More precautionary approach: the same basic method as (1), except that the calculated number of additional visits to each specified location has been taken as a percentage of an estimated 500,000 annual visits to the Sizewell survey area as a whole (based on extrapolation of the 4214 visitors observed over the survey period).

8.3.64. Aldeburgh was identified as the most likely site near to the Alde-Ore Estuary SPA that users could be displaced to, with smaller predicted increases to other locations. Increased visitor use in and around Aldeburgh would be unlikely to impinge directly upon the estuary, with the focus of any additional activity likely to be the main beach frontage. Small increases to the access locations at Snape Maltings, Iken and Sailor's Path would be unlikely to lead to any additional disturbance pressure that would have adverse ecological consequences. Increased disturbance pressure to controlled areas at Orfordness and Havergate Island is not predicted to arise. While increased visitor use at Butley could lead to increased disturbance to saltmarsh and intertidal mudflats in the Butley and the Ore estuaries, via the Suffolk Coastal Path, this location has the lowest estimated number of annual visits and was identified as a potential alternative location by the smallest percentage of survey respondents.

8.3.65. Overall it is considered that, while there could an increase in the number of visits to some locations around the Alde-Ore estuary, limited accessibility to habitats used by breeding and wintering waterbirds and seabirds indicates that it is unlikely that an increase in direct disturbance that would cause an adverse effect on the populations of SPA qualifying features would occur.

Recreational disturbance assessment for Sandwich tern

8.3.66. In relation to the SPA Sandwich tern population specifically, the primary nesting area within the SPA is Havergate Island as seen in section 6.3a of this report, although the species has not been recorded nesting anywhere within the SPA since 2009. Supplementary advice on the conservation objectives for the Alde-Ore Estuary SPA (Ref. 8.3), however, includes a target to restore the size of the breeding population to a level to be agreed. Havergate Island is within an area of controlled access where visitor use is not predicted to increase. Consequently, direct disturbance due to an increase in recreational pressure is not predicted to adversely affect the conservation objectives for breeding Sandwich tern using the Alde-Ore Estuary SPA.

8.3.67. As described above, the potential also exists for indirect effects to arise associated with recreational disturbance on birds via the habitats on which they depend. However, no adverse effects due to recreational disturbance on the various qualifying habitats of the Alde-Ore and Butley Estuaries SAC as seen in section 7.4 c ii of this report and associated Ramsar site, or on the Orfordness to Shingle Street SAC as seen in section 7.9 c iv of this report, were identified (with likely significant effects excluded for several due to their inaccessibility). Given this, indirect effects on Sandwich tern as a result of effects of recreational disturbance on supporting habitats are highly unlikely.

8.3.68. In conclusion, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding Sandwich tern using the Alde-Ore Estuary SPA.

Operation

8.3.69. There is the potential for the recreational response of people displaced by construction activity to be maintained through into the operational phase of Sizewell C. If this were to occur, displacement of recreational users from the Sizewell area to the alternative locations adjacent to and within the designated European Sites under consideration would continue.

8.3.70. The operational workforce for Sizewell C would be considerably smaller than that during construction. There would be an operational workforce of approximately 900 people, based within 25 miles (40km) of the main development site. An additional 940 temporary workers would be present for short-term periods (8-10 weeks) twice a year for planned outages.

8.3.71. The assessment above for construction and decommissioning has concluded that there is limited accessibility to habitats used by breeding and wintering waterbirds and seabirds. It is, therefore, unlikely that an increase in

recreational disturbance that would cause an adverse effect on the populations of SPA qualifying features would occur. This conclusion is considered also to apply to the operational phase.

8.3.72. Further, in this context it is noted that measures would be taken by SZC Co. to restore and improve the access and recreational resources and landscape that may be affected by the construction of Sizewell C; as described in the site masterplan, landscape and PRoW and access strategies. Current proposals are described in the Rights of Way and Access Strategy. The objective is to strengthen existing recreational resources within and around the EDF Energy Sizewell Estate in terms of resource provision and management.

8.3.73. Any residual effects of visitor displacement from Sizewell C post-construction, and recreational use of the local area by operational workers, are predicted to be so small as to be undetectable in the context of the likely future drivers of trends in recreational use of the Suffolk Coast (population growth, initiatives to promote tourism and the increasing popularity of outdoor recreation) and the predicted numbers of annual visitor trips to the Suffolk Coast in the vicinity of the main development site.

8.3.74. During operation, no adverse effects due to recreational disturbance on the various qualifying habitats of the Alde-Ore and Butley Estuaries SAC as provided in section 7.4c ii of this report above and associated Ramsar site, or on the Orfordness to Shingle Street SAC as provided in section 7.9 c iv of this report, were identified (with likely significant effects excluded for several due to their inaccessibility). Given this, indirect effects on Sandwich tern as a result of effects of recreational disturbance on supporting habitats are highly unlikely to occur.

8.3.75. During the operation of Sizewell C, no adverse effects associated with increased recreational pressure are predicted on any SPA qualifying feature, either directly or indirectly via habitat change, including on breeding Sandwich tern using the Alde-Ore Estuary SPA.

vii. Physical interaction between species and project infrastructure

Operation

8.3.76. During the operation of the Sizewell C Project, populations of the fish and marine invertebrate prey of Sandwich terns may be affected by impingement or entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

Overview of assessment for impingement and entrainment

8.3.77. Impingement occurs when larger organisms are filtered out from water entering the cooling system by bars and mesh screens. Entrainment occurs when smaller organisms (mostly fish eggs and larvae and other plankton) go through the screens and pass through the power station cooling system. Both impingement and entrainment are likely to lead to mortality of fish and other marine organisms. If this were to result in a reduced abundance of fish and invertebrate prey for SPA qualifying bird species which feed in offshore waters in the vicinity of Sizewell C, there could be indirect effects on SPA populations.

Thresholds for identifying change to seabird prey populations

8.3.78. There are no formal UK regulatory guidelines for assessing the significance of mortality levels of fish and marine invertebrates caused by impingement and entrainment from coastal power stations and therefore any assessment must be based on expert judgment. For the purposes of the assessment, two screening thresholds have been selected such that losses lower than the appropriate threshold are considered to have negligible effects on the year to year sustainability of a fish or invertebrate population, whereas effects above the appropriate threshold would require further investigation to determine whether detectable population effects were likely. The thresholds have been selected based upon internationally accepted scientific practice for the sustainability of fish stocks under anthropogenic pressures, and are as follows (Ref. 8.5):

- For commercially exploited stocks and conservation species (which includes stocks that are not currently exploited): 1% of the Spawning Stock Biomass (SSB) or, as a highly conservative proxy, 1% of international landings of the stock.
- For unexploited stocks: 10% of the SSB or, as a highly conservative proxy, 10% of international landings of the stock.

8.3.79. A detailed scientific rationale for the selection of these thresholds is given in Ref. 8.5; which is summarised here. Similar thresholds were used an accepted during the assessment for Hinkley Point C.

8.3.80. Fishing is the selective removal (or harvesting) of fish and other marine organisms. Impingement and entrainment could therefore be thought of as a form of fishing (Ref. 8.5) but of lower selectivity and including earlier life stages of fish and marine invertebrates than those that would generally be targeted by fisheries.

8.3.81. Losses to impingement and entrainment are unlikely to be additive to other sources of mortality for the source populations, given that populations of fish

and marine invertebrates are reselected (producing large numbers of small offspring of which only a small proportion survive to breed) and subject to density dependent population regulation.

8.3.82. Density dependant population regulation provides a scientific basis for the sustainable use of fish populations. As the abundance of a density regulated population is reduced by harvesting, productivity (in terms of the production of new individuals as recruits to the population) increases (due to increased rates of growth, survival and reproduction of unharvested individuals). This continues until harvesting increases to a point where the population cannot compensate for additional mortality from harvesting, after which productivity of the stock decreases and it eventually becomes at risk of collapse. A sustainable harvest rate is one where the rate of abstraction is less than or equal to the rate at which the population can regenerate itself. Determination of that rate for different fish stocks has been an internationally coordinated endeavour for more than 70 years and has led to well established stock assessment principles regulated through the International Council for the Exploration of the Sea (ICES) (Ref. 8.5).

8.3.83. In terms of indirect effects on SPA qualifying bird species that forage in the marine environment, it is assumed that where, according to the criteria given above, effects on the SSB of a prey species are considered to negligible, then the effects on the SPA species would be so small as to be undetectable.

8.3.84. During the breeding season, foraging ranges of seabirds are constrained by requirements for breeding adults to attend nests to incubate eggs and feed chicks. Information on foraging ranges of individual SPA qualifying seabirds relevant to the assessment is given in section 6.3 of this report. There is a difference between the scale of SSB areas for prey species impinged and entrained at Sizewell C, and the foraging ranges of individuals within local SPA populations. For example, for key fish prey species of seabirds, SSB areas are as follows: sprat - North Sea; herring - North Sea, Skagerrak & Kattegat, Eastern Channel; whiting - North Sea, Eastern Channel, cod -North Sea, Eastern Channel, Skagerrak & Kattegat (Ref. 8.5). These areas are much larger than the foraging ranges of breeding adults from the nest. If the effects of the impingement and entrainment are negligible at the scale of an SSB for a given prey species but result in a local reduction in abundance of a prey species in the Sizewell bay area, within the foraging range of a given species, then effects on SPA seabird populations might still occur.

8.3.85. Fish stocks are, however, subject to considerable annual variability due to highly variable levels of recruitment, food availability and predation pressure. Individual populations and predator-prey relationships are adapted to cope with high levels of variability at local and ecosystem scales. Monitoring of impingement at Hinkley Point B between 1981-2017 illustrates the variability of local fish populations (as the power station is an efficient sampler with low

interspecies bias unlike trawl or other net sampling techniques). During this period the largest year-to-year changes (the ratio of impingement numbers in consecutive years) for the same sample of species which are common prey of seabirds were: cod (29.7), herring (31.2), sprat (4.2) and whiting (3.4). Although similar data are not available for the Sizewell area (from Sizewell B), the results from Hinkley Point B illustrate year to year variations in a given location (Ref. 8.5).

8.3.86. Thus, against the background of other environmental drivers of year to year change in fish prey populations in coastal waters offshore of Sizewell C, losses to impingement and/or entrainment lower within the SSB thresholds identified, are considered to be so small as to be undetectable.

Entrainment

8.3.87. Assessment of entrainment effects (Ref. 8.4) found that, based on sampling from Sizewell B, the eggs or larvae of up to 23 fish species may be entrained at Sizewell C, although only eight of these were part of the 24 species identified as key components of the local finfish assemblage based on the impingement monitoring programme at Sizewell B (see below and Ref. 8.5). The predicted losses to populations due to mortality of entrained fish plankton were converted to equivalent adult values and compared to the criteria described above (SSB or international landings). In all such cases the predicted losses to entrainment were considered to be so small as to be undetectable.

8.3.88. Monitoring of the Sizewell B cooling water identified 49 invertebrate zooplankton taxa which might be entrained at Sizewell C, falling mainly into four groups: copepods; gammarids; mysids; and, barnacles. The likely effects of entrainment mortality (Ref. 8.4) on local populations were estimated and it was concluded that any effects would be negligible.

Impingement

8.3.89. Predictions of impingement effects during the operation of the Sizewell C Project are set out in BEEMS Technical Report TR406 - Ref. 8.5). It is proposed that the cooling water intakes would be protected by widely spaced bars to prevent the intake of cetaceans, seals and large items of debris, but smaller organisms (small fish and crustaceans, and plankton) would enter them. The larger of these organisms would be removed before the water enters the power station cooling system to prevent them blocking the condenser tubes. These organisms would be removed through impingement on rotating fine-mesh drum screens which protect the main cooling water supply to the station condensers and band screens that protect the essential and auxiliary cooling water systems. Impinged organisms would be returned to the sea via the FRR system, although not all would survive. The smaller

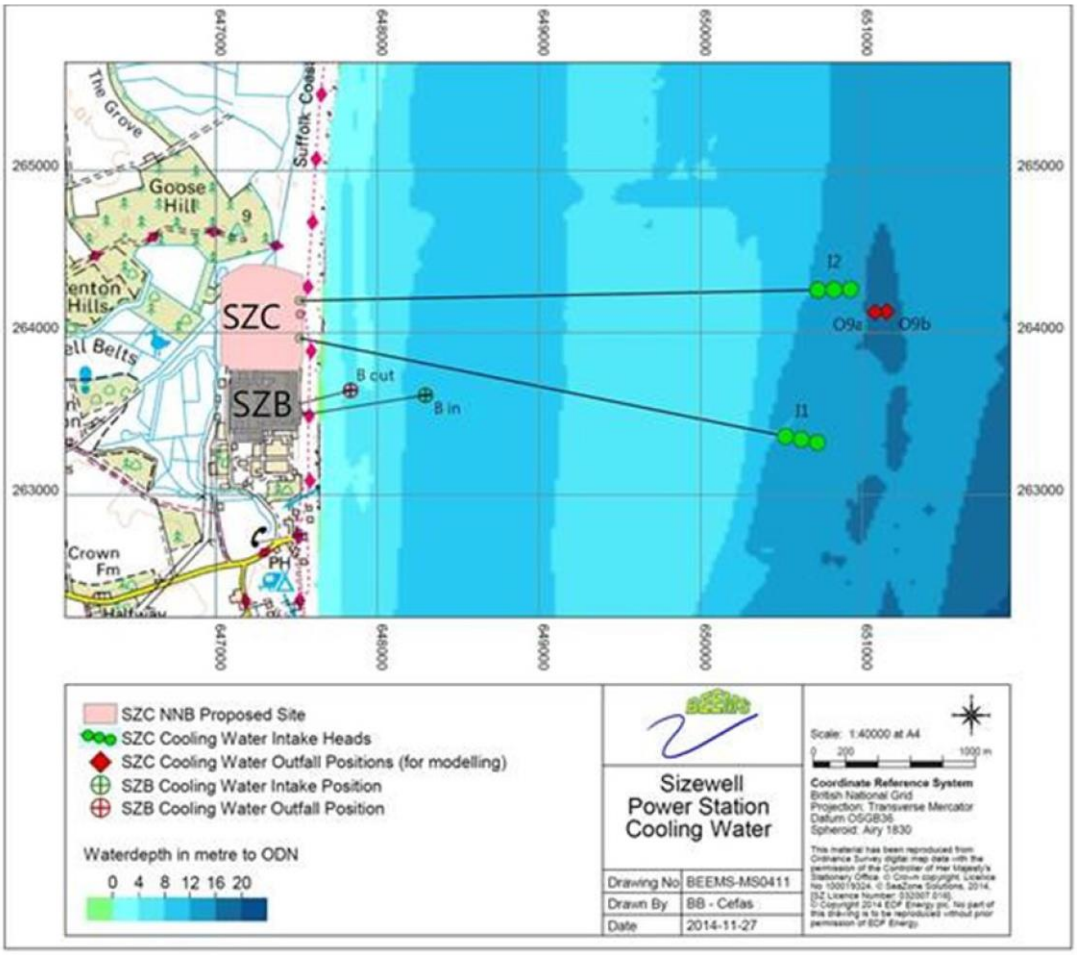
organisms (mostly fish eggs and larvae and other plankton) that pass through the drum screens would be entrained and pass through the power station cooling system (as considered above).

8.3.90. Twenty-four of the finfish species recorded at Sizewell over a 9-year impingement monitoring programme (undertaken between February 2009 and March 2013 and, following a break in sampling, between April 2014 and December 2017) were selected as being representative of the assemblage. These include species of importance commercially, ecologically and from a conservation perspective (river and sea lamprey are included in the latter category).

8.3.91. The locations of the intakes and outfalls for Sizewell B and the proposed locations for Sizewell C are shown in **Plate 8.6**. To estimate the (unmitigated) impingement, the measured impingement at Sizewell B was scaled by the ratio of the cooling water volumes extracted by the two stations. BEEMS Technical Report TR406 (Ref. 8.5) notes that the accuracy of the assessment depends upon whether:

- the fish community is the same at the location of the Sizewell C intakes (approximately 3km offshore) as at the Sizewell B intakes (approximately 700m offshore); and
- the Sizewell C intakes would abstract the same amount of fish per cumec ($m^3 s^{-1}$) as Sizewell B.

Plate 8.6: Locations of the intake and outfall for the cooling water system for Sizewell B and the proposed locations for Sizewell C (Ref. 8.5)



8.3.92. With respect to the first point, BEEMS Technical Report TR345 (Ref. 6.64) found – with the exception of bass – no significant difference in the fish community or fish length distributions between the locations of the Sizewell C and Sizewell B intakes.

8.3.93. With respect to the second point, the impingement calculations have been undertaken with and without mitigation in the form of low velocity side entry intake heads. Predictions of impingement at Sizewell C used in the assessment take account of the low velocity side entry intake heads and the FRR system.

8.3.94. Combined impingement and entrainment effects on fish have been assessed by comparing the predicted annual mortality of a given species - equivalent adult values - as a percentage of the SSB or international landings, depending on the available data, as described above.

8.3.95. Estimates of impingement mortality were made for three species of marine invertebrates which are of socioeconomic importance, brown crab, brown shrimp and European lobster. In each case, with mitigation in place, the predicted annual mortality at Sizewell C was less than 1% of fishery landings and losses were considered to be negligible in population terms against the stock unit assessed (the Southern North Sea for brown crab and East Anglia for lobster and brown shrimp).

Predicted impingement and entrainment of Sandwich tern prey

8.3.96. Information on the foraging behaviour and diet of Sandwich terns is provided in section 6.3 of this report. Based on a mean maximum foraging range of 32km, birds breeding at the Alde-Ore Estuary SPA may forage offshore of the main development site. Key fish prey species of this species in the southern North Sea include clupeids (herring and sprat) and sandeels.

8.3.97. Sprat and herring were the most frequently recorded species impinged at Sizewell B. For sprat the combined estimated annual mortality for entrainment and impingement at Sizewell C (with the low velocity side entry and FRR in place) was 2,249,905 equivalent adult values, equivalent to 0.01% of the SSB for the ICES North Sea stock area for this species. For herring the estimated combined annual mortality was 724,095 equivalent adult values, equivalent to 0.01% of the SSB for the ICES North Sea, Skagerrak and Kattegat and Eastern Channel stock area for this species.

8.3.98. Sandeels were insufficiently abundant in the available fish datasets for Greater Sizewell Bay to be considered a key species in the local fish assemblage. Entrainment predictions for all sandeel species combined at Sizewell C were 14,966-18,999 adult fish per year, equivalent to 0.0001% of SSB (Ref. 8.4). Unmitigated estimates of 1,459 (112-19,034), 44 (18-104) and 8,128 (no upper and lower estimates provided) individuals per year are given respectively for great sandeel, Raitt's sandeel and common sandeel (Ref. 8.5). The estimates above indicate that the combined effect of impingement and entrainment is likely to be considerably lower than 1% of SSB.

Potential effects on the SPA Sandwich tern population

8.3.99. Impingement and entrainment mortality is predicted to have a negligible effect on the SSB populations of key prey species for breeding Sandwich tern using the Alde-Ore Estuary SPA. Impacts at the scale of the SSB populations and on local populations are likely to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

8.3.100. Impingement and entrainment at the main development site is not predicted to result in depletion of prey resources for Sandwich terns breeding in the Alde-Ore Estuary SPA, and there would be no adverse effect on the SPA's conservation objectives for this species.

c) Effects on breeding little tern, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.3.101. The assessment presented above for Sandwich tern is also applicable to little tern. Therefore, there is no likelihood of an adverse effect on the conservation objectives for breeding little tern arising.

ii. Water quality effects – marine environment

Introduction

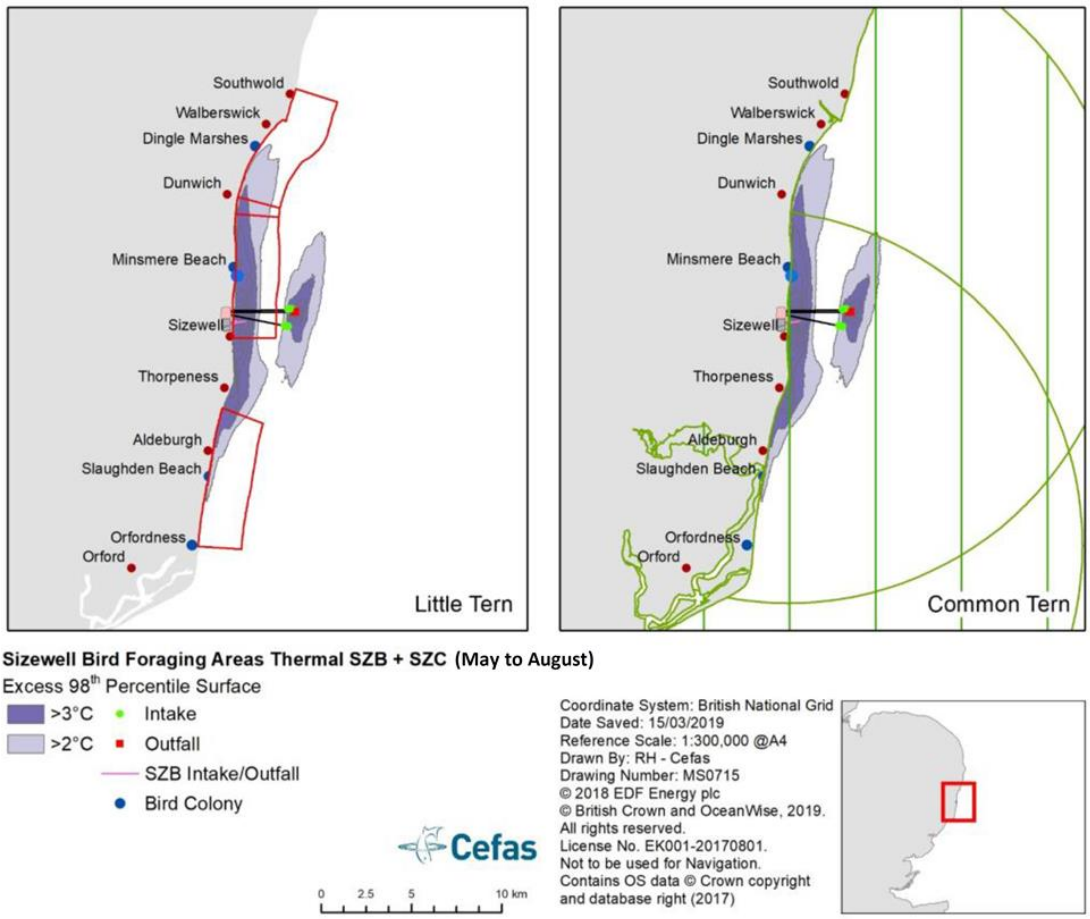
8.3.102. As for the Alde-Ore Estuary SPA breeding Sandwich tern population, the marine environment water quality effects on the SPA breeding little tern population relate to the operational period only as provided in section 8.3a of this report. The basis for the assessments of the thermal and chemical discharges from Sizewell C are also as outlined above for the SPA Sandwich tern population as provided in section 8.3 b ii of this report. Therefore, the thresholds are as applied in the assessment of the SPA Sandwich tern population, whilst the potential effects are concerned with the impacts on the prey species of little tern.

Operation

Thermal discharge

8.3.103. For little tern, the thermal plumes associated with the 2°C and 3°C temperature uplifts are considered for May to August (as the period over which it is present as a breeding species at the SPA). Over this period, the areas encompassed at the sea surface by the 98th percentiles for the existing 2°C and 3°C thermal plumes (for Sizewell B) extend to 16.7km^2 and 9.4km^2, respectively (whilst the equivalent plumes for Sizewell C, when considered alone, extend across 9.0km^2 and 2.5km^2, respectively). Incorporating the Sizewell C thermal plumes together with the Sizewell B plumes increases these areas to 36.9km^2 for the 2°C uplift and 15.3km^2 for the 3°C uplift (**Plate 8.7**).

Plate 8.7: The 2°C and 3°C uplifts (as a 98th percentile) for sea surface temperatures for Sizewell B together with Sizewell C for May to August, in relation to the breeding colony locations and predicted foraging ranges for little tern associated with the Alde-Ore Estuary, Minsmere-Walberswick and Outer Thames Estuary SPAs and for common tern associated with the Outer Thames Estuary SPA



8.3.104. As detailed in section 6.3a of this report, little terns have not bred at the Alde-Ore SPA since 2013. However, should breeding birds recolonise the SPA, it is reasonable to assume that the main foraging area for the population would be defined by the area within 3.9km of the colony alongshore and 2.4km seawards as seen in section 6.3a of this report (Ref. 6.43). Based on the 98th percentile, the 2°C and 3°C thermal plumes for the combined effects of Sizewell B and Sizewell C encompass 15.4% and 5.4% of this foraging range, respectively (**Plate 8.7**). This compares with overlaps of 8.7% (for the 2°C uplift) and 2.5% (for the 3°C uplift) for the existing thermal plumes resulting from Sizewell B.

8.3.105. For the combined effects of Sizewell B and Sizewell C, the instantaneous plumes (as calculated at hourly intervals from May to August), encompass a maximum of 24.6% (at any one point in time) and an average of 1.7% of the little tern foraging range for the 2°C uplift, and a maximum of 14.2% and average of 0.3% for the 3°C uplift. This compares with maximum and average overlaps between the existing Sizewell B plume and the foraging range of 16.9% and 0.7%, respectively, for the 2°C uplift, and of 11.5% and 0.2%, respectively, for the 3°C uplift.

8.3.106. Based on the above, the thermal discharges from Sizewell C are predicted to cause a relatively large increase in the extent to which the 2°C thermal plume encroaches onto the likely foraging range of the Alde-Ore Estuary SPA little tern population, with the current 8.7% overlap (from the existing discharges from Sizewell B) increasing to 15.4% (as determined by the 98th percentiles of the thermal plumes). However, over the course of the breeding period, the average extent of overlap between the 2°C uplift plume (for Sizewell B combined with Sizewell C) and the foraging range remains below 2%. Furthermore, for the reasons given in section 8.3 b ii of this report, it is considered that the 2°C uplift is likely to represent an overly precautionary threshold. The 3°C uplift indicates a relatively small overlap with the little tern foraging range (5.4% for the 98th percentile of the thermal plume, and 0.3% for the average instantaneous overlap) and small absolute increases relative to the existing, baseline, conditions. Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of thermal discharges during the operational period.

Chemical discharges

8.3.107. There is no overlap of the predicted foraging range of the SPA breeding little tern population with the Sizewell C plumes (for the defined thresholds) for total residual oxidant, bromoform or hydrazine (**Plate 8.3**, **Plate 8.4** and **Plate 8.5**). Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of chemical discharges during the operational period.

iii. Water quality effects – terrestrial environment

Construction

8.3.108. The assessment presented above for Sandwich tern is also applicable to little tern.

8.3.109. Therefore, there is no likelihood of an adverse effect due to the alteration of water quality in the terrestrial environment to arise with regard to the conservation objectives for breeding little tern.

iv. Alteration of local hydrology and hydro-geology

Construction and operation

8.3.110. There is no likelihood of an adverse effect due to the alteration of local hydrology and hydrogeology to arise with regard to the conservation objectives for breeding little tern.

v. Changes in air quality

Construction, operation and decommissioning

8.3.111. The assessment presented above for Sandwich tern is also applicable to little tern.

8.3.112. Therefore, there is no likelihood of an adverse effect on the conservation objectives for breeding little tern.

vi. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.113. The assessment of the potential direct and indirect effects associated with an increase in recreational pressure described above for the SPA Sandwich tern population is also applicable to the SPA little tern population.

8.3.114. As described in section 6.3a of this report, the Alde-Ore Estuary SPA is no longer recognised as a regularly occupied breeding site for little tern. The most recent breeding attempt was on Orfordness, at Sudbourne Beach, near Slaughden, and historically little terns have also nested on Havergate Island). Supplementary advice from Natural England on the conservation objectives for the Alde Ore Estuary SPA (Ref. 8.3) includes a restore target for the little tern breeding population, although no target population size is set.

8.3.115. Havergate Island is within an area of controlled access where visitor use is not predicted to increase. Sudbourne Beach is potentially accessible via a car park south of the village of Aldeburgh as seen in **Appendix E** of this report**,** Access Point W, **Figure 007**. The Recreational Evidence Base as seen in **Appendix E** of this report, concludes that any increase in visitor numbers (as a result of potential displacement from Sizewell C (estimated at 2.9 - 13% for this location, see **Table 8.2**) would not increase the disturbance pressure at this site. This takes account of existing access management measures, including prohibition of dogs on the beach between 1 May and 30 September, signage, fencing and vehicle barriers.

8.3.116. The site improvement plan for the Alde-Ore Estuary SPA (Ref. 8.6) identifies little tern as a feature affected by public access / disturbance to the shingle

areas used for nesting. This includes low-flying aircraft and access by boats to Orfordness, as well as recreational visitors accessing via land. An investigation into public access and disturbance levels is recommended by the site improvement plan, as well as management of shingle habitats to minimise disturbance through zonation, wardening and awareness raising. Although public access pressure has been identified as an issue for little terns at the Alde-Ore Estuary, the levels of increase and specific alternative destinations predicted as a result of the construction (and decommissioning by proxy) of Sizewell C are not considered likely to limit the potential nesting areas for little tern.

8.3.117. Therefore, direct (and indirect) disturbance due to an increase in recreational pressure as a result of the construction or decommissioning of Sizewell C is not predicted to impede the ability for the conservation objectives for breeding little tern at the Alde-Ore Estuary SPA to be met.

Operation

8.3.118. The assessment of the potential direct and indirect effects of an increase in recreational pressure presented above for Sandwich tern is also applicable to little tern.

8.3.119. Direct or indirect effects associated with an increase in recreational pressure during the operation of Sizewell C are not predicted to adversely affect the conservation objectives for breeding little tern using the Alde-Ore Estuary SPA.

vii. Physical interaction between species and project infrastructure

Operation

8.3.120. Populations of the fish and marine invertebrate prey of little terns may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

8.3.121. An overview of the potential for impingement and entrainment of seabird prey at Sizewell C, and the assessment methodology, is given above for Sandwich tern.

Predicted impingement of little tern prey

8.3.122. Information on foraging behaviour and diet of little terns is provided in section 6.3a of this report. Given the restricted foraging range of this species from breeding colonies (mean maximum of 3.9km alongshore and 2.4km seawards), and the distance of the SPA from the main development site (5km at the nearest point), little terns nesting within the Alde-Ore Estuary SPA are unlikely to forage offshore in the vicinity of Sizewell C.

8.3.123. It is also noted that little tern no longer breeds regularly within the SPA due to factors including changes in the beach profile (and availability of nesting habitat), predation and disturbance.

8.3.124. The most important fish prey for little tern in the southern North Sea are herring and sprat.

8.3.125. As described above in the assessment for Sandwich tern, predicted impingement mortality of herring and sprat is estimated at less than 1% of the relevant SSB and predicted effects on these fish species are assessed as negligible.

8.3.126. The likely effects of entrainment and impingement on marine invertebrates were assessed as negligible.

Potential effects on the SPA little tern population

8.3.127. Impingement and entrainment mortality is predicted to have a negligible effect on the prey species for breeding little tern using the Alde-Ore Estuary SPA. Impacts at the scale of the SSB populations and on local populations are likely to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

8.3.128. Therefore, impingement and entrainment of prey at the main development site is not predicted to result in depletion of prey resources for little terns breeding in the Alde-Ore Estuary SPA, and there would be no adverse effect on the SPA conservation objectives for this species.

d) Effects on breeding lesser black-backed gull, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.3.129. The assessment presented above for Sandwich tern is also applicable to lesser black-backed gull. Therefore, there is no likelihood of an adverse effect on the conservation objectives for breeding lesser black-backed gull.

ii. Water quality effects – marine environment

Introduction

8.3.130. As for the Alde-Ore Estuary SPA breeding Sandwich tern population, the marine environment water quality effects on the SPA breeding lesser black-backed gull population relate to the operational period only as seen in section 8.3a of this report. The basis for the assessments of the thermal and chemical discharges from Sizewell C are also as outlined above for the SPA Sandwich

tern population as provided in section 8.3 b ii of this report. Therefore, the thresholds are as applied in the assessment of the SPA Sandwich tern population, whilst the potential effects are concerned with the impacts on the prey species of lesser black-backed gull.

Operation

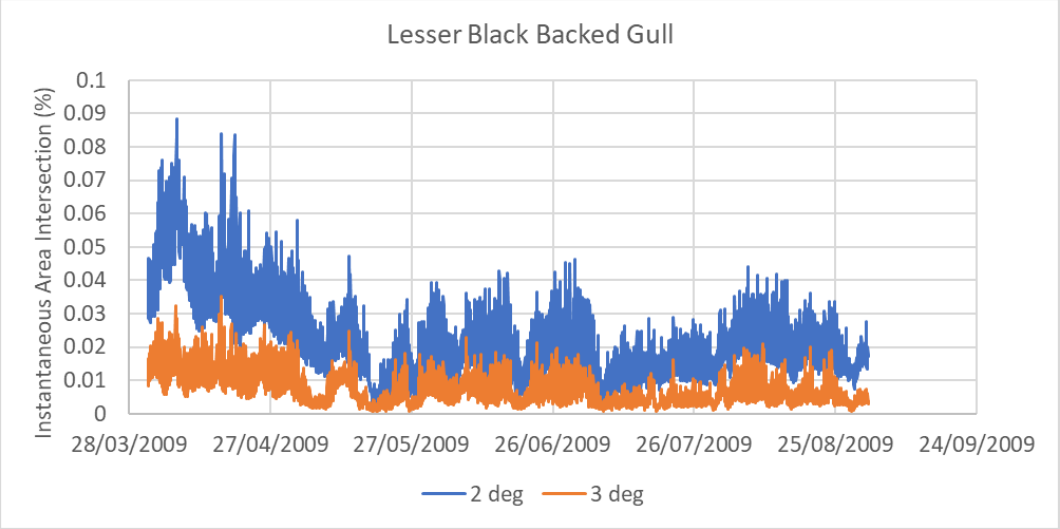
Thermal discharges

8.3.131. For lesser black-backed gull, the thermal plumes associated with the 2°C and 3°C temperature uplifts are considered for April to August (as the period over which it is present as a breeding species at the SPA). Over this period, the areas encompassed at the sea surface by 98th percentiles for the existing 2°C and 3°C thermal plumes (for Sizewell B) extend to 18.6km^2 and 10.5km^2, respectively (whilst the equivalent plumes for Sizewell C, when considered alone, extend across 9.8km^2 and 2.8km^2, respectively). Incorporating the Sizewell C thermal plumes together with the Sizewell B plumes increases these areas to 51.3km^2 for the 2°C uplift and 17.7km^2 for the 3°C uplift (**Plate 8.1**).

8.3.132. Lesser black-backed gulls forage widely during the breeding period, with the mean maximum foraging range in marine environments estimated as 141km as provided in section 6.3a of this report (Ref. 4.8), although it is likely that much of the foraging activity would occur in those parts of the range which are closer to the colony. As well as having extensive marine foraging ranges, lesser black-backed gulls may also exploit terrestrial foraging habitats, including during the breeding season (Ref. 6.65). Based on the 98th percentile, the 2°C and 3°C thermal plumes lie entirely within the predicted marine foraging range but represent only 0.13% (for the 2°C uplift) and 0.05% (for the 3°C uplift) of the assumed range when the combined effects of Sizewell B and Sizewell C are considered. This compares with 0.05% (for the 2°C uplift) and 0.03% (for the 3°C uplift) for the existing thermal plumes that result from Sizewell B. Relating these thermal plumes to the marine area encompassed by the mean foraging range of this species (i.e. 72km – Ref. 4.8), to account for the likely greater importance to foraging birds of areas closer to the colony, makes little meaningful difference because the areas of overlap do not exceed 0.5%.

8.3.133. The instantaneous plume sizes show the same pattern as for the SPA Sandwich terns (given that the plumes are modelled over the same time period and they are fully encompassed within the foraging range), with the area of the plumes greatest in April and lower in June and July (**Plate 8.8**). However, the percentage overlap with the foraging range is considerably smaller (due to the larger extent of the predicted foraging range of the SPA lesser black-backed gull population).

Plate 8.8: Instantaneous area of overlap of the SPA lesser black-backed gull marine foraging range with the 2°C and 3°C uplifts for Sizewell B together with Sizewell C for April to August



8.3.134. Thus, for the combined effects of Sizewell B and Sizewell C, the 2°C uplift accounts for a maximum of 0.09% of the SPA lesser black-backed gull foraging range at any one point in time, and an average of 0.02% over the breeding period (**Table 8.3**). These percentages are considerably lower when considering the 3°C uplift and represent small absolute increases only on the existing baseline situation, as represented by the Sizewell B thermal plume.

Table 8.3: The maximum and mean instantaneous areas of thermal plumes at the sea surface for the 2°C and 3°C uplifts for Sizewell B alone and for Sizewell B together with Sizewell C for April to August, with the percentage overlap with the predicted foraging range of the SPA lesser black-backed gull population

Temperature Uplift	Projects		Area (km²)	Percentage (%) Of The SPA Lesser Black-Backed Gull Foraging Range
2°C	Sizewell B alone	Mean	3.6	0.01
		Maximum	13.9	0.03
	Sizewell B plus C	Mean	8.5	0.02
		Maximum	34.6	0.09
3°C	Sizewell B alone	Mean	1.6	<0.01
		Maximum	8.1	0.02
		Mean	2.8	0.01

Temperature Uplift	Projects		Area (km^2)	Percentage (%) Of The SPA Lesser Black-Backed Gull Foraging Range
	Sizewell B plus C	Maximum	13.8	0.04

8.3.135. Records of foraging lesser black-backed gulls were scarce during the project-specific surveys, with most records being of loafing and commuting birds (with the latter unsurprising, given the large foraging range of the species and limited areas of this foraging range which would be covered by these shore-based surveys) as provided in section 6.3a of this report.

8.3.136. The thermal plume for the 2°C uplift for Sizewell B combined with Sizewell C represents a small percentage only of the predicted marine foraging range of the SPA breeding lesser black-backed gull population, with the contribution of Sizewell C causing a small absolute increase to the existing baseline (resulting from Sizewell B). Furthermore, the extent of this overlap is smaller still for the 3°C uplift which is considered to represent a sufficiently precautionary threshold. Given this, no adverse effects on the SPA lesser black-backed gull population are predicted as a consequence of thermal discharges during the operational period.

Chemical discharges

8.3.137. The extents of the total residual oxidant, bromoform and hydrazine plumes (for the defined thresholds) at the sea surface within the predicted foraging range of the SPA lesser black-backed gull population are as detailed above for the SPA Sandwich tern population (**Plate 8.3, Plate 8.4**, and **Plate 8.5**). However, in the case of lesser black-backed gull, they represent smaller percentages of the foraging range, with each plume resulting from the Sizewell C discharges being less than 0.01% of this range (Ref. 8.1). When considered in relation to the marine area encompassed by the mean foraging range of lesser black-backed gull (as a proxy for the area in which foraging activity is more concentrated – see above), each of these plumes for Sizewell C represent less than 0.04% of this smaller range. As such, no adverse effects on the SPA breeding lesser black-backed gull population are predicted as a consequence of chemical discharges during the operational period.

iii. Water quality effects – terrestrial environment

Construction

8.3.138. The assessment presented above for Sandwich tern is also applicable to lesser black-backed gull.

8.3.139. Therefore, there is no likelihood of an adverse effect associated with the alteration of water quality in the terrestrial environment on the conservation objectives for breeding lesser black-backed gull.

iv. Alteration of local hydrology and hydrogeology

Construction and operation

8.3.140. The assessment presented above for Sandwich tern is also applicable to lesser black-backed gull.

8.3.141. Therefore, there is no likelihood of an adverse effect associated with the alteration of local hydrology and hydrogeology on the conservation objectives for breeding lesser black-backed gull.

v. Changes in air quality

Construction, operation and decommissioning

8.3.142. The assessment presented above for Sandwich tern is also applicable to lesser black-backed gull. Therefore, there is no likelihood of an adverse effect on the conservation objectives for breeding lesser black-backed gull arising.

vi. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.143. The assessment of the potential direct and indirect effects of increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA breeding population of lesser black-backed gulls.

8.3.144. As described in section 6.3a of this report, historically, the primary breeding colony for lesser black-backed gulls in the SPA was on Lantern Marshes at Orfordness, whereas the main nesting areas are now on Havergate Island. The SPA breeding population has declined, with contributory factors being predation by foxes and emigration of adults to other colonies after several consecutive years of breeding failure (Ref. 8.7). Supplementary advice from Natural England on the SPA conservation objectives includes a target to restore the breeding population to a level above 14,074 pairs (the number present at classification), whilst avoiding deterioration from the current level as indicated by the latest mean peak count or equivalent (Ref. 8.3).

8.3.145. The site improvement plan for the SPA (Ref. 8.6) identifies lesser black-backed gull as a species affected by public access / disturbance, including low-flying aircraft and access by boats to Orfordness as well as recreational visitors accessing via land. Former breeding areas at Lantern Marshes and

the currently used Havergate Island are, however, within areas of controlled access where visitor use is unlikely to increase. Consequently, direct disturbance due to increase in recreational pressure is not predicted to impede the ability to meet conservation objectives for breeding Lesser black-backed gull at the Alde-Ore Estuary.

8.3.146. In conclusion, direct and indirect effects on supporting habitats due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding lesser black-backed gulls at the Alde-Ore Estuary.

Operation

8.3.147. The assessment of the potential direct and indirect effects associated with an increase in recreational pressure presented above for Sandwich tern is also applicable to breeding lesser black-backed gull.

8.3.148. Neither direct nor indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for breeding lesser black-backed gull at the Alde-Ore Estuary.

vii. Physical interaction between species and project infrastructure

Operation

8.3.149. Populations of the fish and marine invertebrate prey of lesser black-backed gulls may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

8.3.150. An overview of the potential for impingement and entrainment of seabird prey at Sizewell C, and the assessment methodology, is given above for Sandwich tern.

Predicted impingement of lesser black-backed gull prey

8.3.151. Information on the foraging behaviour and diet of lesser black-backed gulls is provided in section 6.3a of this report. Based on a mean maximum foraging range of 141km, birds breeding at the Alde-Ore Estuary SPA may forage offshore from the main development site. Lesser black-backed gulls forage in terrestrial and intertidal as well as marine environments. When foraging at sea, key fish prey species of this species in the Sizewell Bay are likely to be herring and sprat.

8.3.152. As described above in the assessment for Sandwich tern, predicted impingement mortality of herring and sprat is estimated to be less than 1%

of the relevant SSB and effects on these fish species are considered to be negligible. Impacts at the scale of the SSB populations and on local populations are likely to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

8.3.153. The likely effects of entrainment and impingement on marine invertebrates were assessed as negligible.

8.3.154. Impingement and entrainment of prey at the main development site, therefore, is not predicted to result in depletion of prey resources for lesser black-backed gulls breeding at the Alde-Ore Estuary SPA, and there would be no adverse effect on the SPA conservation objectives for this species.

e) Effects on breeding avocet, project alone

i. Changes in air quality

Construction, operation and decommissioning

8.3.155. The assessment presented above for Sandwich tern is also applicable to breeding avocet.

8.3.156. Therefore, there is no likelihood of an adverse effect arising on the conservation objectives for breeding avocet.

ii. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.157. The assessment of the potential direct and indirect effects of an increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA breeding avocet population.

8.3.158. Breeding avocets at the Alde-Ore SPA have declined since the SPA was classified (**Table 6.1**). Recent nesting areas are at Havergate Island and Orfordness, including new habitat created within the former military Airfield (Ref. 8.3; Ref. 8.8) and new intertidal habitat at Hazlewood Marshes SWT reserve (RSPB *unpublished*). Breeding success has been poor since monitoring began in 1996 with few chicks surviving to fledge; attributed to predation by foxes and gulls (Natural England, undated). Increases in lesser black-backed gull numbers at Havergate Island are likely to be linked to the decline of avocets at this site, and the RSPB has created suitable breeding sites nearby (outside the SPA) at their Boyton and Hollesley Marshes Reserve (RSPB *unpublished*). Supplementary advice from Natural England on the SPA conservation objectives for breeding avocet includes a target to

restore the breeding population although a target population size is not set (Ref. 8.3).

8.3.159. The site improvement plan for the SPA (Ref. 8.6) identifies breeding avocet as a qualifying feature affected by public access / disturbance, including low-flying aircraft and access by boats to Orfordness as well as recreational visitors accessing via land. Current breeding areas within the SPA, at Orfordness, Havergate Island and Hazlewood Marshes are, however, within areas of controlled access where visitor use is unlikely to increase. The same is true for breeding populations at Boyton and Hollesley Marshes, which may be considered to be functionally linked to the SPA population. Consequently, direct disturbance due to increase in recreational pressure is not predicted to impede the ability to meet conservation objectives for breeding avocet at the Alde-Ore Estuary.

8.3.160. In conclusion, neither direct or indirect effects on supporting habitat due to an increase in recreational pressure during the construction or decommissioning of Sizewell C are predicted to adversely affect the conservation objectives for breeding avocet at the Alde-Ore Estuary.

Operation

8.3.161. The assessment of the potential direct and indirect effects of increase in recreational pressure presented above for Sandwich tern is also applicable to breeding avocet.

8.3.162. Neither direct or indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for breeding avocet at the Alde-Ore Estuary.

f) Effects on breeding marsh harrier, project alone

i. Changes in air quality

Construction, operation and decommissioning

8.3.163. The assessment presented above for Sandwich tern is also applicable to breeding marsh harrier.

8.3.164. Therefore, there is no likelihood of an adverse effect arising on the conservation objectives for breeding avocet.

ii. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.165. The assessment of the potential direct and indirect effects of increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA breeding marsh harrier population.

8.3.166. The most recent population estimate of breeding marsh harriers for the SPA, 3 breeding pairs, is the same as that at the time of classification (**Table 6.1**). Natural England (Ref. 8.3) describes this qualifying feature of the SPA as in good condition and/or currently un-impacted by anthropogenic activities.

8.3.167. Increased disturbance due to public access pressure has been identified as a potential issue for breeding marsh harrier at the Alde-Ore Estuary SPA (Ref. 8.6). However, given the relatively small levels of increase and specific alternative destinations predicted as a result of the construction of Sizewell C, and the existing network of footpaths and access management controls which mean that the marsh and reedbed habitats favoured by this species for nesting within the SPA are not easily accessible as provided in section 8.3 b vi, **Appendix E** of this report, increased recreational pressure is considered unlikely to limit or impinge upon the available nesting habitat for this species.

8.3.168. In conclusion, neither direct or indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding marsh harrier at the Alde-Ore Estuary.

Operation

8.3.169. The assessment of the potential direct and indirect effects of increase in recreational pressure presented above for Sandwich tern is also applicable to breeding marsh harrier.

8.3.170. Hence, neither direct or indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for breeding marsh harrier at the Alde-Ore Estuary.

g) Effects on non-breeding avocet, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.3.171. The assessment presented above for Sandwich tern is also applicable to avocet during the non-breeding period.

8.3.172. Therefore, there is no likelihood of an adverse effect arising on the conservation objectives for non-breeding avocet.

ii. Water quality effects – terrestrial environment

Construction

8.3.173. The assessment presented above for Sandwich tern is also applicable to non-breeding avocet.

8.3.174. There is no likelihood of an adverse effect to arise due to alteration of water quality in the terrestrial environment on the conservation objectives for non-breeding avocet.

iii. Alteration of local hydrology and hydrogeology

Construction and operation

8.3.175. The assessment presented above for breeding Sandwich tern is also applicable to non-breeding avocet.

8.3.176. There is no likelihood of an adverse effect to arise due to the alteration of local hydrology and hydrogeology on the conservation objectives for non-breeding avocet.

iv. Changes in air quality

Construction, operation and decommissioning

8.3.177. The assessment presented above for Sandwich tern is also applicable to avocet during the non-breeding period.

8.3.178. There is no likelihood of an adverse effect to arise on the conservation objectives for non-breeding avocet.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.179. The assessment of the potential direct and indirect effects due to an increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA non-breeding avocet population.

8.3.180. The SPA population of non-breeding avocet has increased from levels at the time of classification (**Table 6.1**). Natural England (Ref. 8.3) describes this qualifying feature of the SPA as in good condition and/or currently un-impacted by anthropogenic activities.

8.3.181. Increased disturbance due to public access pressure has been identified as a potential issue for non-breeding avocet at the Alde-Ore Estuary SPA (Ref. 8.6). Within the Alde-Ore Estuary SPA avocets roost on saltmarsh and banks between Blackheath and Snape, with foraging focused on intertidal areas around Iken, Snape and Butley Creek (Ref. 6.56). However, given the relatively small levels of increase and specific alternative destinations predicted as a result of the construction of Sizewell C, and the existing network of footpaths and access management controls which mean that the intertidal and associated saltmarsh habitats favoured by this species are not easily accessible as provided in section 8.3 b vi, **Appendix E** of this report, increased recreational pressure is considered unlikely to increase anthropogenic disturbance levels for non-breeding avocet.

8.3.182. In conclusion, neither direct or indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are predicted to adversely affect the conservation objectives for non-breeding avocet at the Alde-Ore Estuary.

Operation

8.3.183. The assessment of the potential direct and indirect effects of increase in recreational pressure presented above for Sandwich tern is also applicable to non-breeding avocet.

8.3.184. Hence, neither direct or indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for non-breeding avocet at the Alde-Ore Estuary.

h) Effects on non-breeding redshank, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.3.185. The assessment presented above for Sandwich tern is also applicable to redshank.

8.3.186. There is no likelihood of an adverse effect occurring on the conservation objectives for non-breeding redshank

ii. Water quality effects – terrestrial environment

Construction

8.3.187. The assessment presented above for Sandwich tern is also applicable to non-breeding redshank.

8.3.188. There is no likelihood of an adverse effect due to the alteration of water quality in the terrestrial environment to affect the conservation objectives for non-breeding redshank.

iii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.3.189. The assessment presented above for Sandwich tern is also applicable to non-breeding redshank. Hence there is no likelihood of an adverse effect to arise due to the alteration of local hydrology and hydrogeology on the conservation objectives for non-breeding redshank.

iv. Changes in air quality

Construction, operation and decommissioning

8.3.190. The assessment presented above for Sandwich tern is also applicable to redshank during the non-breeding period. Hence there is no likelihood of an adverse effect arising on the conservation objectives for non-breeding redshank.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.191. The assessment of the potential direct and indirect effects due to an increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA non-breeding redshank population.

8.3.192. The SPA population of non-breeding redshank has increased from levels at the time of classification (**Table 6.1**) although, over this time period, the population has fluctuated, with more birds present in warmer winters and far fewer during periods of extreme cold (Ref. 6.56). Natural England (Ref. 8.3) describes this qualifying feature of the SPA as in good condition and/or currently un-impacted by anthropogenic activities.

8.3.193. Redshank frequent saltmarsh, intertidal flats and saline lagoons throughout the site. High tide roosting areas are saltmarshes at the Snape, on Orford Ness and Havergate Island with smaller numbers at Butley Creek (Ref. 6.56).

8.3.194. Given the relatively small levels of increase and specific alternative destinations predicted as a result of the construction of Sizewell C, and the existing network of footpaths and access management controls which mean that the intertidal and associated saltmarsh habitats favoured by this species are not easily accessible as seen in section 8.3 b vi, **Appendix E** of this report, increased recreational pressure is considered unlikely to increase anthropogenic disturbance levels for non-breeding redshank.

8.3.195. In conclusion, neither direct or indirect effects due to an increase in recreational pressure during the construction or decommissioning of Sizewell C are predicted to adversely affect the conservation objectives for non-breeding redshank at the Alde-Ore Estuary.

Operation

8.3.196. The assessment of the potential direct and indirect effects of increase in recreational pressure presented above for Sandwich tern is also applicable to non-breeding redshank.

8.3.197. Hence, direct or indirect effects due to an increase in recreational pressure during the operation of Sizewell C are not predicted to adversely affect the conservation objectives for non-breeding redshank at the Alde-Ore Estuary.

i) Effects on non-breeding ruff, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.3.198. The assessment presented above for Sandwich tern is also applicable to ruff. Therefore, there is no likelihood of an adverse effect occurring on the conservation objectives for non-breeding ruff.

ii. Water quality effects – terrestrial environment

Construction

8.3.199. The assessment presented above for Sandwich tern is also applicable to non-breeding ruff.

8.3.200. Hence there is no likelihood of an adverse effect arising due to alteration of water quality in the terrestrial environment and affecting the conservation objectives for non-breeding ruff.

iii. Alteration of local hydrology and hydrogeology

Construction and operation

8.3.201. The assessment presented above for breeding Sandwich tern is also applicable to non-breeding ruff. There is no likelihood of an adverse effect due to alteration of local hydrology and hydro-geology to affect the conservation objectives for non-breeding ruff.

iv. Change in air quality

Construction, operation and decommissioning

8.3.202. The assessment presented above for Sandwich tern is also applicable to ruff. There is no likelihood of an adverse effect arising on the conservation objectives for non-breeding ruff.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.3.203. The assessment of the potential direct and indirect effects of increase in recreational pressure described above in the assessment for the SPA Sandwich tern population is also applicable to the SPA non-breeding ruff population.

8.3.204. Natural England (Ref. 8.3) has set a restore target for this species at the Alde-Ore Estuary SPA, based on a 5 year mean WeBS count of 13 birds for the period 1989/90-1993/94. The most recent SPA count is 6 individuals (**Table 2.1**).

8.3.205. Ruff feed on intertidal flats and associated marshes and scrapes. Natural England (Ref. 6.56) identifies high tide feeding areas within the SPA as grazing marshes at Havergate, Orford Ness and Hazelwood.

8.3.206. Given the relatively small levels of increase and specific alternative destinations predicted as a result of the construction of Sizewell C, and the existing network of footpaths and access management controls which mean that the intertidal and associated grazing marsh habitats favoured by this species are not easily accessible as provided in section 8.3 b vi, **Appendix E** of this report, increased recreational pressure is considered unlikely to increase anthropogenic disturbance levels for non-breeding ruff, and impede the ability for the conservation objectives for this species at the Alde-Ore Estuary SPA to be met.

Operation

8.3.207. The assessment of the potential direct and indirect effects of increase in recreational pressure presented above for Sandwich tern is also applicable to non-breeding ruff.

8.3.208. Neither direct or indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for non-breeding ruff at the Alde-Ore Estuary.

j) Conclusion Alde-Ore Estuary SPA, project alone

8.3.209. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Alde-Ore Estuary SPA.

8.3.210. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:

- affect the extent and distribution of the habitats of the qualifying features;
- adversely affect the structure and function of the habitats of the qualifying features;
- adversely affect the supporting processes on which the habitats of the qualifying features rely;

- adversely affect the populations of each of the qualifying features; and
- adversely affect the distribution of the qualifying features within the site.

k) In-combination effects

8.3.211. The screening exercise for plans or projects that could have a likely significant in-combination effect with the construction, operation and decommissioning of the Sizewell C Project identified possible likely significant in-combination effect on the Alde-Ore Estuary SPA in relation to the alteration of coastal processes, changes to marine water quality and disturbance due to changes in recreational pressure as provided in **Appendix C** of this report.

8.3.212. The screened in plans and projects and the assessment for adverse effects on site integrity as a result of these potential in-combination effects is presented separately for each impact pathway in **Table 8.4, Table 8.5,** and **Table 8.6**.

8.3.213. No plans or projects are identified as having the potential to result in an adverse in-combination effect with the Sizewell C Project on the Alde-Ore Estuary SPA. For each impact pathway, this is the case when the different plans or projects identified in **Table 8.4, Table 8.5,** and **Table 8.6** are considered individually and when the assessments for each plan or project in-combination with the Sizewell C Project are considered together.

Table 8.4: In-combination assessment of plans and projects with the potential to affect birds within the Alde-Ore Estuary SPA due to altered coastal processes

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Suffolk SMP	Adjacent	Alteration of coastal processes. The assessment in section 7.4 e of this report above applies here. None of the proposed management approaches in the Suffolk SMP have potential to cause in combination effects on coastal processes / sediment transport.	The changes to coastal processes / sediment transport due to the Sizewell C Project would similarly be very small, local to the Sizewell C Project, and too far away to interact with the proposed management approaches. Therefore, it is predicted that an in-combination effect on coastal processes / sediment transport would not arise due to the Sizewell C Project and the outcomes of the Suffolk SMP.	There would be no in combination effect on any of the qualifying features of the Alde-Ore Estuary SPA.

Table 8.5: In-combination assessment of plans and projects with the potential to affect birds within the Alde-Ore Estuary SPA through changes to marine water quality

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Operations and Maintenance Marine Licence applications for generation and	11km from cable corridor. 48km from windfarm site to	Water quality effects – marine. This Operations and Maintenance Licence relates to the East Anglia ONE offshore wind farm. The assessment for the construction, operation and decommissioning of the East Anglia	There is no potential for in-combination effects with the Sizewell C Project in relation to this Operations and Maintenance Licence.	There is no potential for an adverse in-combination effect with the Sizewell C Project to arise.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
transmission assets. Licence to commence on 1st August 2019 and expire by May 2045	nearest seaward point. 52km from wind farm site to the main development site.	ONE project (including non-material changes to the DCO) concluded no adverse effects in relation to the Alde-Ore Estuary SPA (Ref. 8.9; Ref. 8.10). The potential for effects on marine water quality is greater during construction (and decommissioning) than during operation.		
Suffolk SMP	Adjacent	Water quality effects – marine. The coastal management approaches outlined within the Environment Agency's preliminary assessment aim to either do nothing, maintain or improve the existing structures, create new embankments along the estuary channel, or maintain existing natural defences (resulting in temporary breaches). These four different approaches would not greatly change the current baseline for the Sizewell C Project as seen in section 7.4 e of this report.	However, there is the potential for an in-combination effect with the Sizewell C Project on the SPA breeding little tern, Sandwich tern and lesser black-backed gull populations as a result of possible effects on marine water quality.	None of the proposed management approaches outlined within the preliminary assessment for the Suffolk SMP have the potential to cause an adverse in-combination effect with the Sizewell C Project.

Table 8.6: In-combination assessment of plans and projects with the potential to affect birds within the Alde-Ore Estuary SPA through disturbance due to increased recreational pressure

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Rendlesham 5.05ha of land west of Garden Square for mixed residential development and greenspace provision for approximately 50 units.	14.2km	Disturbance due to increased recreational pressure	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure. The assessment in section 7.5 e. iii of this report above applies here: proposed housing developments would be covered by the Suffolk RAMS Strategy, or by project-specific mitigation commitments. Therefore, it is considered that there is no potential for an in-combination effect due to potential increases in recreational pressure with the activities of the Sizewell C Project. Whilst the Suffolk RAMS is not directly applicable to the Sizewell C Project, SZC Co. would adopt a similar approach to mitigate for any potential impacts. Such an approach would be secured via a monitoring and mitigation plan/agreement with relevant organisations/site managers to the European site in question. Consequently, it is predicted that an in-combination effect due to recreational disturbance upon the Alde-Ore Estuary SPA would not arise.	No
Rendlesham 4.3ha of land to the east of Redwald Road, identified for residential use approximately 50 units	13.7km	Disturbance due to increased recreational pressure		No
Saxmundham c. 66.6ha of land for a garden neighbourhood comprising primary school, community facilities,	6.5km	Disturbance due to increased recreational pressure		No

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
employment land, open space and residential development				

8.3.214. Therefore, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse in-combination effects on the integrity of the Alde-Ore Estuary SPA.

8.4 Assessment of effects: Alde-Ore Estuary Ramsar site

a) Summary of screening outcomes, project alone

8.4.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site for Ramsar criterion 3, a notable assemblage of breeding and wintering wetland birds, and Ramsar criterion 6, species populations occurring at levels of international importance:

- Alteration of coastal processes / sediment transport, during construction, operation and decommissioning.
- Water quality effects – marine environment, during operation.
- Changes in air quality, during construction, operation and decommissioning.
- Disturbance due to increase in recreational pressure, during construction, operation and decommissioning.
- Physical interaction between species and project infrastructure, during operation.

8.4.2. The following potential effects were screened in for Appropriate Assessment in relation to the associated development sites (the two village bypass) for Ramsar criterion 3 and 6:

- Water quality effects – terrestrial environment, during construction.
- Alteration of local hydrology and hydro-geology, during construction and operation.

b) Effects on qualifying features screened in, project alone

8.4.3. Although the Ramsar qualifying criteria are different from those of the SPA, there is considerable overlap in the species and populations covered by each designation.

8.4.4. The qualifying species and populations occurring at levels of international importance are breeding lesser black-backed gull and wintering populations of avocet and redshank (Ramsar criterion 6), each of which are also qualifying features of the SPA. In terms of the notable assemblage of

breeding and wintering wetland birds (Ramsar criterion 3), the SPA qualifying features also encompass many of the bird species listed on the Ramsar Information Sheet for the site (Ref. 6.20). Thus, for these species, the assessment above for each impact pathway in relation to the Alde-Ore Estuary SPA, and the conclusion of no adverse effect on integrity is also considered to apply to the Ramsar site.

c) Conclusion Alde-Ore estuary Ramsar site, project alone

8.4.5. Given the above it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C Project would not have adverse effects on the internationally important bird populations and notable assemblage of breeding and wintering wetland birds associated with the Alde-Ore Estuary Ramsar site.

d) In-combination assessment

8.4.6. The conclusions of the in-combination assessment undertaken for the Alde-Ore Estuary SPA also apply to the Alde-Ore Estuary Ramsar site. Hence an adverse effect on site integrity is not predicted.

8.5 Assessment of effects: Benacre to Easton Bavents SPA

a) Summary of screening outcomes, project alone

8.5.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site:

- Alteration of coastal processes / sediment transport, during construction, operation and decommissioning for the qualifying feature:
  - Breeding populations of little tern
- Water quality effects – marine environment, during operation for the qualifying feature:
  - Breeding populations of little tern
- Disturbance due to increase in recreational pressure, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of bittern; marsh harrier; and little tern.
- Physical interaction between species and project infrastructure, during operation for the qualifying feature:
  - Breeding populations of little tern

8.5.2. No potential effects were screened in for Appropriate Assessment in relation to the associated development sites.

b) Effects on breeding bittern, project alone

i. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.5.3. During the construction and decommissioning of the main development site, recreational users of the Sizewell C area may be displaced elsewhere, including to locations within and close to nearby European sites. The background to the assessment of potential increase in recreational pressure during the construction, operation and decommissioning of Sizewell C is described above in section 8.3 b vi of this report and the Recreational Evidence base as seen in **Appendix E** of this report includes further details.

Overview of recreational assessment for Benacre to Easton Bavents SPA

8.5.4. The SPA, about 15km north of Sizewell C at the nearest point, has the following access points - letters refer to maps in **Figures 001** and **003** and **Table 4.1** in **Appendix E** of this report:

- Kessingland (A).
- Covehithe (B).

8.5.5. Covehithe was not identified as an alternative site to relocate to during the visitor access surveys, therefore, no additional recreational pressure is predicted for this site as a result of displacement of visitors during the construction or decommissioning of Sizewell C.

8.5.6. Kessingland is outside the recreation and access study area but it was named as a potential alternative location by a small number of respondents in the survey. However, as only 4% of respondents stated they would relocate to sites outside the study area (including, but not limited to Kessingland), any increase in visitor pressure at this site due to construction of Sizewell C is considered likely to be so small as to be undetectable.

8.5.7. As described in section 8.3 b vi of this report, the potential also exists for indirect effects to arise associated with recreational disturbance on birds via the habitats on which they depend. However, no likely significant effect was identified in relation to increase in recreational disturbance on the qualifying habitats of the Benacre to Easton Bavents Lagoons SAC as seen in section 7.5 of this report. Given this, indirect effects on any SPA qualifying species as a result of effects of recreational disturbance on supporting habitats are highly unlikely.

8.5.8. In conclusion, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for any qualifying species of the Benacre to Easton Bavents SPA, including breeding bittern.

Operation

8.5.9. The information included in the assessment of the potential direct and indirect effects of increased recreational pressure during the operational phase of Sizewell C for Sandwich tern at the Alde-Ore Estuary SPA as provided in section 8.3 b vi of this report, is also applicable to breeding bittern at the Benacre to Easton Bavents SPA.

8.5.10. Hence, neither direct nor indirect effects due to an increase in recreational pressure during the operation of Sizewell C are predicted to adversely affect the conservation objectives for any SPA qualifying species at Benacre to Easton Bavents SPA, including breeding bittern.

c) Effects on breeding little tern, project alone

i. Alteration of coastal processes / sediment transport

Construction, operation and decommissioning

8.5.11. The Benacre to Easton Bavents SPA is situated approximately 15km northeast of the main development site. As per the assessment above for Sandwich tern and the Alde-Ore Estuary SPA, at this distance no effects are predicted on the coastal processes and sediment transport as a result of the construction, operation or decommissioning of the main development site.

8.5.12. Therefore, no changes in the extent of the coastal habitats used by breeding little tern are predicted and there is no likelihood of an adverse effect occurring on the conservation objectives for the qualifying features little tern.

ii. Water quality effects – marine environment

Operation

8.5.13. The Benacre to Easton Bavents SPA breeding little tern population could be subject to potential operational effects from thermal and chemical discharges which could affect the prey resource available to the population as seen in sections 8.3 b ii and 8.5 a of this report, in the same way as for the seabird qualifying features of the Alde-Ore Estuary SPA.

8.5.14. However, there is no spatial overlap between the thermal plumes for the 2°C and 3°C uplifts or any of the chemical plumes with the predicted foraging range (as defined by Ref. 6.43) of the Benacre to Easton Bavents SPA

breeding little tern population as seen in **Figure 4.1** and **Plate 8.7**. Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of thermal and chemical discharges during the operational period.

iii. Disturbance due to increase in recreational pressure

Construction, operation and decommissioning

8.5.15. The recreational assessment for the Benacre to Easton Bavents SPA, presented above for breeding bittern, also applies here.

8.5.16. Neither direct nor indirect effects due to an increase in recreational pressure during the construction, operation and decommissioning of Sizewell C are predicted to adversely affect the conservation objectives for any SPA qualifying species at Benacre to Easton Bavents SPA, including breeding little tern. This applies to the species at breeding colonies and in the marine environment.

iv. Physical interaction between species and project infrastructure

Operation

8.5.17. As described in section 8.3 b vii of this report, during the operation of Sizewell C, populations of the fish and marine invertebrate prey of little terns may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

8.5.18. Information on foraging behaviour and diet of little terns is provided in section 6.3 c of this report. Given the restricted foraging range of this species from breeding colonies (mean maximum of 3.9km alongshore and 2.4km seawards), and the distance of the SPA from Sizewell C (15km at the nearest point), little terns nesting within the Benacre to Easton Bavents SPA are very unlikely to forage offshore in the vicinity of Sizewell C.

8.5.19. The most important fish prey for little tern in the southern North Sea are herring and sprat.

8.5.20. As described in the assessment for Sandwich tern at the Alde-Ore Estuary SPA as provided in section 8.3 b vii of this report, the predicted impingement and entrainment (entrapment) mortality of herring and sprat is estimated at less than 1% of the relevant SSB and effects on these fish species, at the scale of the SSB populations and on local populations, are predicted to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

8.5.21. The likely effects of entrainment and impingement on marine invertebrates were assessed as negligible.

Potential effects on the SPA little tern population

8.5.22. Impingement and entrainment of prey at the main development site, therefore, is not predicted to result in depletion of prey resources for little terns breeding in the Benacre to Easton Bavents SPA, and there would be no adverse effect on the SPA conservation objectives for this species.

d) Effects on breeding marsh harrier, project alone

i. Disturbance due to increase in recreational pressure

Construction, operation and decommissioning

8.5.23. The recreational assessment for the Benacre to Easton Bavents SPA, presented above for breeding bittern, also applies here.

8.5.24. Neither direct nor indirect effects due to an increase in recreational pressure during the construction, operation and decommissioning of Sizewell C are predicted to adversely affect the conservation objectives for any SPA qualifying species at Benacre to Easton Bavents SPA, including breeding marsh harrier.

e) Conclusion Benacre to Easton Bavents SPA, project alone

8.5.25. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C Project would not result in adverse effects on the integrity of the Benacre to Easton Bavents SPA.

8.5.26. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C Project would not:

- affect the extent and distribution of the habitats of the qualifying features;
- adversely affect the structure and function of the habitats of the qualifying features;
- adversely affect the supporting processes on which the habitats of the qualifying features rely;
- adversely affect the populations of each of the qualifying features; and
- adversely affect the distribution of the qualifying features within the site.

f) In-combination assessment

8.5.27. The screening exercise for plans or projects that potentially could have a likely significant in-combination effect with the construction, operation and decommissioning of the Sizewell C Project identified possible likely significant in-combination effect on the Benacre to Easton Bavents SPA in relation to changes to marine water quality and the alteration of coastal processes as seen in **Appendix C** of this report.

8.5.28. The assessment for adverse effects on site integrity as a result of these potential in-combination effects is presented separately for each impact pathway in **Table 8.7** and

8.5.29. **Table** 8.8. No plans or projects are identified as having the potential to result in an adverse in-combination effect with the Sizewell C Project on the Benacre to Easton Bavents SPA, with only a single plan or project identified for each of the relevant impact pathways.

8.5.30. Therefore, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse in-combination effects on the integrity of the Benacre to Easton Bavents SPA.

Table 8.7: In-combination assessment of plans and projects with the potential to affect birds within the Benacre to Easton Bavents SPA due to marine water quality effects

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
Suffolk SMP	Adjacent	Water quality effects – marine	There is the potential for an in-combination effect with the Sizewell C Project on the SPA little tern population as a result of possible effects on marine water quality. The details of Suffolk SMP are described in section 7.4 e of this report. However, as described for the Alde-Ore Estuary SPA, as seen in section 8.3 k of this report, it is considered that none of the proposed management approaches actually have the potential to cause an in-combination effect with the Sizewell C Project due to changes in marine water quality.	No

Table 8.8: In-combination assessment of plans and projects with the potential to affect birds within the Benacre to Easton Bavents SPA due to alteration of coastal processes

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
SMP	Adjacent	Alteration of coastal processes The assessment in section 7.4 e of this report above applies here. It is considered that none of the proposed management approaches in the Suffolk SMP have potential to cause in combination effects on coastal processes / sediment transport.	The changes to coastal processes / sediment transport due to the Sizewell C Project would be very small, local to the Sizewell C Project, and too far away to interact with the proposed management approaches. Therefore, it is predicted that an in-combination effect on coastal processes / sediment transport would not arise due to the Sizewell C Project and the outcomes of the Suffolk SMP.	No

8.6 Assessment of effects: Deben Estuary SPA

a) Summary of Screening outcomes, project alone

8.6.1. No potential effects were screened in for the Deben Estuary SPA for Appropriate Assessment in relation to the main development site.

8.6.2. The following potential effect was screened in for Appropriate Assessment in relation to the Freight Management Facility associated development site:

- Disturbance effects on species populations, during construction, operation and decommissioning for non-breeding populations of avocet and dark-bellied brent goose.

b) SPA qualifying features, project alone

i. Disturbance effects on species populations

8.6.3. Disturbance effects on the Deben Estuary SPA non-breeding avocet and dark-bellied brent goose populations may arise via visual or noise disturbance associated with the construction, operation or decommissioning of the Freight Management Facility. These SPA populations could be affected as a result of disturbance to feeding or roosting birds, which could act to reduce the available foraging habitat, reduce foraging efficiency or increase energetic demands.

Construction, operation and decommissioning

8.6.4. The Freight Management Facility is adjacent to the A14 trunk road and located over 2.5km to the south of the Deben Estuary SPA at its closest point (**Figure 8.1**).

8.6.5. The construction and decommissioning of the Freight Management Facility site (expected to last for approximately 12 to 18 months during construction, with this assumed to be a worst-case for decommissioning) would be sources of noise and visual disturbance, but the distance of the site from the Deben Estuary SPA means that any effects of such disturbance on the SPA qualifying features are highly unlikely. In addition, construction and decommissioning activities would result in increased vehicle movements, estimated to total 224 per day, including 42 HGVs (Ref. 8.11) for the construction phase. Within the context of the existing vehicle movements on the A14 trunk road, this is considered to be of little consequence in terms of disturbance to the SPA qualifying features.

8.6.6. During the operational phase of the Freight Management Facility (expected to be 10 years), it is estimated that 275 HGVs would arrive on the site on a

typical weekday, with up to 425 HGVs during the busiest periods. Most of this activity is expected to occur during the morning, and the peak hourly rate of vehicle movements is expected to be approximately 40 in each direction (Ref. 8.11). As for construction of the Freight Management Facility, within the context of existing vehicle movements on the A14 and in conjunction with the considerable distance of the site from the SPA, this increase in vehicle movements is highly unlikely to result in any increase in disturbance effects on the SPA qualifying features.

8.6.7. Artificial lighting would also be in place at the Freight Management Facility during its construction, operation and decommissioning. However, lighting designs would ensure minimal light spillage at the site's boundaries (Ref. 8.11). Consequently, given the distance of the Freight Management Facility site to the SPA, it is considered that this would not lead to any effects on the SPA qualifying features.

8.6.8. Given the above, no adverse effects on the SPA qualifying features are predicted as a consequence of noise and visual disturbance from construction, operation and decommissioning of the Freight Management Facility.

c) Conclusion Deben Estuary SPA, project alone

8.6.9. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C Project would not result in adverse effects on the integrity of the Deben Estuary SPA.

8.6.10. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:

- affect the extent and distribution of the habitats of the qualifying features;
- affect the structure and function of the habitats of the qualifying features;
- affect the supporting processes on which the habitats of the qualifying features rely;
- adversely affect the populations of each of the qualifying features; and
- adversely affect the distribution of the qualifying features within the site.

d) In-combination assessment

8.6.11. The screening exercise for plans or projects that potentially could cause a likely significant in-combination effect with the construction, operation and

decommissioning of the Sizewell C Project identified a possible likely significant in-combination effect on the Deben Estuary SPA in relation to disturbance effects on species populations as provided in **Appendix C** of this report.

8.6.12. The assessment for adverse effects on site integrity is presented in **Table 8.9**. For the single project identified as having the potential to cause a likely significant in-combination effect it is concluded that there is no potential for an adverse in-combination effect with the Sizewell C Project on the Deben Estuary SPA.

8.6.13. Therefore, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse in-combination effects on the integrity of the Deben Estuary SPA.

8.7 Assessment of effects: Deben Estuary Ramsar site

a) Summary of Screening outcomes, project alone

8.7.1. No potential effects were screened in for Appropriate Assessment in relation to the main development sites.

8.7.2. However, the following potential effect was screened in in relation to the Freight Management Facility:

- Disturbance effects on species populations, for Ramsar criterion 6; species populations occurring at levels of international importance, dark-bellied brent goose.

b) Effects on qualifying features screened in, project alone

8.7.3. Although the Ramsar qualifying criteria are different from those of the SPA, the bird species cited as a qualifying feature under Ramsar criterion 6 are also qualifying features of the SPA. Thus, the assessment above for each impact pathway in relation to dark-bellied brent goose as qualifying feature of the Deben Estuary SPA, and the conclusion of no adverse effect is also considered to apply to the Ramsar site.

Table 8.9: In-combination assessment of plans and projects with the potential to affect birds within the Deben Estuary SPA due to disturbance

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Operations and Maintenance Marine Licence applications for generation and transmission assets. Licence to commence on 1st August 2019 and expire by May 2045	11km from cable corridor. 48km from windfarm site to nearest seaward point. 52km from wind farm site to the main development site.	Disturbance effects on species populations. This Operations and Maintenance Licence relates to the East Anglia ONE offshore wind farm. The landfall site is to the north of the SPA and the onshore cable route crosses the SPA, but no likely significant effect was identified in the assessment for the construction, operation and decommissioning of the East Anglia ONE project (Ref. 8.9; Ref. 8.10). Construction of the cable route has been completed and the potential for disturbance from operational and maintenance activities will be considerably lower.	There is considered to be no potential for an in-combination effect with the Sizewell C Project on the qualifying features of the Deben Estuary SPA as a consequence of disturbance. Decommissioning would not overlap with construction of the Sizewell C Project.	There is no potential for an adverse in-combination effect with the Sizewell C Project.

a) In-combination assessment

8.7.4. The conclusions of the in-combination assessment undertaken for the Deben Estuary SPA are also assumed to apply to the Deben Estuary Ramsar site, for the same reasons as outlined above in relation the project alone assessment.

8.8 Assessment of effects: Minsmere–Walberswick SPA

a) Summary of screening outcomes

8.8.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site:

- Alteration of coastal processes / sediment transport, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of little tern.
- Water quality effects – marine environment, during construction, operation and decommissioning for the qualifying features:
  - Breeding populations of little tern.
- Water quality effects – terrestrial environment, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of avocet; bittern; little tern; marsh harrier; gadwall; shoveler; and teal
  - non-breeding populations of gadwall; shoveler; white-fronted goose; and hen harrier.
- Alteration of local hydrology and hydro-geology, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of avocet; bittern; little tern; marsh harrier; gadwall; shoveler; and teal
  - non-breeding populations of gadwall; shoveler; white-fronted goose; and hen harrier.
- Changes in air quality, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of avocet; bittern; little tern; marsh harrier; nightjar; gadwall; shoveler; and teal

  - non-breeding populations of gadwall; shoveler; white-fronted goose; and hen harrier.

- Direct habitat loss and fragmentation, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of marsh harrier; and nightjar
  - non-breeding populations of gadwall; shoveler; and hen harrier.
- Disturbance effects on species populations, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of avocet; bittern; little tern; marsh harrier; nightjar; gadwall; shoveler; and teal
  - non-breeding populations of gadwall; shoveler; white-fronted goose; and hen harrier.
- Disturbance due to increase in recreational pressure, during construction, operation and decommissioning for the qualifying features:
  - breeding populations of avocet; bittern; little tern; marsh harrier; nightjar; gadwall; shoveler; and teal
  - non-breeding populations of gadwall; shoveler; white-fronted goose; and hen harrier.
- Physical interaction between species and project infrastructure, during operation for the qualifying features:
  - Breeding populations of little tern.

8.8.2. No potential effects were screened in for Appropriate Assessment in relation to the associated development sites.

b) Breeding avocet, project alone

i. Water quality effects – terrestrial environment

Construction and decommissioning

8.8.3. Alteration to water quality in the terrestrial environment was not screened in for likely significant effects in relation to the qualifying habitats of the Minsmere to Walberswick Heaths and Marshes SAC - annual vegetation of drift lines, European dry heaths, and perennial vegetation of stony banks as seen in section 7.7a of this report. Therefore, there would be no indirect effects on SPA qualifying bird species using these habitats.

8.8.4. There is potential for the construction and decommissioning phase to result in changes to water quality (surface water and groundwater) that could affect the freshwater and marshland habitats under Ramsar criterion 1. For example, the range of plant species supported, and plant composition and distribution could be affected by a change in the water quality. However, with mitigation in place to manage surface water discharges, as described in section 7.8.b of this report above, there would be no adverse effects on any of the Ramsar qualifying habitats within the Minsmere-Walberswick SPA. As these habitats also underpin the presence of SPA qualifying bird species, it is concluded that there would not be an adverse effect on any SPA qualifying feature, including the breeding avocet, during the construction or decommissioning phases.

Operation

8.8.5. As described for the Minsmere-Walberswick Ramsar site in section 7.8 b iv of this report, a drainage strategy would be in place for the operational phase (as it would be the construction and decommissioning phases). No adverse effects are, therefore, predicted on any of the Ramsar or SAC qualifying habitats within the Minsmere-Walberswick SPA. As these habitats also underpin the presence of SPA qualifying bird species, it is concluded that there would not be an adverse effect on any SPA qualifying feature, including breeding avocet, during the operational phase.

ii. Alteration of local hydrology and hydrogeology

Construction and decommissioning

8.8.6. The construction and decommissioning phases may result in changes to hydrological conditions (surface water and groundwater). This may affect, the extent of wetland habitats (including marshland, reedbed and open water), as well as the distribution and composition of associated plant species and communities.

8.8.7. The assessment provided in section 7.8 b iii of this report for the habitats of the Minsmere-Walberswick Ramsar site applies to the habitats of the SPA qualifying features for which likely significant effect has been determined. Alteration to local hydrology and hydrogeology was not screened in in relation to the qualifying habitats of the Minsmere to Walberswick Heaths and Marshes SAC - annual vegetation of drift lines, European dry heaths, and perennial vegetation of stony banks as provided in section 7.7a of this report.

8.8.8. Primary mitigation measures are embedded in the project design to manage surface water discharges adequately during the construction phase that could affect the flow regime of the systems. These measures, combined with the proposed Sizewell Drain realignment, largely isolate the proposed

development from the surrounding areas. Similar measures would be applied in the decommissioning phase.

8.8.9. Proposed water management structures would also allow for easy manipulation of the water levels and flows. Therefore, it is anticipated that the construction and decommissioning of the Sizewell C Project would have no significant effects on the flow regime and no effect on the habitats within the Ramsar site.

8.8.10. Modelling predicts a small and localised drawdown on groundwater affecting an area of 0.6ha (less than 0.03% of the SPA area) which would be short-term and reversible. This is in an area of habitat not considered sensitive to changes in groundwater level.

8.8.11. No adverse effects on the any of the SAC or Ramsar qualifying habitats within the Minsmere-Walberswick SPA are, therefore, predicted as a result of alteration of local hydrology and hydrogeology. As these habitats also underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature, including breeding avocet, during the construction or the decommissioning phases.

Operation

8.8.12. As described for the Minsmere-Walberswick Ramsar site in section 7.8 b iii of this report, no effects on hydrology and hydrogeology are predicted during the operational phase. Consequently, there would be no adverse effects on any of the Ramsar or SAC qualifying habitats within the Minsmere-Walberswick SPA and, as these habitats underpin the presence of SPA qualifying bird species, no adverse effect on any SPA qualifying feature, including breeding avocet, during the construction phase.

iii. Changes in air quality

8.8.13. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.8.14. During construction and decommissioning, changes in air quality could result from the generation of dust from construction works and emissions from the campus, construction plant, other vehicles and generators to power equipment.

8.8.15. The assessment and mitigation reported for the Minsmere to Walberswick Heaths and Marshes SAC, included in section 7.7 b I of this report, also applies to the Minsmere - Walberswick SPA. Hence there would be no

adverse effect on the integrity of the habitats used by SPA qualifying features due to air quality effects during the construction and decommissioning phases and, therefore, no adverse effect on any SPA qualifying species, including breeding avocet.

Operation

8.8.16. The assessment included in section 7.7 b I of this report for the Minsmere to Walberswick Heaths and Marshes SAC qualifying habitats sensitive to combustion activities (European dry heaths and perennial vegetation of stony banks) and in section 7.8 b v of this report for the Minsmere to Walberswick Ramsar site (coastal floodplain grazing marsh), found predicted changes which required detailed assessment in terms of modelled increases in NOx (long- and short-term), SO_2, nutrient nitrogen and acid deposition.

8.8.17. However, this assessment concluded that there would be no adverse effect on the integrity of the SAC qualifying habitats and Ramsar habitats. As these habitats underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature, including breeding avocet, due to changes in air quality during the operational phase.

iv. Disturbance effects on species populations

Introduction

8.8.18. Disturbance effects on the Minsmere-Walberswick SPA breeding avocet population may arise via visual and acoustic stimuli associated with the construction, operation and/or decommissioning of the Sizewell C Project. Such stimuli could affect this SPA population as a result of disturbance to nesting or feeding birds, resulting in a range of possible consequences with the potential to cause adverse effects (see below).

8.8.19. To consider the potential for these effects on the SPA breeding avocet population, the available evidence for effects of noise and visual disturbance on waterbird populations is first reviewed and the extent to which the construction, operation and decommissioning of the Sizewell C Project would lead to noise and visual disturbance is considered (with the construction effects considered to also represent a worst-case for decommissioning). The assessment of these effects is undertaken on the basis of this evidence, in conjunction with the information relating to the baseline conditions as provided in section 6.3 f of this report.

8.8.20. The evidence base used for the assessment of the effects of disturbance on the SPA breeding avocet population draws upon studies and information that relate to both breeding and wintering waterbirds, as well as to bird

populations more generally. Given this, and the extent of inter-dependencies within this evidence base, it is presented as an evidence base for the effects of disturbance on waterbirds generally (both for breeding and wintering populations), as opposed to being specific to breeding avocet. As such, it is also applied to the assessments for the other waterbird populations that are qualifying features of the Minsmere-Walberswick SPA (see below).

Potential effects of anthropogenic disturbance

8.8.21. Humans and human activity can cause disturbance effects on birds via noise and visual stimuli, with these stimuli potentially leading to a range of impacts as summarised below, after Liley *et al*. (2015 - Ref. 8.12) and others (e.g. Ref. 8.13, Ref. 8.14):

- redistribution / displacement (short-term or long-term avoidance) of birds in response to the presence of people;
- reduced intake-rate of food due to birds feeding in areas with poorer available food resources, or by disturbance (e.g. increased noise) directly reducing prey detection rates or altering the distribution of food sources;
- increased energy expenditure as a result of birds reacting to disturbance by flying to different areas to feed and being flushed while feeding and roosting;
- interference with auditory communication signals (e.g. bird song);
- physiological impacts, such as increased stress, which may also have consequences for energy expenditure; and
- direct mortality, such as predation from domestic dogs, predators exploiting disturbance events or nests being trampled.

8.8.22. While it is acknowledged that studies demonstrating the consequences of disturbance on population size, rather than effects on behaviour, are most useful for providing evidence of impacts on a species (Ref. 8.15), long-term studies of the effects of disturbance at the population level are currently lacking.

8.8.23. Where the disturbance source is associated with the direct presence of humans, the response can be considered as a trade-off between access to, or use of, a certain resource and the perceived predation risk posed by humans (Ref. 8.16; Ref. 8.17). Above a certain threshold of disturbance, perceived threats outweigh potential benefits (Ref. 8.18). Behavioural responses to disturbance, for example flushing, can be seen as part of a continuum towards complete avoidance of certain areas.

8.8.24. In the case of wintering waterbirds, interference with feeding and roosting activities is usually the primary cause for concern in relation to disturbance effects because this may lead to long-term, adverse, consequences. Repeated disturbance may result in birds taking flight, thereby expending energy and depleting energy reserves that are required for successful migration and / or over-winter survival (particularly during periods of intense or prolonged cold weather). Habitat that is suitable for breeding / wintering birds may also become unavailable as a result of disturbance and effectively represents a form of habitat loss (Ref. 8.19).

8.8.25. The responses of wintering waterbirds to disturbance stimuli may vary greatly and the sensitivity of species varies with factors such as weather, age, and habitat use (Ref. 8.20). Habituation may arise if disturbance events are relatively frequent, although again, some species exhibit a greater capacity for habituation than others (Ref. 8.21).

8.8.26. In the case of breeding waterbirds, and other ground-nesting birds, disturbance may not only affect feeding activities but also has the potential to lead to direct effects on breeding productivity, via increases in predation rates on nests or chicks, chilling of eggs, desertion of nests or abandonment of breeding areas (Ref. 8.22, Ref. 8.14; Ref. 8.23; Ref. 8.24).

8.8.27. The term displacement is used to describe the movements away from areas that normally would be used in the absence of disturbance or other perturbations and, as such, can reflect either short distance movements within a home-range (both walked or flown) or longer distance movements to unfamiliar areas. The impacts of displacement on individuals are then moderated by (for short distance movements):

- the importance of the area of the home-range being disturbed (i.e. its value as a foraging resource or secure roosting area); and
- the length of time and frequency that the area is disturbed (e.g. influenced by the duration of events and the number of disturbance events per hour).

8.8.28. For example, a single disturbance event from an area of the home-range used infrequently will have a different impact to that associated with frequent disturbance of a core foraging area. Also, the effects are likely to differ according to whether displacement is from a wintering or breeding season home range or territory.

8.8.29. The effects of displacement or movements away from the home-range are governed by a number of factors, including the:

- length of time and frequency that the area is disturbed (e.g. influenced by the duration of events and the number of disturbance events per hour);
- availability of other suitable habitat in the general area;
- quality of other suitable habitat in the general area;
- ability of displaced individuals to exploit unfamiliar habitat patches; and
- level of competition within other suitable habitat in the general area.

8.8.30. Similarly, effects of disturbance on breeding productivity are likely to vary according to a range of factors, including the stage of the breeding cycle (e.g. pre-laying, incubation or chick-rearing) at which disturbance occurs, the types and abundance of predatory species present within the breeding areas and other factors that may affect the condition of the breeding waterbirds (e.g. food availability) (Ref. 8.23).

8.8.31. Because of the variability of response between species and in respect of the nature of the stimuli and conditions, quantifying the (observed or potential) effects of disturbance, particularly at the population level, is challenging. Therefore, the assessment of effects has to rely largely on documented observations of the response of waterbirds to stimuli (e.g. noise from human activities, human presence, activities such as walking etc.) and the application of these findings to specific situations.

Noise disturbance evidence base

8.8.32. Because of their reliance on acoustic communication, birds have been viewed as potentially vulnerable to changes in their noise environment that may be caused by anthropogenic activity. Anthropogenic noise has been associated with reduced bird densities, as a result of displacement from otherwise suitable habitat due to ecological sensitivities or intolerance to noise. Studies suggest that noise may disrupt acoustic communication, interfere with detection of warning signals or prey and elevate stress levels (see above).

8.8.33. Infrequent activities / operations that can generate intense noise levels (e.g. aircraft activity in remote areas, intermittent industrial activities) in a relatively small area may lead to species abandoning areas of suitable habitat. Evidence from studies into this type of noise pollution indicate that generally birds, if undertaking a flight response, are likely to return to the affected area if the noise is generally infrequent and has dissipated (Ref. 8.25, Ref. 8.26).

8.8.34. Chronic anthropogenic noise from busy roads, urban areas, and permanent industrial structures has been implicated as having detrimental impacts upon

breeding bird populations. Although many such studies fail to disentangle the effects of noise from potentially confounding effects that may be associated with proximity to roads (e.g. visual disturbance or associated habitat variation), other recent studies have demonstrated such effects using experimental designs that control for confounding effects (Ref. 8.27, Ref. 8.13). The effects of such chronic anthropogenic noise appear to vary between species, with responses in breeding densities apparent in some species only (Ref. 8.28, Ref. 8.27, Ref. 8.13). Possible explanations for such variable responses include differences in the hearing sensitivity of species or in their song or call structure, affecting the extent to which these are masked by the anthropogenic noise.

8.8.35. To help establish the basis for predicting the extent to which noise disturbance effects may extend from the main development site, a brief summary of some of the key findings of studies on the influence of noise on bird populations and communities is provided in the following sections. This evidence base provides the foundation for assessing the likely response of waterbirds to increased noise levels during the construction phase for Sizewell C. Many of the studies undertaken to date relate to the effects of traffic / road noise on birds, although more recently, some studies have focused on chronic industrial noise and its effects.

Impulsive-type construction noise

8.8.36. Work by the Institute for Estuarine and Coastal Studies on wintering waterbirds has provided data on the noise levels at which a behavioural response reaction from birds is elicited (Ref. 8.29; Ref. 8.30). This work categorises disturbance responses based on potential sources, with the following attributed to noise levels:

- Irregular piling noise (above 70dB) — High to Moderate
- Regular piling noise (above 70dB) — Moderate
- Irregular noise (50dB - 70dB) — Moderate
- Regular noise (50dB - 70dB) — Moderate to Low
- Noise below 50dB — Low

8.8.37. Disturbance generated by the noise levels reported above was observed to lead to the interruption of birds' normal activity patterns and / or short-distance displacement from the area of disturbance (Ref. 8.30, Ref. 8.26). Studies suggest that any effects are temporary and in only a small number of cases have disturbance events actually been shown to cause birds to permanently vacate a site.

8.8.38. Studies on wintering waterbirds in the Waddenzee (Netherlands) have revealed that high noise levels associated with military activity (shooting, low flying aircraft) can lead to significant disturbance, particularly for roosting birds. Smit and Visser (1993 - Ref. 8.31), in a review of information and studies record that, at Vlieland, bombing and rocket shooting from jets (which occur for most of the year) yield sound levels of 84-100 dB(A) at 5km from the firing range. At roost sites in the area, surveys show that the total numbers of ducks, waders and gulls in the heavily disturbed area were reduced from 69,000 prior to shooting sessions (Monday-Friday) to 38,000 during the shooting sessions. Roosting birds were found to continue to respond to shooting activities in the area despite the fact that shooting activities had been ongoing for a period of 40 years. Smit and Visser (1993 - Ref. 8.31) attribute this continued disturbance effect to the high noise levels and the use of different ammunition types which generate strong differences in sound levels. However, Smit and Visser (1993 - Ref. 8.31) also report that shooting activities at Vlieland have little visible effects on feeding waders. Prey choice, behaviour and intake rates of oystercatcher and curlew were not different on days with and without shooting although the diversity of feeding shorebirds south of Vlieland was higher on days without shooting, suggesting that some species are less tolerant of high noise levels.

8.8.39. Wintermans (1991 - Ref. 8.32), referenced in Smit and Visser (1993 - Ref. 8.31), studied the effects from a shooting range in the Marnewaard (Waddenzee) and found no indications for a lower diversity of waterbirds on the tidal flats. This was attributed to lower noise levels (between 43- 87 dB(A)) in the area, compared to those recorded in Vlieland by Smit and Visser (1993 - Ref. 8.31).

8.8.40. Little evidence is available pertaining to the effects of impulsive noise on breeding waterbirds. However, waterbirds are known to breed in areas that are subjected to frequent impulsive noise from anthropogenic activities, such as at the SWT's Trimley Marshes reserve[20]. This site is adjacent to the Felixstowe Port, with noise monitoring showing that maximum noise levels at the site from the port activities are variable but, on some days, can exceed 70dB, L_{Amax} one to three times an hour and 65dB, L_{Amax} 10 times an hour (Ref. 8.33).

8.8.41. Gull and tern species will also breed within, and close to, ports and docks (e.g. Ref. 8.34), whilst both monitoring of anthropogenic noise events and experimental studies generating aircraft noise at breeding colonies have shown that in, some situations at least, certain gull and tern species tend to show limited responses only to impulsive noise events of less than 75dB L_{Amax} (Ref. 8.35, Ref. 8.36; Ref. 8.37).

[20] https://www.suffolkwildlifetrust.org/trimleymarshes

Chronic noise disturbance

8.8.42. Chronic noise disturbance effects may be associated with a number of anthropogenic noise sources, in particular road traffic and industrial installations.

8.8.43. Some birds may be sensitive to noise resulting from human activities because auditory signals used for communication or (in the case of some predatory species) prey detection may be masked by the anthropogenic noise. Noise that distorts or masks communication signals may influence population density, mating behaviour, and breeding success; ambient noise may reduce male to female communication, increase redundancy of songs, drown out begging calls, or inhibit predator detection. Noise may affect bird community structure by favouring certain species (e.g. Ref. 8.38; Ref. 8.39), whilst it has been shown to reduce prey detection by hunting owls (Ref. 8.40; Ref. 8.41).

8.8.44. Habib *et al*. (2007 - Ref. 8.42) found a reduction in pairing success and a higher proportion of inexperienced ovenbirds at industrial well compressor stations compared with control sites surrounding habitat-disturbed but noiseless stations. Bayne *et al*. (2008 - Ref. 8.43) found a 30% reduction in songbird density at noisy gas compressor stations in Canada compared with nearby well pads that were almost identical in habitat, but were much quieter, thus suggesting that disturbance through increased noise levels was a factor in the reduced breeding density. Francis *et al*. (2009 - Ref. 8.38) used a similar system of noisy gas compressors and quiet well pads in New Mexico to show that species richness of birds was reduced at noisy sites, with 14 species avoiding areas surrounding gas compressors. They concluded that altered species interactions may be contributing to the success of species well-adapted to noisy environments and to the decline of species more sensitive to noise. This is also a phenomenon that probably arises in areas exposed to traffic noise (Ref. 8.27).

8.8.45. As stated above, experimental designs have been used in studies to control for potential confounding effects, providing compelling evidence for effects of chronic noise on bird populations. For example, reductions in the overall densities in migrant and breeding bird communities, and in the numbers of male greater sage-grouse attending leks have been demonstrated in relation to experimentally generated anthropogenic noise of various types (e.g. traffic and compressor engine noise) (Ref. 8.44; Ref. 8.45; Ref. 8.13). However, as also noted above, several such studies demonstrate variable responses in the densities or abundance of individual species.

8.8.46. Although much of the work relating to effects of chronic noise concerns songbird populations, effects on other bird groups have also been documented, including for greater sage-grouse (as noted above – Ref. 8.44).

Hirvonen (2001 - Ref. 8.46) conducted a study on a new road being built in Finland and found that the conservation value of adjacent wetlands decreased due to the loss of several wetland habitat specialist species, including bittern, during and after construction of the road. No detailed mechanism for why these species should have been displaced was determined, but it could have been related to an increase in noise levels, an increase in human activity levels (visual intrusiveness), or a combination of factors. Breeding densities of several meadow-bird species (including some wader and duck species) were found to be lower in proximity of motorways in the Netherlands, but in this study the extent to which these effects were due to noise or visual impacts associated with traffic, or possible habitat variation associated with distance from motorways was unclear (Ref. 8.47). Densities of nesting stone-curlew on areas of suitable nesting habitat in southeast England were also reduced up to at least 1km from major trunk roads, although again the relative importance of noise and visual effects in causing the response is unclear (Ref. 8.48).

8.8.47. Behavioural evidence and studies of other anthropogenic noise sources suggest that road noise should be a major driver of observed road effects. However, although road ecology studies attempting to directly address the effect of traffic noise on wildlife have suggested that noise is a major cause of negative effects, they are typically conducted in the presence of other effects of roads, such as mortality, visual disturbance and edge effects (habitat alteration).

8.8.48. To isolate the potential effects of noise associated with roads, McClure *et al.* 2013 (Ref. 8.45) set up a 'phantom' road using an array of speakers broadcasting road noise into a roadless landscape. They recorded a decline of bird abundance of over one-quarter along the phantom road, and the almost complete avoidance of habitat alongside the road by two species of bird. This work suggests that road noise may be a major driver of the documented negative effects of roads on wildlife and, in particular, bird communities.

8.8.49. In relation to the effects of chronic noise on the foraging success of predatory birds, studies have demonstrated effects of traffic noise on prey detectability by nocturnally foraging owls (primarily short-eared and long-eared owls), with the probability of detection of 'artificial prey rustling sounds' (aimed at mimicking the sound produced by small mammals walking on the ground) declining from c.0.75 under conditions with background noise levels of 32dB to c.0.1 at traffic noise levels of 80dB(A) (Ref. 8.41). Similarly, under experimental conditions, prey capture probabilities by northern saw-whet owls declined from slightly less than 0.2 to nearly zero as the generated noise levels increased from 29dB(A) to 60dB(A) (Ref. 8.40). Such effects are likely to be extreme amongst predatory birds because they apply to owls (which are hearing-specialist hunters) hunting in conditions where prey detection

relies entirely (or almost entirely) on the use of auditory cues, and where the control (or baseline) noise levels are low (i.e. 32dB and 29dB in each of the two studies).

8.8.50. Of particular relevance to this assessment, in relation to potential impacts on wintering waterbirds, is the work undertaken by Briggs 2007 (Ref. 8.49) and Briggs *et al*. 2012 (Ref. 8.50) on the use of waterbodies in the South West London Waterbodies SPA by wintering gadwall and shoveler. While no noise measurements at sites used by wintering birds were undertaken, a number of open water habitats used by both gadwall and shoveler throughout the winter are within 1-4km of Heathrow Airport (e.g. Stanwell Moor, Staines Reservoirs) and immediately under the flight paths of aircraft landing and taking off. Noise contours for these flight path areas show that noise levels (at ground level) are within the range of 60-70dB LA_{eq}, so that the LA_{max} values would be significantly higher than these levels (see below).

Sensitivity thresholds

8.8.51. For the purposes of this assessment, sensitivity thresholds have been based upon impulsive, as opposed to chronic, noise. This is because impulsive noises are considered more likely to lead to behavioural responses by birds, such as 'escape behaviours' and the desertion or avoidance of areas, than are equivalent levels of chronic noise (Ref. 8.51). Also, as detailed above, the evidence for chronic noise effects is strongest in relation to songbirds, with considerable variability between species in the extent of response. Sensitivity thresholds at which the onset of noise disturbance may start to lead to potentially deleterious behavioural responses in birds and animals have been developed in respect of impulsive noise levels, with these often focussed on wintering waterbirds.

8.8.52. An experimental study of the response of waterbirds to impulsive noise (an air horn) by Wright *et al*. 2010 (Ref. 8.26) found a statistically significant positive relationship between the sound pressure level (dB(A)) experienced by the birds and the behavioural response observed. This experimental work indicated that intentional disturbance at very low dB(A) levels is highly unlikely to elicit a behavioural response, while at above 65.5dB(A) a behavioural response of some kind becomes more likely to occur than no response. For sudden unexpected noises in the range of 72-81dB(A) flight with abandonment is the most likely outcome of disturbance. On the basis of the results of the experiment, Wright *et al.* 2010 (Ref. 8.26) conclude that if non-response and non-flight response are taken to be relatively harmless, and flight responses potentially costly (in terms of energy expenditure), then for the waterbird species studied at the site a costly outcome becomes more likely at noise levels above 70dB(A). As remote noise-making equipment was not used in the study, it is likely that the observed increase in severity of behavioural responses with noise levels was to some extent confounded by

visual stimuli because the increase in noise levels experienced by the birds under study was associated with a closer approach by the recorder (Ref. 8.26). Thus, the conclusions may be conservative in relation to the noise levels which may elicit responses in wintering waterbirds. It is also considered important to note that the study was undertaken using infrequent impulsive noises and therefore, the potential for habituation by birds to the noise stimuli was not explored as part of the study.

8.8.53. Cutts *et al.* 2013 (Ref. 8.51) using a combination of literature review and field observations linked the likely behavioural responses of waterbirds to typical noise levels that may arise during construction works. They categorised disturbance effects into high, moderate or low and linked these to a range of noise levels, as follows:

- High noise level effects - noise disturbance is typified by regular responses to stimuli with birds moving away from the works to areas which are less disturbed (within noise tolerances). Most birds will show a degree of response to noise stimuli. Birds that remain in the affected area may not forage efficiently and if there are additional pressures on the birds (cold weather, extreme heat etc.) then this may impact upon the survival of individual birds or their ability to breed. For auditory disturbance to qualify as a high level, it must constitute a sudden noise event of over 60dB (at the bird, not at source) or a more prolonged noise of over 72dB.

- Moderate noise level effects - moderate noise disturbance is typified as high-level noise which has occurred over long periods so that birds become habituated to it or lower level noise which causes some disturbance to birds. This encompasses occasional noise events above 55dB, regular noise 60-72dB and long-term regular noise above 72dB, where birds have become habituated. There is cross-over in moderate and high-level noise thresholds although the lower band can be assumed unless the species is particularly sensitive. Those species that are considered particularly sensitive are brent goose, curlew and redshank. Birds that may be more sensitive than average include shelduck & bar-tailed godwit (Ref. 8.31).

- Low noise level effects – low level noise is classed as that which is unlikely to cause response in birds using a fronting intertidal area. As such, noises of less than 55dB at the bird are included in this category. These effects are likely to be masked by background inputs in all but the least disturbed areas and thus would not disturb the birds close by. Noise between 55-72dB in some highly disturbed areas (e.g. industrial or urban areas and adjacent to roads) may feature a low level of disturbance provided the noise level was regular as birds will to often habituate to a constant noise level.

8.8.54. Cutts *et al*. 2013 (Ref. 8.51) suggest that the above categorisations may be relatively simplistic and that development specific situations need to be taken into account as well as the known sensitivities of the species under investigation. In respect of this, they note (from observation) that a single sudden sound will generally cause more disturbance than a constant or regular noise regardless of noise level. Habituation to stimuli will also usually entail a reduction in the level of reaction - this applies to both visual and noise related disturbance. An exception to this is if multiple stimuli occur at the same time (e.g. walkers, works and planes). In this case a greater effect (i.e. behavioural response) may arise.

8.8.55. Based on the observed responses of waterbirds (primarily mallard and redshank) to various noise stimuli, Cutts *et al.* 2013 (Ref. 8.51) derive an overview table (TIDE Toolkit) utilising the standard distance decay rates for noise. This enables the calculation of the likely disturbance effect for a noise level and distance of receptor from source – **Plate 8.9**.

Plate 8.9: Standard distance decay rates for noise – from Ref. 8.51

Metres from Source	dB(A)										
0.67	120	110	100	95	90	85	80	75	70	65	60
1.33	114	104	94	89	84	79	74	69	64	59	54
2.67	108	98	88	83	78	73	68	63	58	53	48
5.33	102	92	82	77	72	67	62	57	52	47	42
10.67	96	86	76	71	66	61	56	51	46	41	36
20.67	90	80	70	65	60	55	50	45	40	35	30
42.67	84	74	64	59	54	49	44	39	34	29	24
85.33	78	68	58	53	48	43	38	33	28	23	
170.67	72	62	52	47	42	37	32	27	22		
341.33	66	56	46	41	36	31	26	21			
682.66	60	50	40	35	30	25	20				
1365.32	54	44	34	49	24						

8.8.56. In **Plate 8.9**, acceptable 'dose' levels (i.e. to 70 dB(A)) are shaded green with dark green unlikely to have any affect whilst the pale green might occasionally induce a low level behavioural response such as a "heads-up"; yellow to orange shading is where a response is likely but mitigation may be effective in reducing the disturbance risk; pale red where mitigation is necessary and might be of value, but with a remaining risk of effect; dark red where a flight response is almost certain to occur and would be increasingly difficult to mitigate.

8.8.57. The values given in **Plate 8.9** are intended to apply to sudden noise levels occurring regularly. Such peak noise levels, which occur for a fraction of a second during a sudden loud event, are described in acoustics by the L_{Amax} parameter. This parameter is commonly used in bird studies (although is not always reported as the L_{Amax} parameter).

8.8.58. In addition to the key L_{Amax} parameter, the overall, typical ambient level also needs to be considered. Ambient noise is described by the L_{Aeq} parameter.

8.8.59. Advice from the TIDE toolkit and elsewhere suggests that where ambient levels are high, there may be, in effect, a masking of maximum levels. It may be that if the overall increase in (relatively steady) noise level from construction activities is relatively high, birds may react less (or become habituated) to the same peak levels compared to when ambient levels are lower. This may be relevant to some locations close to the construction site during some construction activities/phases.

8.8.60. In this respect, it may be more pertinent to consider L_{Aeq} values as representing chronic noise levels that may arise on a daily basis over the duration of the construction period. The predicted L_{Amax} noise levels, given their intermittent and localised nature within the footprint of the development, can be used to determine where, within and around the main development site, thresholds at which behavioural change in birds might be expected to arise. Such behavioural change largely involving avoidance / displacement or localised flight and return once noise levels had dissipated.

8.8.61. On the basis of the information presented in the TIDE Toolkit and Wright *et al.* 2010 (Ref. 8.26), a 70dB noise level (L_{Amax}) is considered appropriate as a precautionary threshold at which the behavioural response of birds may start to become potentially costly in terms of energy expenditure. In other words, this is a threshold at which the potential for adverse effects to individual birds may start to arise and, below this level, significant effects would not be expected. It should be noted that a 70dB threshold has, as a general rule, been in use for a number of years, based on published data as well as findings from primary observations (e.g. Ref. 8.52 and Ref. 8.20). Noise levels at the receptor above 75 - 80dB L_{Amax} are considered more likely to have an effect that may be of consequence, although, as noted by Cutts *et al.* 2013 (Ref. 8.51), habituation to such levels can arise.

Breeding birds

8.8.62. Given that the above threshold is based upon work undertaken on wintering waterbirds, it may not be applicable to breeding waterbirds because the same species may show different sensitivities (in terms of their behavioural response) in different seasons, whilst the mechanisms by which effects of noise disturbance arise may differ between breeding and wintering

populations (see above). As indicated above, the available evidence for breeding gulls and terns suggests that for certain species in certain situations (at least) responses occur at noise levels above 70dB L_{Amax}, but this evidence derives from colonially nesting species and so may not be directly applicable to the species and populations of interest (Ref. 8.35, Ref. 8.36, Ref. 8.37). The paucity of evidence relating to breeding waterbirds suggests that, on a precautionary basis, it is appropriate to adopt a lower threshold than is used for wintering waterbirds.

8.8.63. For wintering waterbirds, behavioural responses (of any type) were found to become more likely than no response when noise disturbance was at levels of 65.5dB(A) or above (Ref. 8.26). Thus, 65dB L_{Amax} may be regarded as representing a suitable lower threshold to use for breeding waterbirds, on the basis that it is sufficient to elicit a level of response amongst wintering waterbirds but is below that at which flight responses become most likely (Ref. 8.26). In addition, levels of noise disturbance at the Trimley Marshes reserve (on which waterbirds breed) are known to frequently exceed 65dB L_{Amax} (Ref. 8.33). As for wintering waterbirds, it is considered that a suitable noise threshold for breeding waterbirds represents a level at which flight responses are expected to become likely because such responses have the potential to lead to effects with population-level consequences (e.g. reductions in breeding productivity).

Modelling of daytime construction noise - main development site

Predictions for the different construction phases

8.8.64. Modelling has been undertaken to determine the daytime noise levels that could arise during the construction period for Sizewell C. For the purposes of this exercise, peak noise levels (LA_{max}) have been determined. Peak levels are the highest levels which might occur for a fraction of second during the noisiest component of an activity. In most instances for construction noise the LA_{max} value represents sudden impulsive or impact sounds such as hammering. As outlined above, such impulsive / impact sounds are those most likely to cause behavioural responses (e.g. startling, flight) in birds and other wildlife. For this reason, it has been selected as the best single parameter to model in this case.

8.8.65. Noise levels can also be characterised by a parameter which represents the typical overall level from a group of activities around the site (for which the LA_{eq} is used). To predict this level, typical noise levels from each type of activity are considered along with the total number of activities of each type; the locations in which they might occur and the durations over which they might operate within a given assessment period (which is typically a busy working day).

8.8.66. Noise modelling was undertaken separately for each of the five construction phases, based upon the current understanding of the predicted worst-case scenario across the entirety of each phase. These noise modelling outputs are summarised in a series of figures as described below.

8.8.67. **Figure 8.2** and **Figure 8.3**: Show the peak noise levels that could arise during Phase 1 construction, without any barrier or other mitigation in place (**Figure 8.2**) and with the presence of a 5m high fence along much of the north-eastern boundary of the main development site to provide greater attenuation of noise out from the site, which will be constructed during Phase 1 (**Figure 8.3**). It is assumed that such a fence (or equivalent mitigation) will be in place and, therefore, the assessment is undertaken in relation to the scenario presented in **Figure 8.3**. Phase 1 construction may extend to the first 2.5 years of the construction programme and will involve activities such as the stripping of soils from borrow pit areas, overburden excavation from borrow pits, crag removal and topsoil stripping on, and overburden excavation from, water management zones.

8.8.68. **Figure 8.4**: Shows the peak noise levels that could arise during Phase 2 construction (with the 5m high fence or equivalent mitigation in place). Phase 2 is expected to extend over a period of 1.5 to 3.5 years, which may have a small overlap with Phase 1. Work during Phase 2 will include backfilling with excavators and stockpiling using bulldozers.

8.8.69. **Figure 8.5**: Shows the peak noise levels that could arise during Phases 3 and 4 of construction (with the 5m high fence or equivalent mitigation in place). Phases 3 and 4 are expected to extend over a period of 7 to 8 years, continuing until approximately year 10 (when final restoration works begin – Phase 5). During Phases 3 and 4, no earthwork movements are anticipated to occur, although inspection and maintenance may be necessary on occasions.

8.8.70. **Figure 8.6**: Shows the peak noise levels that could arise during Phase 5 construction (with the 5m high fence or equivalent mitigation in place). Phase 5 is expected to extend over approximately 6 months and will involve restoration works, such as the removal of stockpiles. During Phase 5 there may also be potential to apply further mitigation to reduce noise emissions from some parts of the main development site.

8.8.71. For each construction phase described above, the modelling outputs show the predicted worst-case from the entire duration of that phase, as determined from the activities occurring at some point during the full duration of this phase (but which, in reality, would not necessarily occur simultaneously). This means that the noise emissions predicted for each phase are likely to be overestimates (and hence precautionary), whilst the duration of the worst-case scenario would not extend over the entire phase.

8.8.72. The extent of this overestimation in the modelling predictions was investigated for the marsh harrier assessment in relation to noise emissions onto the proposed marsh harrier habitat improvement area in the north-east part of the main development site as provided in section 8.8 d of this report. This involved examining the maximum extent of the activities and works that could occur within weekly or monthly periods during each construction phase and undertaking modelling for these shorter time periods. Modelling these finer scale time periods resulted in predictions with considerably lower peak noise emissions onto the marsh harrier habitat improvement area, and also indicated that the predicted noise emissions were considerably lower than the peak levels for the majority of the time during each phase as seen in section 8.8 d of this report. Therefore, when interpreting the noise modelling outputs in **Figure 8.2** to **Figure 8.6**, it is important to consider the precautionary approach to the modelling, which is likely to result in overestimation of the peak noise levels and their duration for each of the construction phases.

Construction works associated with the water storage area

8.8.73. The construction works associated with the proposed water storage area in the northeast of the main development site would be limited to the first winter of the construction period. As such, noise disturbance from these works would not coincide with the seasonal period relevant to the SPA breeding avocet population (or indeed other SPA breeding bird populations) and, consequently, is not considered in the assessment for this SPA qualifying feature. Predicted noise levels from the construction works associated with the water storage area are not included in **Figures 8.2** to **8.6**.

Extent of predicted noise disturbance effects

8.8.74. As outlined above, a likely noise level threshold at which a potentially adverse behavioural response could be initiated for wintering waterbirds is taken as 70dB LA_{max}, with a value of 65dB L_{Amax} assumed for breeding waterbirds (but with the assessment based upon the slightly more precautionary 64dB L_{Amax} threshold, in line with the outputs from the noise modelling). These thresholds are based on observational and experimental work in respect of impulsive noise and the response of waterbirds to these noise sources and levels. However, it should be noted that the conclusions reached from the work on impulsive noise levels relate to the behavioural responses of birds already present within the area exposed to the increased noise levels and not birds moving into an area already subject to such noise levels, as would apply at Sizewell.

8.8.75. The noise modelling outputs demonstrate that, under the worst-case scenario which is assumed, noise levels of 70 or 64dB L_{Amax} or above encroach onto a small part of the Minsmere-Walberswick SPA only, with this

encroachment limited to the south-eastern extremity of the SPA (**Figure 8.3** to **Figure 8.6**). The extent to which the SPA is affected by this encroachment is greatest during Phase 1 of the construction period (with approximately 0.12km^2 and 0.21km^2 of the SPA within the 70 and 64dB L_{Amax} footprints (i.e. where noise is at or above these levels), respectively), with similar areas affected during Phase 2 and considerably smaller areas affected in Phases 3 to 5. Construction noise levels across the vast majority of the SPA area, including the main reedbed and open water habitats within the RSPB reserve, are predicted to be close to, or below, 54dB L_{Amax}.

8.8.76. The Minsmere South Levels and Sizewell Marshes also provide potentially suitable habitat for waterbirds which is outside, but in close proximity to, the Minsmere-Walberswick SPA and may be functionally linked. Encroachment of the 70dB LA_{max} footprint onto the Minsmere South Levels is also minimal during all construction phases (and restricted to the southern extremities of the area), but a substantial part of the Sizewell Marshes is predicted to occur within this footprint during Phases 1 and 2, with this reducing substantially during Phases 3 to 5 (**Figure 8.3** to **Figure 8.6**). Encroachment of the 64dB L_{Amax} footprint onto both areas is substantive during Phases 1 and 2, with this footprint encompassing the vast majority of the Sizewell Marshes during these phases (**Figure 8.3** and **Figure 8.4**). A large part of the Sizewell Marshes continues to be encompassed by the 65dB L_{Amax} contour during Phases 3 and 4, but by Phase 5 there is little encroachment (**Figure 8.5** and **Figure 8.6**).

Night-time noise levels during construction - main development site

8.8.77. Construction activities between 2300 and 0700 hours would be considerably reduced compared to the day-time activities. As such, night-time noise levels would be considerably lower. Activities occurring during the defined night-time period would include rail freight arrivals, unloading and transportation, pre-placement of materials, repositioning of scaffolding, essential plant maintenance, unloading of marine deliveries, dewatering operations and (during Phase 3) tunnelling and excavation activities as provided in **Volume 2, Chapter 11** of the **ES** (Doc Ref. 6.3).

8.8.78. The predicted night-time noise levels (dB L_{Amax}) at different receptors within and surrounding the main development site indicate the lower noise levels generated compared to the day-time period as seen in **Volume 2, Chapter 11** of the **ES** (Doc Ref. 6.3). Therefore, night-time construction activities are not predicted to affect the SPA breeding avocet population.

Visual disturbance evidence base

Response thresholds and the evidence for defining zones of potential visual impact

8.8.79. A common method used to prescribe 'acceptable separation distances' between people and birds is to use one or two measures of disturbance distance: 'alert distance', the distance between the disturbance source and the animal at the point where the animal changes its behaviour in response to the approaching disturbance source, and 'flight initiation distance', the point at which the animal flushes or otherwise moves away from the approaching disturbance source. When used as a criterion to set up minimum approach distances (in relation to feeding or roosting as opposed to nesting waterbirds), flight distance may not be a good indicator of tolerance, since it may be greatly affected by other factors (Ref. 8.53), and it may fail to decrease disturbance because it does not include the area in which birds adapt their response to the source of disturbance.

8.8.80. In respect of wintering waterbirds, Laursen *et al*. 2005 (Ref. 8.54) observed the following mean escape distances (shortest distance by which birds flush when approached by people) for wildfowl and waders on intertidal mudflats and saltmarsh in the Danish Wadden Sea:

- Curlew – 300m.
- Pintail – 294m.
- Wigeon – 269m.
- Mallard – 236m.
- Shelduck – 225m.
- Teal – 197m.
- Lapwing – 142m.
- Redshank – 137m.
- Grey plover – 132m.
- Black-headed gull – 116m.
- Dunlin – 70m.
- Ringed plover – 42m.

8.8.81. Bregnballe *et al*. 2009 (Ref. 8.55 and Ref. 8.56) recorded flight escape distances for a number of waterbird species from advancing pedestrians at a nature reserve in Denmark. For birds with unobstructed views the mean escape distances were recorded as 156m for teal, 166m for mallard and 205m for wigeon.

8.8.82. While these observed 'response' distances may vary in relation to a number of factors, such as the time of year, flock size, body condition of the birds and the influence of previous stimuli, they at least provide an indication of the range over which potential human visual disturbance effects may occur for individual species. The alert distances for the species studied by Laursen *et al*. 2005 (Ref. 8.54) and Bregnballe *et al*. 2009 (Ref. 8.55 and Ref. 8.56) would be greater than those of the recorded flight initiation distances. However, there is very limited information on the alert distances of waterbirds and, therefore, the size of any buffer that should be applied to the flight initiation distance to enable birds to adapt their response to the source of disturbance. Laursen *et al*. 2005 (Ref. 8.54) suggested taking the variation into account when creating buffer zones. Bregnballe *et al*. 2009 (Ref. 8.56) suggest that this could be achieved by adding two standard deviations to the mean escape distance. For the waterfowl species that they studied this would result in overall buffer widths of 223m for wigeon, 177m for mallard and 178m for teal. Alternatively, Fernandez-Juricic *et al*. 2001 (Ref. 8.57) in their study of park-dwelling bird species suggest using the distances at which birds are alerted when planning buffer zones, which was on average 1.5 times longer than the escape distances of the same species (Ref. 8.57). Using the escape distance data from the Bregnballe *et al*. 2009b (Ref. 8.56) study, this would equate to buffer zones of 300m for wigeon, 249m for mallard and 234m for teal.

8.8.83. A review of FIDs in birds determined mean and maximum average values of 71m and 250m, respectively, for non-nesting wildfowl species (i.e. ducks, geese and swans) from a total of 80 values from 13 different studies, with only three of these values being in excess of 200m (Ref. 8.58). For non-nesting wader species, the mean and maximum average values were 50m and 500m, respectively, from a total of 157 values recorded in 16 different studies (with two and five values in excess of 300m and 200m, respectively). These 'response' distances were recorded in relation to a range of human-related disturbance sources, including dogs, aircraft, motorised vehicles and watercraft, but with the majority attributed to pedestrians. Therefore, in some cases, there would be the potential for confounding effects of noise and visual stimuli in causing the observed bird response. The two largest flight initiation distance values of 339m and 500m were recorded for Eurasian curlew in response to pedestrians and Eurasian oystercatcher in response to aircraft, respectively (Ref. 8.58).

8.8.84. The flight initiation distance values recorded for nesting wildfowl and waders in the review by Livesey *et al.* 2016 (Ref. 8.58) tended to be lower than those for the non-nesting situation, with mean and maximum average values of 52m and 175m, respectively. These estimates are based on only 14 values derived from two different studies, but broadly similar findings have been obtained in most other studies of flight initiation distances for breeding waterbirds.

8.8.85. Thus, flushing distances of less than 100m are reported for nesting New Zealand dotterels, whilst alarm responses of breeding golden plover averaged 187m (suggesting lower flight initiation distance values) and the highest mean flushing distance amongst 15 species of nesting waders and waterbirds in Florida in relation to approaching pedestrians or boats was 32m (Ref. 8.59; Ref. 8.60; Ref. 8.61). Also, Ruddock and Whitfield 2007 (Ref. 8.62) report median flight initiation distances for five different wader and waterbird species during both incubation and chick-rearing, with all values being 300m or less (although sample sizes are small for some species). Breeding stone-curlew were found to show active responses (i.e. running or flying) to disturbance sources at distances of up to 500m, although the mean (or median) distances at which such responses occurred is unclear (Ref. 8.63). For a given distance to the disturbance source, the likelihood of such responses by stone-curlews was greatest for approaching people with a dog and least for a vehicle (with approaching people without a dog being intermediate).

8.8.86. Based on data from the above studies, it is apparent that the disturbance response of waterbirds to human activity is variable. However, for the majority of waterbird species, flight initiation in the non-breeding season is likely to occur at distances of less than 200m of the source of the disturbance, with evidence that it will often occur at lesser distances for birds on their nesting or breeding territories. The findings of Laursen *et al*. 2005 (Ref. 8.54) and Bregnballe *et al*. 2009 (Ref. 8.55 and Ref. 8.56) can also be used as an indication of the sensitivity of waterbird species to potential disturbance. It should be noted, however, that the flight escape distances observed in these studies are associated with direct human activity and movement or approach rather than the movement of machinery and vehicles. It is possible that mean escape distances or flight initiation distances may be lower in relation to certain types of machinery and vehicles, given that human presence would be not be as discernible to birds (as is suggested by the transport disturbance studies undertaken by McLeod *et al*. 2013 (Ref. 8.64) and the stone-curlew study by Taylor *et al.* 2007 (Ref. 8.63).

8.8.87. The presence of man-made structures may also act as a visual disturbance cue to birds, leading to the avoidance of areas around structures. Evidence specifically relating to the disturbance effects of immobile towers or cranes on waterbird species is lacking. However, a significant amount of work has

been undertaken on the disturbance / displacement effects of onshore wind turbines.

8.8.88. Waterbirds may show avoidance of wind turbines during both the breeding and non-breeding seasons, although findings are variable between species and sometimes between studies of the same species. For eight wader and waterfowl species or groups (i.e. goose species) in the non-breeding season, all but one (oystercatcher) showed evidence of avoidance in the majority of wind farm impact studies reviewed by Hötker *et al.* 2006 (Ref. 8.65). Avoidance distances were greatest for goose species, with median and mean minimum distances to turbines of 300m and 375m, respectively, and values of greater than 600m recorded in some studies. Most other species considered in the review tended to show mean and median minimum distances to turbines of approximately 150m to 250m during the non-breeding season (Ref. 8.65). Based on these findings, Hötker *et al*. 2006 (Ref. 8.65) suggest that important roosting areas for waders and wildfowl should be kept free of wind farms, with a buffer of at least 400m for waterfowl generally, and at least 500m for goose roosts (noting that these buffer distances are disturbance free distances for roost sites, rather than applying to feeding areas). In other studies of wintering geese, average displacement distances of 100m for wind turbines in lines and of 200m for turbines in clusters have been observed for pink-footed geese in Denmark (Ref. 8.66).

8.8.89. Of four breeding wader species considered by Hötker *et al.* 2006 (Ref. 8.65), all showed evidence of avoidance in the majority of wind farm impact studies reviewed, although in two cases (black-tailed godwit and oystercatcher) there were almost as many studies indicating no, or positive, effects on densities. Mean and median minimum distances to turbines for these breeding waders tended to range from approximately 100m to 250m (with the higher values recorded for black-tailed godwit considered less reliable, as they may have been a consequence of the relatively rarity of this species - Ref. 8.65). A large-scale comparative study in the UK uplands also documented reduced densities of breeding waders in proximity to onshore wind farms, with effects on distribution apparent up to distances of approximately 400m for most species, and up to 800m for curlew (Ref. 8.67). However, studies comparing sites before and after wind farm operation (sometimes associated with simultaneous comparisons on control sites to provide Before-After-Control-Impact designs) have tended to find conflicting evidence for effects of turbines on the densities and distribution of breeding waders, including for curlew (Ref. 8.68; Ref. 8.69; Ref. 8.70; Ref. 8.71; Ref. 8.72).

8.8.90. Based on the available evidence from disturbance studies and the potential complexity of defining disturbance zones for individual species, which show variability of response to sources of disturbance, a zone of sensitivity to disturbance of 300m from potential sources of activity and visual intrusion is considered precautionary. As such, this is considered to be an appropriate

buffer distance in situations where the activities in question are visible to the birds using the potentially affected areas. However, where visibility is obscured by screening or as a result of the topographical and habitat conditions on the site, reduced buffer distances are likely to be appropriate.

8.8.91. This definition for this zone of sensitivity to sources of activity and visual intrusion (subsequently termed the 'potential visual impact zone') is considered to encompass the occurrence of tall structures (e.g. cranes) within the main development site. Although the evidence presented above suggests that displacement of waterbirds by onshore wind turbines may extend beyond 300m, it also demonstrates considerable variability in such responses (particularly amongst breeding populations). Furthermore, it cannot be assumed that the occurrence of tall structures within the main development site will represent an equivalent visual impact to that produced by a wind turbine array. It is considered highly likely that the size and number of turbines that may constitute an onshore wind farm, together with the movement from the rotation of the turbine blades, will mean that the visual impact from an onshore wind farm is greater than that associated with tall structures that may be present within the main development site during construction. As such, it is considered likely that any impacts on waterbirds would extend over shorter distances.

Artificial lighting

8.8.92. Artificial lighting would also be associated with the construction-related activities and may act as a potential form of visual disturbance. Many species of geese and ducks forage at night (Ref. 8.73) with evidence to suggest that nocturnal feeding seems often to be actively preferred, either because daytime feeding is too disturbed or dangerous, or because night feeding is more profitable. Ducks that normally forage more at night than by day include teal, gadwall, mallard and pintail and many wildfowl take advantage of moonlight to increase foraging opportunities. McNeil *et al*. 1992 (Ref. 8.73) note that daytime foraging is performed in habitats where waterfowl are often subject to various kinds of disturbance and to terrestrial or aerial predators. Surface feeding ducks, when up-ending, may be particularly vulnerable to predation during the day as they cannot see approaching predators.

8.8.93. As many waterbird species show a preference for nocturnal feeding, the influence of artificial lighting on this activity needs to be considered. Artificial lighting of habitats used by waterbirds occurs in many areas, particularly developed coastal and estuarine sites. The effects of lighting have been studied for a number of species. Dwyer *et al*. 2012 (Ref. 8.74) showed that ambient light levels affect the timing and distribution of foraging opportunities for wintering redshank on the intertidal mudflats of the Forth Estuary. Based on field data they conclude that light emitted from an industrial complex improved nocturnal visibility for redshank. The increased light levels allowed

sight-based foraging in place of tactile foraging, which implied both a preference for sight-feeding and enhanced night-time foraging opportunities under these conditions.

8.8.94. Santos *et al*. 2010 (Ref. 8.75) found that artificial illumination caused a considerable increase in the use of tidal areas by waders, and significant changes in their foraging behaviour at night. Prey intake rate in illuminated areas increased 78% across all studied wader species as birds shifted from tactile to sight-based foraging. While, for foraging birds, there may be some negative effects, such as prey depletion, exposure to greater disturbance pressure (particularly in urban areas) and an increase in vulnerability to nocturnal predators, Santos *et al*. 2010 (Ref. 8.75) conclude that artificial illumination may, overall, help to improve foraging conditions for waders in intertidal areas.

Extent of predicted visual disturbance effects during construction - main development site

8.8.95. Activities that could cause visual disturbance would be confined to the main development site but would have the potential to cause effects on adjacent and nearby areas that are used by SPA waterbirds. As described above, it is assumed that such effects could extend as far as 300m from the boundary of the main development site, although this distance would be less where visibility of the construction activities is sufficiently obscured.

8.8.96. A significant portion of the main development site is contained within the coniferous plantation of Dunwich Forest (inclusive of Kenton Hills and Goose Hill), which extends beyond the boundary of the main development site and into the adjacent land, particularly in proximity of the Minsmere South Levels and Sizewell Marshes (**Figure 8.7**). Within the main development site, woodland will be retained along the northern border of the Kenton Hills section of Dunwich Forest (abutting Sizewell Marshes), as well as within a substantive part of the Goose Hill section of Dunwich Forest in the north-eastern part of the main development site (Ref. 8.76). Furthermore, much of the land within and around the Sizewell Marshes comprises small fields with relatively heavily wooded boundaries, interspersed by small areas of woodland and scrub (**Figure 8.7**). These features (in conjunction with the Kenton Hills woodland) act to obscure visibility of the main development site from large parts of the Sizewell Marshes.

8.8.97. Given the above, a variable potential visual impact zone is applied around the main development site for the purposes of assessing the extent of the surrounding area that may be subject to visual disturbance effects. This is based on using a default distance of 300m which is reduced to 150m where woodland or other habitat features are considered to provide sufficient cover to mean that little, if any, of the construction activities will be visible. In such

cases it is possible that high structures (e.g. cranes) may remain visible on the skyline but other activities (e.g. movement of vehicles and people) would be concealed. The full extent of the potential visual impact zone is shown in **Figure 8.7**, with the main areas where the reduced distance is applied being:

- The section of the main development site boundary bordered by the Kenton Hill woodland.
- The north side of the electricity supply cable corridor, east of 'The Studio'.
- The sections along the northern boundary of the main development site which are bordered by Ash Wood, Great Mount Wood and woodland at Goose Hill, as well as a small part of the section of boundary within which the woodland at Goose Hill is retained within the main development site.

8.8.98. As for noise disturbance, the effects from visual disturbance are considered to have the potential to extend across a small part of the Minsmere-Walberswick SPA only, being limited to the south-eastern extremity of the SPA (**Figure 8.7**). This is also the case in relation to the Minsmere South Levels, although there is potential for visual disturbance effects to extend across a more substantial part of the Sizewell Marshes, again as for noise disturbance (**Figure 8.7**).

8.8.99. Given that the construction works associated with the water storage area in the northeast of the main development site would be limited to the first winter of the construction period, no visual disturbance effects from these works are predicted on the SPA breeding avocet population (or on any other SPA breeding bird populations). Thus, the potential visual impact zone for the SPA breeding avocet population is not considered to extend out from this part of main development site (**Figure 8.7**).

Construction and decommissioning: Assessment of the effects of noise and visual disturbance

8.8.100. Due to the distance of the SPA from the main development site, there is considered to be little potential for noise and visual disturbance from construction and decommissioning activities to affect avocet using habitats within the SPA itself. The main breeding areas of avocet within the SPA (i.e. the coastal lagoons – as seen in section 6.3 f iii of this report are more than 1km from the main development site at the closest point, with the peak noise levels predicted to be close to, or below, 54 dB L_{Amax} throughout the construction period (**Figure 8.3** to **Figure 8.6**).

8.8.101. As detailed above, there is no evidence of avocet breeding in the Sizewell Marshes, whilst they have not been recorded breeding in the Minsmere

South Levels since 2010. Also, the numbers breeding in the Minsmere South Levels in past years have been small relative to the SPA population, and the areas that have been used are outside the 64 dB L_{Amax} noise contour footprint and potential visual impact zone (**Figure 8.8**).

8.8.102. After hatching avocet may lead their chicks to feeding areas that are relatively remote from the nesting area (Ref. 8.77) but it is reported that avocet breeding within the Minsmere-Walberswick SPA tend to feed in proximity of their nests, whilst the chicks may be unable to leave the nesting areas due to the perimeter fencing and ditches that deter predatory mammals (Ref. 6.66).

8.8.103. Based on the above, no adverse effects on the SPA breeding avocet population are predicted as a consequence of noise and visual disturbance from construction or decommissioning activities.

Operation: Assessment of the effects of noise and visual disturbance

8.8.104. Noise levels associated with the operation of the Sizewell C Project are unlikely to differ substantially from the existing baseline situation. This is also considered to be the case for visual disturbance, except in relation to artificial lighting. Operational lighting of the Sizewell C power station platform and a small number of other areas, detailed below, would increase light levels and could cause light intrusion into adjacent habitats.

8.8.105. As detailed in **Volume 2, Chapter 14** of the **ES** (Doc Ref. 6.3), during the operational phase lighting would be present on the Sizewell C power station platform, comprising perimeter lighting on fences of 10-20 lux and lighting within the Sizewell C power station platform of 5-20 lux. Outside this area the access road to the Sizewell C power station, at the location of the SSSI crossing and adjacent land to the north would be lit at 5-10 lux, the car park (within former Goose Hill area) would be also lit at 5-10 lux. Lighting at the roundabout on Abbey Road would be at 10-30 lux, in line with highways requirements, but the access road between this roundabout and the car park would not be lit, except for one area at the north edge of Goose Hill where lighting (ambient levels of 10-20 lux, occasionally up to 100 lux) would be required for a vehicle search area. The proposed sub-station south of the access road, between Leiston Old Abbey and the Upper Abbey Bridleway would be lit at 5-20 lux, and the Back-up Emergency equipment Store and Back-up Generator buildings next to Upper Abbey Farm would be lit at 5-20 lux. Consequently, no part of the site would be subject to ambient light levels above 30 lux, and there would be no lighting at all between the Upper Abbey Bridleway and Goose Hill. Light spillage from these proposals would not affect the areas used by the SPA breeding avocet population.

8.8.106. Therefore, adverse effects on the SPA breeding avocet population are not predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.107. During the construction and decommissioning of the main development site, recreational users of the Sizewell C area may be displaced elsewhere, including to locations within and close to nearby European sites. The background to the assessment of potential increase in recreational pressure during the construction, operation and decommissioning of Sizewell C is described in section 8.3 b vi of this report, and the Recreational Disturbance evidence base as seen in **Appendix E** of this report includes further details.

Overview of recreational assessment for Minsmere-Walberswick SPA

8.8.108. The Minsmere-Walberswick SPA comprises two distinct areas separated by Dunwich Forest. It has the following access points - letters refer to maps in **Figures 001, 004, 005** and **Table 4.1** in **Appendix E** of this report:

- Hen Reedbed (C)
- Blythburgh (D)
- Walberswick (Tinker's Walk E)
- Walberswick Common (F)
- Southwold (G)
- Walberswick (village car parks H)
- Walberswick (Lodge Road I)
- Walberswick (New Delight Walks J)
- Dunwich (village car park L)
- North Westleton (M)
- Westleton Heath (N)
- RSPB Minsmere Outer Periphery (car parks O)
- RSPB Minsmere (main car park P)
- Dunwich Heath (National Trust car park Q)

- Eels Foot Eastbridge (R).

8.8.109. The Minsmere to Walberswick area (including Dunwich Forest) was identified as potentially receiving the highest number of displaced people during the 2014 visitor survey, being named by a total of 92 (17.9%) out of the 514 respondents. It was estimated that total visits to access points associated with the SPA could increase by 0.2-3.1% or 1.6-50.3% based on the different scenarios set out in **Table 8.10**. The largest potential increase is predicted for the Minsmere-Eastbridge area.

Table 8.10: Estimated additional visits to locations in the study area as a result of displacement of existing users from the Sizewell area and the construction workforce - Minsmere-Walberswick SPA

Location And Estimated Number Of Annual Visits	% Of Survey Visitors Who Gave As Alternative Location	Based On % Of Displaced Visitors[1]			Based On 500,000 Visits To Sizewell Area[2]		
		Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits	Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits
Minsmere-Walberswick SPA							
Dunwich Heath – 175,934	2.33%	4,288	11.7	2.4	11,839	32.4	6.7
Dunwich Beach – 150,000	3.11%	5,043	13.8	3.3	15,928	43.6	10.6
Eastbridge – 38,871	1.56%	606	1.7	1.6	7,800	21.4	20.1
Minsmere Core – 103,844	0.74%	844	2.3	0.8	3,776	10.3	3.6
Minsmere Outer – 30,000	2.96%	1,190	3.3	4.0	15,102	41.4	50.3
Sizewell Beach – 195,557	1.95%	3,813	10.4	1.9	9,750	26.7	5.0
Southwold – 150,000	1.75%	4,325	11.8	2.9	10,450	28.6	7.0
Walberswick – 150,000	1.17%	1,944	5.3	1.3	6,039	16.5	4.0
Westleton – 60,000	1.36%	1,005	2.8	1.7	6,989	19.1	11.6
Westwood Marshes – 60,000	0.19%	114	0.3	0.2	950	2.6	1.6

1. 'Realistic' approach: involves determining the percentage of survey respondents who said that they would be displaced to each named location and then calculating the number of additional visits that would be generated by multiplying the estimated number of annual visits at each of the locations by the percentage of displaced users.
2. More precautionary approach: the same basic method as (1), except that the calculated number of additional visits to each specified location has been taken as a percentage of an estimated 500,000 annual visits to the Sizewell survey area as a whole (based on extrapolation of the 4214 visitors observed over the survey period).

8.8.110. It is considered likely that a large proportion of those who said they would relocate to Minsmere, particularly if local to the Sizewell Area, would relocate to sites on the periphery of the RSPB Minsmere Reserve (Minsmere Outer, access point O) rather than the main reserve itself, as such locations would provide access to the local footpath network without having to access the main Reserve. Further, the 2015 visitor survey at RSPB Minsmere suggested that 27% of visitors to the main reserve could seek alternative sites to visit during the construction of Sizewell C.

8.8.111. Mitigation measures have been identified to minimise the ecological effects of increased recreational pressure on habitats and associated species in the Minsmere RSPB Reserve area. A Rights of Way and Access Strategy is being developed to minimise the displacement of existing recreational users from Sizewell C and the likelihood that displaced visitors and construction workers would access the Minsmere-Walberswick SPA for recreation. In addition, the strategy outlines a monitoring programme for recreational displacement to identify local mitigation measures, to be agreed with local land managers, which could be introduced to further reduce recreational disturbance.

8.8.112. It is proposed that the Rights of Way and Access Strategy for Sizewell C would be developed to align with the Suffolk RAMS Strategy (Ref. 7.22) to avoid or mitigate potential additional recreational pressures from housing developments on estuarine, coastal and heathland European sites. SZC Co. would adopt a similar approach to mitigate for any potential impacts. Such an approach would be secured via a monitoring and mitigation plan/agreement with relevant organisations/site managers of the European site in question.

8.8.113. As well as direct effects of recreational disturbance on birds, the potential also exists for indirect effects to arise associated with recreational disturbance on birds via the habitats on which they depend. However, subject to mitigation through the Rights of Way and Access Strategy, no adverse effects due to recreational disturbance are predicted on the various qualifying habitats of the Minsmere to Walberswick Heaths and Marshes SAC as seen in section 7.7 of this report and Minsmere-Walberswick Ramsar site as seen in section 7.8 of this report. Given this, indirect effects on any SPA qualifying feature as a result of effects of recreational disturbance on supporting habitats are highly unlikely.

Assessment of potential increased recreational disturbance on breeding avocet

8.8.114. The majority of the SPA breeding avocet population occurs on the RSPB Minsmere Reserve as detailed in section 6.3 f iii of this report, where access is controlled and restricted to a well-defined set of screened paths and hides.

The permissive footpath network does not readily provide access to areas of habitat in or surrounding the Reserve which support SPA wetland birds (wintering and breeding), including breeding avocet. The possible exception is a footpath running from Eastbridge to the coast - route R on **Figure 005**, **Appendix E** of this report.

8.8.115. For most of its length the footpath runs 200-400m south of the Minsmere New Cut which forms the southern boundary to the SPA and the RSPB Reserve. At Minsmere Sluice, the footpath runs adjacent to the Reserve and SPA boundary for approximately 400m. Although largely located outside of the SPA and the RSPB Reserve, the footpath does run through areas of lowland grazing marsh (e.g. Minsmere South Levels) that are used by wintering and breeding birds functionally linked to the designated SPA populations. However, given the existing popularity of the route (estimated to receive nearly 40,000 visits per year), disturbance effects are already likely to be reflected in the frequency and intensity of use of habitats by birds along the route. Estimated additional usage of 1.6 – 20.1% (**Table 8.10**) is not considered likely to result in any significant change in the existing behaviour of birds and their use of habitats along the route.

8.8.116. Avocets also breed at Dingle Marshes and Tinkers Marshes within the Walberswick NNR. These areas are also within nature reserves managed by Natural England and RSPB/SWT, and access to sensitive areas used by breeding waterbirds is managed through networks of footpaths and barriers such as deep-water ditches. Estimated increases in visitor numbers to these areas during the construction of Sizewell C are 1.3-4.0% as seen in **Table 8.10** (Walberswick), **Appendix E**, **Table 4.1** of this report. Given the relatively small predicted increase in visitor numbers and the limited access to habitats used by breeding avocets, recreational disturbance levels are also not predicted to increase in these areas.

8.8.117. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding avocet in the Minsmere-Walberswick SPA.

Operation

8.8.118. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA as detailed in section 8.3 b vi of this report, also applies to breeding avocet at Minsmere-Walberswick SPA.

8.8.119. As described above, because of limited accessibility to habitats used by breeding avocets, potential increases in recreational pressure during the construction (and decommissioning) of Sizewell C were not predicted to cause adverse effects through direct disturbance. If the changes in visitor

use predicted during construction continue into the operational phase, then no direct adverse effect would be predicted during this phase. In this context it is noted that the size of the workforce at Sizewell C would be less during operation than construction, so that predicted recreational use of European sites by the operational workforce would also be less.

8.8.120. There is the potential for indirect effects of recreational disturbance on birds via the habitats on which they depend. However, during the operational phase, no adverse effects due to recreational disturbance were identified on the various qualifying habitats of the Minsmere to Walberswick Heaths and Marshes SAC as seen in section 7.7 of this report and Minsmere-Walberswick Ramsar site as seen in section 7.8 of this report. Given this, indirect effects on any SPA qualifying feature as a result of effects of recreational disturbance on supporting habitats are highly unlikely.

8.8.121. Thus, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding avocet using the Minsmere-Walberswick SPA.

c) Breeding bittern, project alone

i. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.122. The assessment reported above for avocet as seen in section 8.8 b i of this report is also applicable to breeding bittern.

8.8.123. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of water quality in the terrestrial environment, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding bittern.

ii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.124. The assessment reported above for avocet as provided in section 8.8 b ii of this report is also applicable to breeding bittern.

8.8.125. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of local hydrology and hydrogeology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding bittern.

iii. Changes in air quality

8.8.126. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.8.127. The assessment reported above for avocet as provided in section 8.8 b iii of this report is also applicable to bittern during the breeding season.

8.8.128. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to air quality effects during the construction or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding bittern.

Operation

8.8.129. The assessment reported above for avocet as provided in section 8.8 b iii of this report is also applicable to bittern during the breeding season.

8.8.130. The assessment of air quality (combustion effects) during operation concluded that there would be no adverse effect on the integrity of the SAC qualifying habitats and Ramsar habitats. As these habitats underpin the presence of SPA qualifying bird species, it is concluded that, similarly, there would be no adverse effect on any SPA qualifying feature, including breeding bittern, due to changes in air quality during the operational phase.

iv. Disturbance effects on species populations

Construction and decommissioning

8.8.131. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above for breeding avocet and is taken to apply to bittern also as seen in section 8.8 b iv of this report. On the basis of this evidence, it is considered unlikely that noise and visual disturbance from the construction of the Sizewell C Project would affect bittern when using habitats within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable bittern habitat[21] – **Figure 8.7**), whilst the peak noise levels during construction of the main development site are not predicted to exceed 54 dB L_{Amax} within those areas of the SPA which provide suitable habitat for this species (**Figure 8.3** to **Figure 8.6**).

[21] This part of the SPA largely comprises sand dune and shingle habitats.

8.8.132. The baseline survey data provide no evidence that bittern breed within either the Minsmere South Levels or Sizewell Marshes, and the overall usage of these areas by the SPA bittern population appears to be limited as seen in section 6.3 f iii of this report. Therefore, although there is potential for the effects of noise and visual disturbance to occur across parts of the Minsmere South Levels and (particularly) the Sizewell Marshes, this would have, at most, a small effect on the SPA bittern population. Furthermore, the height and density of vegetation in the reedbed habitats occupied by bittern is likely to reduce the risk and extent of any visual disturbance effects on this species. The low likelihood of any such effects, together with their small potential magnitude, should be considered within the context of a population which is currently more than three times larger than at the time of citation, and which readily meets the supplementary advice on the generic conservation objective of maintaining a breeding population at a level which is above five breeding pairs, whilst avoiding deterioration from its current level (Ref. 6.66, **Table 6.5**).

8.8.133. As for breeding avocet as provided in section 8.8 b iv of this report, the construction works associated with the water storage area in the north-east of the main development site are not considered to affect the assessment for the SPA breeding bittern population because they would be limited to the first winter of the construction period only.

8.8.134. Therefore, no adverse effects on the SPA bittern population are predicted as a consequence of noise and visual disturbance from construction or decommissioning activities.

Operation

8.8.135. As detailed above for breeding avocet and seen in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect areas of the Minsmere South Levels and Sizewell Marshes that may be used by the SPA bittern population. Therefore, no adverse effects on the SPA bittern population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.136. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet as seen in section 8.8 b v of this report also applies here.

8.8.137. Bitterns occupy wetlands with large areas of reedbed; they are secretive birds, nesting and foraging within stands of reedbed. The majority of the SPA breeding bittern population occurs on the RSPB Minsmere Reserve as seen in section 6.3 f iii of this report. As described above for breeding avocet, access to the reserve is controlled and restricted, and increase in recreational disturbance during the construction of Sizewell C is not predicted to increase disturbance levels to habitats for wetland birds, including breeding bittern, in this area.

8.8.138. Other areas identified as strongholds for breeding bittern within the SPA are Hen Reedbed and Westwood Marshes (Ref. 6.66). the former site is a SWT nature reserve and access is limited to established paths around the edge of the reedbeds leading to a viewing platform and hides. Westwood Marshes is within an area of the Walberswick NNR managed by Natural England; access is limited to a single footpath located on a causeway. Estimated increases in visitor numbers to these areas during the construction of Sizewell C are respectively 1.3-4.0% and 0.2-1.6% as seen in **Table 8.10**; **Appendix E**, **Table 4.1** of this report. Given the relatively small predicted increase in visitor numbers and the limited access to reedbed habitats used by breeding bitterns, recreational disturbance levels are also not predicted to increase in these areas.

8.8.139. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding bittern in the Minsmere-Walberswick SPA.

Operation

8.8.140. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA as provided in section 8.3 b vi of this report also applies to breeding bittern at Minsmere-Walberswick SPA.

8.8.141. The assessment above for breeding avocet as provided in section 8.8 b v of this report also applies to breeding bittern. Thus, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding bittern using the Minsmere-Walberswick SPA.

d) Breeding marsh harrier, project alone

i. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.142. The assessment reported above for avocet as seen in section 8.8 b i of this report is also applicable to breeding marsh harrier.

8.8.143. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of water quality in the terrestrial environment, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding marsh harrier.

ii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.144. The assessment reported above for avocet as provided in section 8.8 b ii of this report is also applicable to breeding marsh harrier.

8.8.145. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to an alteration of local hydrology and hydrogeology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding marsh harrier.

iii. Changes in air quality

8.8.146. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.8.147. The assessment reported above for avocet as seen in section 8.8 b iii of this report is also applicable to marsh harrier during the breeding season.

8.8.148. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to air quality effects during the construction or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding marsh harrier.

Operation

8.8.149. The assessment reported above for avocet is also applicable to marsh harrier during the breeding season.

8.8.150. The assessment of air quality (combustion effects) during operation concluded that there would be no adverse effect on the integrity of the SAC qualifying habitats and Ramsar habitats. As these habitats underpin the presence of SPA qualifying bird species, it is concluded that there would not be an adverse effect on any SPA qualifying feature due to changes in air quality during the operational phase, including breeding marsh harrier.

iv. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.8.151. As described in section 6.3 f of this report, wetland habitats (i.e. coastal grazing marsh and reedbed or fen habitats) provide the key foraging areas for the Minsmere-Walberswick SPA marsh harrier population (**Table 6.7** and **Table 6.8**). The Sizewell Marshes provides such habitat and is used by foraging marsh harrier from the SPA, although to a lesser extent than the Minsmere South Levels which are closer to the nesting area of marsh harriers at Minsmere (**Table 6.7**, **Figures 6.3** to **6.5**).

8.8.152. The construction works at the main development site would lead to the loss of 7.03ha of the Sizewell Marshes to accommodate the SSSI crossing, the western part of the main platform, realignment of Sizewell Drain and the restringing of pylons (with the affected area being the part of the Sizewell Marshes SSSI which lies within the Order Limits in **Figures 6.3** to **6.5**). This area represents approximately 8% of the coastal grazing marsh and reedbed habitats within the Sizewell Marshes, but a much smaller proportion of the total area of wetland foraging habitat available to the SPA marsh harrier population (e.g. the extent of wetland foraging habitat on the Minsmere South Levels exceeds that found within the Sizewell Marshes). Furthermore, as indicated above the intensity of usage by marsh harriers is greater in areas of wetland closer to the nesting area at Minsmere.

8.8.153. Therefore, this habitat loss represents a small proportion of the available wetland foraging habitat for the SPA marsh harrier population and occurs within a wider area (the Sizewell Marshes) which is less heavily used by foraging marsh harriers than other areas of wetland habitat closer to the nesting area (e.g. the Minsmere South Levels). No adverse effects on the Minsmere-Walberswick SPA marsh harrier population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

8.8.154. Although not required in order to reach the above conclusion, primary mitigation measures to create like for like replacement reedbed and ditch habitat have been implemented at Aldhurst Farm. This habitat has established and developed successfully so far, with attempted breeding by a pair of marsh harriers recorded at the site in 2019 as detailed in **Volume 2, Chapter 14, Appendix 14A7** – Ornithology (Doc Ref. 6.3). The new reedbed and ditch habitats at Aldhurst Farm are located adjacent to the western edge of the Sizewell Marshes SSSI, so are contiguous with existing wetland habitat used by foraging marsh harriers.

v. Disturbance effects on species populations

Introduction

8.8.155. As outlined above for breeding avocet and seen in section 8.8 b iv of this report, disturbance effects on the Minsmere-Walberswick SPA breeding marsh harrier population may arise via visual and acoustic stimuli associated with the construction, operation and decommissioning of the Sizewell C Project. Such stimuli could affect this SPA population as a result of disturbance to nesting or foraging birds, resulting in a range of possible consequences with the potential to cause adverse effects.

8.8.156. The available evidence for effects of noise and visual disturbance is reviewed in section 8.8 b iv of this report; albeit the ecology evidence base for marsh harrier and differences in the evidence base (e.g. for sensitivity thresholds) are presented below.

8.8.157. The extent to which the construction, operation and decommissioning of the Sizewell C Project would lead to noise and visual disturbance is considered below (with the construction effects also considered to represent a worst-case for decommissioning). The assessment of these effects has been undertaken on the basis of the evidence, in conjunction with the information relating to the baseline conditions as seen in section 6.3 f of this report, and involved:

- Assessing the usage of the habitats around and within the main development site by marsh harrier in order to establish the potential importance of specific habitat areas to the species as detailed in section 6.3 f of this report.
- Determining the potential sources of disturbance (noise and visual) during construction and calculating the footprint within which thresholds that could elicit significant behavioural response may arise.
- On the basis of the disturbance footprint, determining the area of habitat from which marsh harrier may be displaced due to avoidance reactions.

- Determining the importance (area and quality) of the habitat from which marsh harrier may be displaced in the context of available foraging area.
- Assessing the likely consequence of changes in foraging resource for the breeding marsh harrier population at Minsmere.
- Determining the significance of effect on the Minsmere-Walberswick SPA population.

Marsh harrier ecology evidence base

Breeding ecology

8.8.158. Marsh harriers are ground-nesting birds that primarily breed in phragmites reedbeds, where a nest of approximately 50-80cm in diameter and a cup of 15-20cm in diameter is constructed from reeds, grasses and twigs (Ref. 8.78). Of 542 UK nests for which habitat was recorded between 1983-90 and 1995, most nests (86%) were in reed beds, with smaller numbers in arable crops (13%), and the remainder in rough grassland (Ref. 8.79). The reed beds or wetlands can be extensive or small (less than 1ha in size). Marsh harriers are not territorial breeders but have been known to nest in loose colonies (Ref. 8.80), however they will defend an area of approximately between 50-300m around the nest location (Ref. 8.81).

8.8.159. Egg-laying typically takes place from mid-April to early May. Clutch size can vary from 2-8 eggs (Ref. 8.82) and laying takes place every 2-3 days. Incubation is undertaken primarily by the female and this lasts 31-38 days. Fledging occurs after a period of 35-45 days and young are dependent on the adults for a further 15-25 days (Ref. 8.83).

8.8.160. Although considered to be a wetland bird species, there is extensive evidence that it is now expanding into areas of agricultural habitat and, in certain parts of its range, even flourishing in such habitats (Ref. 6.82, Ref. 6.85). In the Ebro Basin, northeast Spain, the marsh harrier population has increased from eight pairs in 1997 to 53 pairs in 2008 (Ref. 6.82). Significantly, this increase has been most noticeable in farmland areas, comprising non-irrigated cereal crops, irrigated fields and both dry and irrigated fruit trees. Cardador *et al.* 2011 (Ref. 6.82) showed that marsh harriers in this location are breeding in small areas of wetland habitat and foraging over the adjacent farmland, and concluded that, providing food availability is not compromised, marsh harrier can and have adapted to agricultural intensification of the wider landscape.

8.8.161. This trend of harriers nesting in small wetland habitats and foraging over adjacent farmland is reflected in the UK, with a census of breeding harriers

in the UK carried out in 1995 finding that over 55% of nests were located in crops, ditches or small remnant reedbeds in predominantly arable areas, up from only 11% in 1983. This rise is also reflected in the number of birds nesting within a crop field, with only 11% of nests in 1983 rising to 20% of nests in 1995 (Ref. 8.79). This study also found that crop-nesting harriers were just as successful at raising their young as those nesting in reedbeds.

Diet

8.8.162. Marsh harriers are prey generalists and opportunists and will take a wide variety of prey from a range of habitats, but notably grasslands, wetlands and agricultural crops. Underhill-Day 1985 (Ref. 8.82) documented the prey taken by marsh harrier in East Anglia during 1983-84 and found that they preyed upon most species of birds and mammals present in their hunting areas. Small birds, young gamebirds and waterbirds and mammals (including rabbits) formed 90-95% of the diet by numbers and weight (see **Table 8.11**). Small adult birds and mammals were important in April-May but, thereafter, young gamebirds and waterbirds formed an increasing proportion of the diet, whilst the proportion of mammals declined.

Table 8.11: Breakdown (%) of key prey types for breeding marsh harrier in East Anglia, as recorded by different methods (Ref. 8.82)

Prey Type	Pellets	Prey Remains	Sightings
Small birds	11.7	10.5	4.7
Gamebirds	31.5	25.2	37.4
Waterbirds	20.8	24.3	31.4
Mammals	26.3	28.5	24.9
Other	9.7	11.5	1.6

8.8.163. Cardador *et al.* 2012 (Ref. 8.84) found that marsh harriers in intensively managed areas of farmland in northeast Spain took higher percentages of small mammals (voles and mice) than harriers in areas managed at low-intensity, where they also had a more diverse diet (including more birds). Male delivery rates increased throughout the breeding season in the intensively managed areas. On the contrary, no significant trend in delivery rates was observed in the traditional area, where harriers turned to larger prey later in the season.

8.8.164. Tornberg and Haapala (2013) (Ref. 8.85) studied the diet of marsh harriers during the breeding seasons 2002–2009 on the isle of Hailuoto in the Gulf of Bothnia in Finland. They found that birds accounted for 73–93% of prey numbers in the marsh harrier during the breeding season. Passerine birds were the most numerous during the nestling (63%) and fledging periods

(21%), while ducks and gulls/terns had the highest biomass (29% and 12%, respectively). Muskrat was the most important prey among mammals by number and weight (15% and 18%, respectively). An important finding of their study was that the opportunistic foraging strategy of marsh harrier and the diversity of prey taken was likely to have contributed to the rapid population increase in the species compared to other raptor species.

8.8.165. In the Minsmere-Sizewell area the main prey species are likely to comprise small birds, young gamebirds, waterbirds, small mammals (e.g. voles, mice, shrews) and rabbits. These prey species occur in all of the key habitats used by marsh harrier, namely: wetland (reedbed and fen vegetation), lowland grassland (grazing marsh) and agricultural (arable) land. The available evidence indicates that marsh harrier make limited use of heathland and very limited use of woodland (apart from grassland along woodland edges) for foraging.

Foraging behaviour

8.8.166. In a study of habitat use by marsh harriers in north-eastern Spain, Cardador and Manosa (2011) (Ref. 8.86) found that breeding birds exploited a wide foraging niche. Two different habitat types were found to be used: wetlands (which coincided with the breeding/roosting sites and which represented LESS2% of total available habitat), and herbaceous crops around the breeding sites which provided an adequate vegetation structure for hunting. One of the key findings of the Cardador and Manosa study was that marsh harrier exploited different agricultural crop types over the year, an aspect of foraging behaviour that appears to be linked largely to vegetation structure. Maize fields, sown in April-May, were scarcely used before September, probably because their green cover is too dense and high (0.6-2m) for hunting but were used during autumn and winter when fields were either covered with stubble or ploughed. Wheat and barley fields were mainly used during winter and spring, during their growing period (before having their maximum vegetation cover). In the study area, marsh harriers took advantage of the presence of regularly mown fields (intensively managed alfalfa), which offered an adequate vegetation structure for hunting during most of the year.

8.8.167. The marsh harrier, as with many other birds of prey, is a relatively long-lived species (typically reaching 6 years old, but 20 years has been recorded[22]), usually having large home ranges. Due to their different roles during breeding (Ref. 8.87), female marsh harriers have smaller home-ranges than males and remain closer to the nest during the nesting period. In East Anglia, the home range of males varied with the stage of the breeding cycle from 569ha during courtship to 1407ha during the post-fledging period (Ref. 8.88). Bavoux *et al*.

[22] BTO BirdFacts - https://app.bto.org/birdfacts/results/bob2600.htm

1994 (Ref. 8.89) using radio-tracking recorded ranges of 480ha to 2000ha for three adult Harriers on grasslands during winter. Sternalski et al. (2008) (Ref. 8.90) recorded home ranges of 349ha for breeding and 1603ha for non-breeding marsh harriers tracked on grasslands.

8.8.168. In a study of a marsh harrier population in northwest France, Sternalski *et al.* (2008) (Ref. 8.90) found that home-range size was influenced by the age and sex of the individuals. In particular, home ranges decreased with age and/or experience. Non-breeding marsh harriers have larger home ranges than breeding birds. Breeding birds exhibit smaller home ranges, because of breeding commitments (males have to provide food for females and young, and therefore return frequently to the nest, whereas females remain in the vicinity of the nest). In order to reduce their energy expenditure, males restrict their hunting movements to the nest area and thus contract their home-range size.

8.8.169. Witkowski (1989) (Ref. 8.91) found that male harrier home ranges could be located at a distance from the nest location, with 2 of the males tracked as part of the study having a home range located at 3km and 6.5km from the nest. Male birds in East Anglia have also been recorded foraging up to 7km from the nest in some situations (Ref. 8.88).

8.8.170. Altenburg *et al.* (1982) (Ref. 8.92) found that during the incubation phase the home range of a male was between 310-440ha, during the chick-rearing phase the home range was 420-2360ha and during the post-fledging phase the home range was 730-2610ha. This was also found to be the case with females, with females during the incubation phase staying close to the nest and having a home range of 100ha rising to 1300ha later in the breeding season (Ref. 8.88).

8.8.171. Using radio-tracked birds, Cardador *et al.* (2009) (Ref. 8.93), studied the extent of the home range of birds within a landscape dominated by land under agricultural cultivation in the Ebro Basin. Birds from two areas of farmed land one comprising intensified-herbaceous irrigated crops, mainly alfalfa, wheat, barley and some sweet corn and the other of more heterogeneous land-use dominated by a large central area of non-irrigated cereal crops, surrounded by fruit trees (some of which were irrigated). The study found that the home range of male birds during the breeding season varied considerably, from 341-6353ha. Birds breeding within areas of intensive (non-irrigated) farmland showed a greater foraging home range than those in irrigated farmland. Within the recorded home ranges, approximately 50% of foraging activity (intensive use areas) occurred within 10–28% of the total home-range. These intensive use areas were generally single areas and included fields around the nesting sites. Within these home ranges, male birds were found to forage up to 15km from the breeding site, although this distance varied considerably and was often within 3km.

8.8.172. Cardador *et al.* (2009) (Ref. 8.93) suggest that the larger home ranges shown by the birds in their study area compared with other studies probably relates to habitat quality. The use of smaller home-ranges on grasslands (Ref. 8.90) may reveal a higher habitat quality in non-intensive grasslands compared with farmed cropland. This reflects the observation that home-range size in raptors often depends largely on prey availability (Ref. 8.94, Ref. 8.95). Cardador *et al.* (2009) (Ref. 8.93) found that the 14-16 nesting pairs of marsh harrier at Utxesa (a 280-ha reservoir in the Ebro Basin, Spain) overlapped home ranges by between 20-100%. A similar, significant overlap of home ranges between birds is also likely to occur at Minsmere (see below).

8.8.173. Based on the evidence presented in the various studies referenced above, the following key points regarding the breeding and foraging ecology of marsh harrier can be made:

- Nesting sites are typically located in areas of reedbed / wetland vegetation, probably in order to provide some protection from potential predators (e.g. fox).
- It is a generalist predator that will take a diverse range of prey species (small mammals, birds), depending on availability within habitat surrounding the breeding site.
- The size of foraging / home range is a function of habitat quality, which in turn reflects the abundance and potential availability of prey. The size and extent of home ranges may therefore vary seasonally and annually.
- Greater foraging use is made of habitats closest to breeding sites, as would be expected for a central place forager where prey abundance and availability is not constrained to specific locations.
- In recent decades, the marsh harrier has shown a significant population increase and range expansion through the exploitation of available habitats in more intensively farmed landscapes. This adaptability reflects the generalist nature of its prey requirements and flexibility in foraging behaviour.

Noise disturbance evidence base

Introduction

8.8.174. There are no available studies that provide specific information on the behavioural responses of marsh harrier to anthropogenic noise (although observations of marsh harrier flight activity at Trimley Marshes, in relation to noise generation from the adjacent Port of Felixstowe, have been undertaken to inform the current assessment – see below). By necessity, the assessment of the likely response of marsh harrier has to be undertaken

through inference with regard to observed effects on other bird species. Information and evidence from studies on other species of birds, including raptors and owls where such information is available, is therefore presented here.

8.8.175. As set out for breeding avocet, because of their reliance on acoustic communication, birds have been viewed as potentially vulnerable to changes in their noise environment that may be caused by anthropogenic activity. Studies suggest that noise may disrupt acoustic communication, interfere with detection of warning signals or prey and elevate stress levels. In this respect, harriers (i.e. species belonging to the genus *Circus*) are notable for having anatomical features, and sometimes using hunting strategies, that are associated with greater reliance on aural detection of prey than is typical of other raptors. Experiments on northern harriers have demonstrated that the directional hearing of this species is similar to that of owls and substantially better than for other diurnal raptor species (Ref. 8.96). Amongst the different harrier species, the reliance on aural detection of prey may be less marked in marsh harriers due their tendency to forage at greater flight heights, whilst, as in Montagu's harrier (but in contrast to some other harrier species), the ruff is restricted to the arc behind each ear opening, again possibly indicating reduced reliance on aural detection of prey (Ref. 8.80). Also, reliance on auditory cues is likely to be greatest when hunting small mammals or other small-sized prey in dense vegetation, whereas the main prey groups of marsh harriers in the Minsmere-Sizewell area are likely to be gamebirds, waterbirds, rabbits and, to a lesser extent, small birds (see above).

8.8.176. Noise has been associated with declining bird densities as a result of displacement from otherwise suitable habitat due to ecological sensitivities or intolerance to noise.

8.8.177. Chronic (largely non-impulsive) anthropogenic noise from busy roads, urban areas, and permanent industrial structures has also been implicated in detrimental impacts upon breeding bird populations. However, its specific effects on species populations and communities may be difficult to determine due to the complex behavioural responses of birds to such signals, including selective avoidance and habituation, and the role that other factors such as changes in habitat and visual disturbance associated with human activities may also play.

Impulsive-type construction noise

8.8.178. High levels of tolerance to aircraft and missile bombing was recorded in one study of northern harrier where a harrier continued hunting during target practice, suspected to be capturing small birds flushed from cover by the bombings (Ref. 8.97). The noise levels in the study were in the range 80 -

87dB (although it is not known what parameter was used to assess this) and the closest explosions occurred at 60m from the foraging bird.

8.8.179. Further background information on impulsive-type construction noise and chronic noise disturbance is provided in section 8.8 b iv of this report (covering work by Institute for Estuarine and Coastal Studies, studies on waterbirds in the Waddenzee, work by Habib *et al.* (2007) (Ref. 8.42), Hirvonen (2001) (Ref. 8.46) and McClure *et al.* (2013) (Ref. 8.45)). Sensitivity thresholds are also discussed in this section; while further information specific to marsh harrier is presented below.

Sensitivity thresholds

8.8.180. To provide an indication of whether a 70dB (L_{Amax}) threshold is appropriate to foraging marsh harrier, survey work was undertaken at the SWT's Trimley Marshes reserve, which is used by foraging marsh harriers and is adjacent to the Port of Felixstowe. This involved simultaneously monitoring marsh harrier flight activity and noise levels in June 2016, when marsh harriers not only foraged over the marshes but also bred at the site, rearing two chicks (Ref. 8.33).

8.8.181. This monitoring revealed that maximum noise levels at the Trimley Marshes site from the port activities are variable but, on some days, can exceed 70dB, LAmax one to three times an hour and 65dB, L_{Amax} 10 times an hour. On this basis, it is considered likely that a high proportion of the site would occur within a contour that encompasses the 65dB, L_{Amax} noise level, whilst some would be within the contour for 70dB, L_{Amax} (Ref. 8.33).

8.8.182. Surveys of marsh harrier flight activity (undertaken using analogous methods to those used in the current assessment – see below) recorded higher levels of flight activity across the Trimley Marshes (based on a total of 27 hours of survey) than those recorded for the Minsmere South Levels (see below). This is unsurprising, given that the harriers were nesting within Trimley Marshes (whilst the data are not directly comparable because only a relatively short period of the breeding season was covered by the Trimley Marshes surveys) but, nonetheless, suggests a tolerance of these noise levels by foraging marsh harriers (Ref. 8.33). Foraging marsh harriers were not observed to react to impulsive noise events noted during the surveys. On one occasion a measured impulsive noise event of 68dB, L_{Amax} coincided with an observed marsh harrier flight, with no apparent response from the harrier, whilst on several other occasions marsh harrier flights were recorded a short time after impulsive noise events above 65dB, L_{Amax}, indicating that such noise events did not cause displacement of foraging harriers from the area (Ref. 8.33).

8.8.183. Although the surveys at Trimley Marshes did not measure actual foraging activity or foraging success by marsh harrier, it is notable that the observed

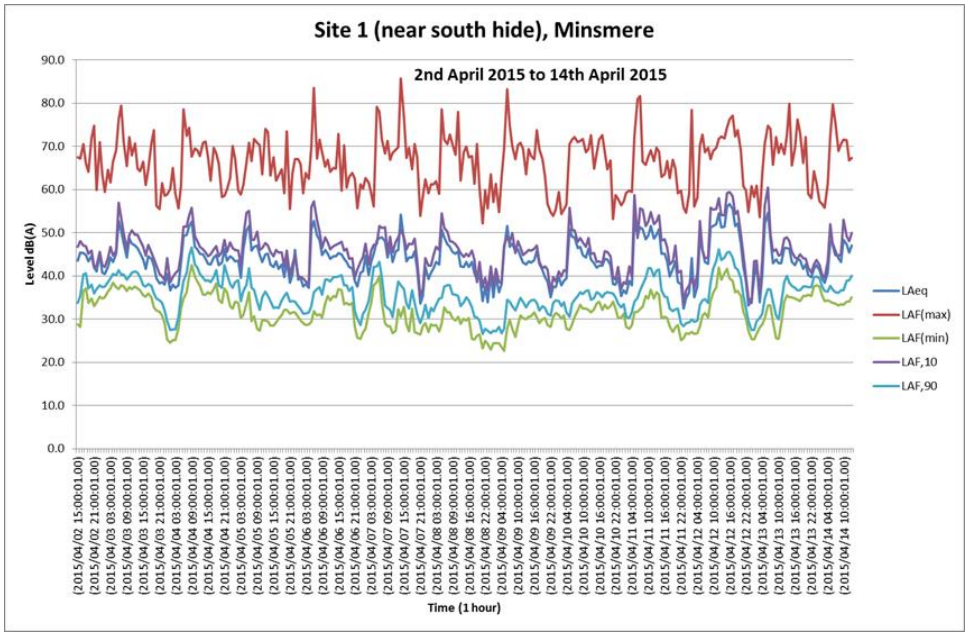
birds were described as actively hunting or foraging in over one third of the flight records during these surveys, suggesting that the Trimley Marshes is used extensively for this purpose (Ref. 8.33). Furthermore, Trimley Marshes is regarded as holding an abundance of breeding, wintering and passage wetland birds[23], which would suggest that there is little evidence for major effects of noise disturbance on the available prey resource for marsh harriers at this site.

8.8.184. As described above, chronic noise disturbance can affect hunting success in owls (Ref. 8.41, Ref. 8.40). Although harrier species tend to rely on aural detection of prey to a greater extent than do other diurnally active raptors (Ref. 8.96), the findings from these studies on owls are likely to have limited applicability when considering the potential effects of noise disturbance on marsh harriers. This is because these findings relate to situations where birds are entirely (or almost entirely) reliant on hearing for prey detection and where the control (or baseline) noise levels are particularly low (e.g. compare **Plate 8.10**). In addition, nocturnally foraging owls hunt more efficiently when conditions are more conducive to visual detection of prey (Clarke 1983) so that effects of noise disturbance on hunting success should be less marked in such situations, whilst the dependence of marsh harrier on auditory cues will be considerably less than for owls (see above).

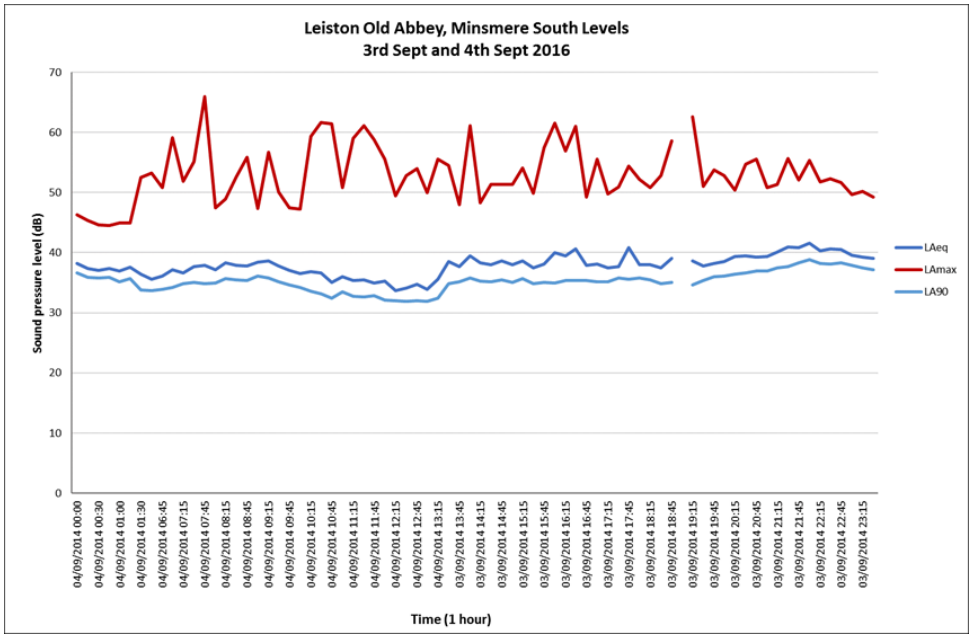
[23] https://www.suffolkwildlifetrust.org/trimleymarshes

Plate 8.10: Hourly noise readings taken from (a) near South Hide, Minsmere over approximately two weeks in April 2015; (b) near Leiston Old Abbey in the Minsmere South Levels, from 3rd – 4th September 2016; and (c) within the marsh harrier habitat improvement area, from 12th – 23rd September 2016

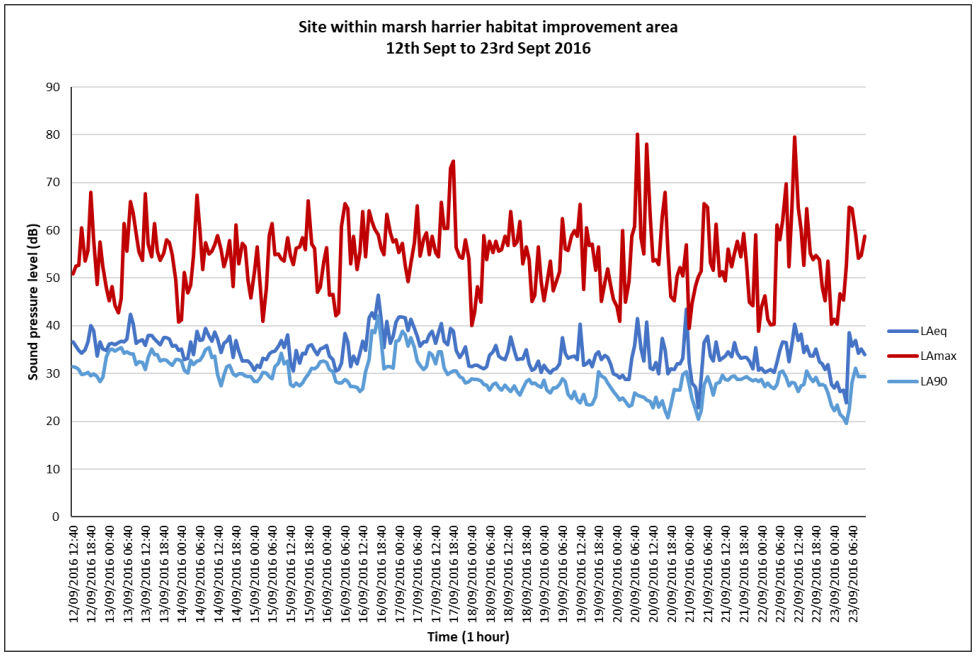
(a)



(b)



(c)



8.8.185. With regard to the adoption of the 70dB L_{Amax} threshold, surveys of noise levels have been undertaken at several locations in the vicinity of the main development site and the wider area used by breeding marsh harriers from the Minsmere-Walberswick SPA. These data are considered to provide context on the types of background noise levels currently experienced in this area.

8.8.186. The longest run of such data is from April 2015, at a location within the RSPB Minsmere Reserve where regular occurrences of noise levels between 70 - 80dB L_{Amax} were recorded (**Plate 8.10a**). These noise levels were associated with both birdsong / calls and anthropogenic activities (e.g. motor vehicles, visitors). Breeding birds at Minsmere, including marsh harrier, may therefore currently experience maximum levels of sound in excess of 70dB L_{Amax} on occasion during the day. However, as this location is close to a visitor route through part of the reserve it may not be representative of the wider areas used by marsh harrier within the reserve. Shorter runs of data were collected at other locations, including from near Leiston Old Abbey in the Minsmere South Levels during two days in early September and one day in mid-November in 2014, and from a location within the marsh harrier habitat improvement area (see below) during mid-September 2016. Noise levels in these locations were associated with sources such as occasional people walking past, agricultural activity, overhead aircraft, insects and birdsong and were often above 60dB L_{Amax} and occasionally close to, or above, 70dB L_{Amax} during daylight hours (**Plate 8.10b** and **Plate 8.10c**).

Modelling of daytime construction noise - main development site

Predictions for the different construction phases

8.8.187. The noise modelling undertaken for the different construction phases is described in section 8.8 b iv of this report, with the outputs (in terms of the L_{Amax} contours) presented in **Figure 8.3** to **Figure 8.6**. As detailed in section 8.8 b iv of this report, noise disturbance from the construction works associated with the water storage area in the north-east of the main development site is not considered to affect the assessment for the SPA breeding marsh harrier population because these works would be limited to the first winter of the construction period only.

Noise emissions near to the marsh harrier habitat improvement area

8.8.188. The noise modelling shows encroachment of the 70dB L_{Amax} contour onto the marsh harrier habitat improvement area (see below) for all construction phases, except Phases 3 and 4. However, it is important to note that the noise modelling for each phase is the predicted worst-case from the entire duration of the phase, as determined from the activities occurring at some point during the full duration of that phase. Therefore, during much of the time, noise levels will be lower than as depicted in **Figure 8.3** to **Figure 8.6**.

This is demonstrated for the northeast part of the main development site where noise emissions encroach on the marsh harrier habitat improvement area. Thus, noise emissions from this part of the main development site were examined in more detail by considering the different construction phases within a series of narrower timescales. This involved considering the maximum extent of activities and works that could occur within different weekly or monthly periods during each phase, and modelling the resultant noise emissions for these periods (using the same modelling approaches and assumptions as for the modelling of the individual construction phases). This work was focussed on the northeast part of the main development site to provide a more detailed examination of noise spillage onto the marsh harrier habitat improvement area.

8.8.189. The modelling outputs for these narrower time periods are described and summarised below to demonstrate the extent to which the predictions derived from the overall construction phase periods (**Figure 8.3** to **Figure 8.6**) overestimate both the duration of the predicted worst-case noise levels and the likely extent of noise emissions at any particular time during the phase (e.g. compare **Figure 8.3** and **Figure 8.9**). This information is used to aid the interpretation of the predicted impacts of noise disturbance on foraging marsh harriers, and specifically inform the extent to which noise emissions are predicted to encroach on the marsh harrier habitat improvement area.

Extent of predicted noise disturbance effects

8.8.190. As described above, there is no empirical evidence that provides a robust indication of the sensitivity of marsh harriers or their likely behavioural response to anthropogenic noise. Information and evidence from studies on the responses of 'birds', as a group, has therefore largely been used to determine the potential response.

8.8.191. Based on the assumption that foraging marsh harriers may be sensitive to increased noise levels, the species may adopt a range of behavioural responses from no avoidance to complete avoidance which encompasses partial avoidance (i.e. a reduction in foraging activity). The type of reaction exhibited is also likely to vary in relation to the noise level, with avoidance assumed to be more likely at higher noise levels.

8.8.192. A likely noise level threshold at which a potentially adverse behavioural response could be initiated by foraging marsh harrier is taken as 70dB L_{Amax}. This threshold is based on observational and experimental work (see above) in respect of impulsive noise and the response of wintering waterbirds to these noise sources and levels, and is supported by the observational evidence on foraging marsh harriers at Trimley Marshes (see above, Ref. 8.33).

8.8.193. As shown on the noise modelling plots, L_{Amax} noise levels within the reedbed habitat at Minsmere used as a breeding site would be below 55dB and, therefore, substantially below LAmax noise levels recorded from the limited monitoring undertaken within the reedbed and generally below the noise levels recorded from other areas in the vicinity of the main development site at which noise monitoring has been undertaken (**Plate 8.10**). Given the relatively low noise levels predicted at the breeding sites, no disturbance effect on birds within the reedbed habitat used for nesting is predicted.

8.8.194. As detailed above, a 5m high fence (or mitigation producing similar effects) will be constructed to ensure attenuation of noise extending to the northeast of the main development site and will be in place prior to the main site clearance associated with the Phase 1 works, so reducing noise levels on the marsh harrier habitat improvement area and the Minsmere South Levels (**Figure 8.2** and **Figure 8.3**). Therefore, the worst-case scenario for the entire period of Phase 1 construction (which may extend up to the first 2.5 years of the construction period) that has been used to inform the current assessment is as presented in **Figure 8.3**. Based on this worst-case for Phase 1, noise levels of 85dB L_{Amax} are predicted to arise within the majority of the main development site, with the predicted levels declining rapidly to reach 70dB L_{Amax} approximately 100-500m into areas surrounding the main development site boundary. The distance at which the threshold level of 70dB L_{Amax} is reached from the main development site boundary depends largely on the

noise source itself, incorporated mitigation measures, location within the site and existing screening. The Phase 1 plot of noise levels shows that the 70dB L_{Amax} threshold will be exceeded over the southernmost part of Minsmere South Levels, the eastern side and southern end of Sizewell Marshes and at the western edge of the marsh harrier habitat improvement area (**Figure 8.3**).

8.8.195. However, as detailed in above, **Figure 8.3** illustrates the worst-case over the full extent of the Phase 1 period, and modelling across narrower time periods reveals that noise levels are predicted to be considerably lower during much of this period. Specifically, in relation to the marsh harrier habitat improvement area, at no single point in time is it predicted that noise levels of 70dB L_{Amax} (or above) would extend across the full area of the encroachment indicated in **Figure 8.3** (encompassing 8.5ha of the 48.7ha habitat improvement area), and any encroachment onto the habitat improvement area (beyond the 0.3ha area in the southwest corner of the habitat improvement area) is predicted to occur for a total of 24 weeks during the entire Phase 1 period. The maximum area of encroachment of noise of 70dB L_{Amax} (or above) onto the habitat improvement area during any one week within the Phase 1 period is predicted to be 4.7ha (**Figure 8.9**), with encroachment of an area in excess of 2.4ha (equivalent to 5% of the habitat improvement area) predicted to occur for a total of seven different weeks over the duration of Phase 1.

8.8.196. Based on the worst-case for Phase 2 construction (which would extend over a period of 1.5 to 3.5 years, possibly overlapping with Phase 1), predicted noise levels remain above 85dB L_{Amax} within the majority of the main construction site. The worst-case Phase 2 plot shows that the 70dB L_{Amax} threshold would be exceeded across part of the south-western edge of the habitat improvement area (comprising 2.1ha), as well as across a similar part of the Minsmere South Levels as the worst-case for Phase 1 (**Figure 8.4**). The area at the eastern side of the Sizewell Marshes across which this noise threshold is exceeded is also similar to that for the worst-case for Phase 1.

8.8.197. For Phase 2, encroachment of noise of 70dB L_{Amax} (or above) onto the habitat improvement area (other than the 0.3ha area in the far southwest corner of the habitat improvement area) is expected to occur during two months of this phase. The predicted maximum encroachment of noise of 70dB L_{Amax} (or above) onto the habitat improvement area (i.e. 2.1ha) is expected to occur during a single month only, with an estimated area of 1.5ha predicted to be affected during the second month of encroachment.

8.8.198. During Phases 3 and 4 of construction (which are planned to extend over a period of seven to eight years, through to year 10), the predicted worst-case footprint of noise levels more than 70dB L_{Amax} would be considerably reduced compared to those for Phases 1 and 2, with no predicted encroachment onto

the habitat improvement area and substantially reduced encroachment onto the Sizewell Marshes (**Figure 8.5**).

8.8.199. During Phase 5 construction (expected to extend over approximately six months), the worst-case predicted noise levels in and around the northern part of the main development site would be higher than in Phases 3 and 4 but would remain lower than those in Phases 1 and 2, and would remain low (and below 70dB L_{Amax}) across the majority of the Sizewell Marshes. Based upon the predicted worst-case for Phase 5, the 70dB L_{Amax} would be exceeded across an area of 4.4ha on the west of the habitat improvement area (**Figure 8.6**), but modelling at narrower temporal resolutions reveals that encroachment into the habitat improvement area would occur during two months of this phase only. Furthermore, during Phase 5 there is potential for additional mitigation to be applied (e.g. use of Heston Bale barriers along part of the eastern boundary), which would reduce the extent to which the 70dB L_{Amax} is exceeded on the habitat improvement area. While uncertainty remains over the behavioural response of marsh harrier, particularly in flight, to increased noise levels, on the basis of the available evidence (see above), 70dB L_{Amax} has been taken as a precautionary threshold at which displacement of marsh harrier could initiate from areas in which noise levels above this threshold are predicted to occur. Based on the mapped L_{Amax} contours this would entail potential displacement from habitat that may be used for foraging in and around the main development site, including parts of the Sizewell Marshes, southern parts of the Minsmere South Levels and land to the south and west of the Minsmere South Levels.

8.8.200. Under the worst-case predictions for Phases 1 and 2, parts of the Sizewell Marshes will be subject to an increase in noise levels greater than 70dB L_{Amax} and, therefore, potentially lost to marsh harrier for foraging (**Figure 8.3** and **Figure 8.4**). As detailed above, these are worst-case predictions and such noise levels are only expected to occur for a proportion of the time period encompassed by construction Phases 1 and 2 (as demonstrated by the modelling at finer temporal resolution undertaken for the northeast part of the main development site), whilst much of the Sizewell Marshes will remain unaffected by these noise levels throughout the entire construction phase. However, it is also possible (albeit unlikely) that noise levels of greater than 80dB L_{Amax} across the main development site could act as a barrier to the movement of foraging marsh harriers from the Minsmere reedbeds to Sizewell Marshes. Therefore, this area of habitat (comprising an estimated 65 ha of grazing marsh and 13ha of reedbed) could effectively be 'lost' in its entirety as a foraging resource to marsh harriers in Phases 1 and 2 as a consequence of any such barrier effect.

8.8.201. Taking into account the duration of the modelled phases as described above, it is considered, from the perspective of potential disturbance effects which may impact at a population level, that the footprints from the worst-case

predictions for Phases 1 and 2 provide a highly precautionary basis for determining the total area of habitat that could be affected by noise levels more than 70dB L_{Amax}. These two phases encompass the largest predicted footprints for noise more than 70dB L_{Amax} and, as detailed above, represent worst-case scenarios which overestimate the extent of the 70dB L_{Amax} footprint which would actually occur at any one point in time.

8.8.202. For the purposes of this assessment it has been assumed that habitat within the 70dB L_{Amax} footprint would be unavailable to foraging marsh harriers and that the whole extent of the Sizewell Marshes would also be unavailable due to the potential for a barrier effect to arise. The calculated habitat areas assumed to be 'lost' to noise disturbance are based on the worst-case predictions for each of Phases 1 and 2 (with separate calculations made for each phase). As described above, these are considered to provide highly precautionary scenarios.

Night-time noise levels during construction - main development site

8.8.203. As outlined above in section 8.8 b iv of this report, construction activities at the main development site would be limited during the night-time period so that noise levels would be considerably lower than those generated during the daytime period. Given that daytime noise levels are predicted to be below 55dB L_{Amax} at the Minsmere breeding site and that marsh harriers do not forage at night, any night-time construction activities would not affect the SPA marsh harrier population.

Visual disturbance evidence base

8.8.204. As discussed above, the role that visual disturbance from the presence of humans and human activities may play in disturbance to birds is often conflated with the effects of noise. There are, however, a number of studies that provide information on the role of human disturbance in the distribution and breeding ecology of marsh harriers, and this has been shown to be a potential problem for marsh harriers during the breeding season, with a study in East Anglia attributing 8.7% of nest failures to human disturbance (Ref. 8.82).

8.8.205. A study by Fernadez and Azcona (1993) (Ref. 8.98) looked in detail at the impacts of human disturbance on breeding marsh harrier. They found that the number of food items and time spent by male and female harriers at the nest decreased during periods of disturbance. However, breeding success was unaffected when comparing disturbed pairs and undisturbed pairs, indicating that the harriers were able to offset the effects of disturbance to some extent at least. The chicks from disturbed nests had higher levels of malnutrition, however, suggesting that survival rates of fledglings could be lower. There was also evidence that the regular presence of crayfish trappers

near to breeding sites caused harriers to become habituated, with only limited displacement. This is thought to be because the crayfish trappers were visiting the same sites each day.

8.8.206. Based on available studies and an expert opinion survey, Ruddock and Whitfield (2007) (Ref. 8.62) suggest that for marsh harrier 300 – 500m is an adequate buffer from breeding sites to avoid the adverse effects of human disturbance (visual / activity). The upper buffer value correlates with the distance at which Fernandez and Azkona (1993) (Ref. 8.98) made their behavioural observations. Ruddock and Whitfield (2007) (Ref. 8.62) note that there is a degree of protection offered by the reedbed environment which reduces both the visible detection of disturbance by the birds and the likelihood of 'casual' human disturbance. The reedbed nest site means that marsh harriers are likely to flush most frequently at close range whilst on the nest, although birds may detect the disturbance source at a greater distance and prior to flushing.

8.8.207. Madders and Whitfield (2006) (Ref. 8.99) provide a review of the displacement effects of upland wind farms on the foraging behaviour of raptors. They conclude that, in general, most research tends to show that disturbance of raptors at wind farms is negligible. Studies quoted in Madders and Whitfield indicate that the response of hen harriers to the presence of wind farms may vary with no indication of displacement being recorded at several wind farms. Madders and Whitfield (2006) (Ref. 8.99) also state that "*preliminary results at Argyll and Northern Ireland sites suggest foraging may be little affected, but local displacement of nesting attempts may occur in the order of 200–300 m around turbines (Natural Research, unpubl. data)"*.

8.8.208. Madders and Whitfield (2006) (Ref. 8.99) consider that marsh harriers have a low sensitivity to displacement (from the effects of operational wind farms), less than that observed for hen harrier.

8.8.209. Alves *et al.* (2014) (Ref. 8.100) in a study of the habitat use of marsh harrier in western Portugal found that human disturbance variables, such as agricultural machinery, constructions, road occupancy and cattle, presented a general negative effect on marsh harriers. This is in contrast to other studies (e.g. Ref. 6.82) which found no relationship between human pressure and nesting-site occupancy. However, Alves *et al*. (2014) (Ref. 8.100) report observations showing clear disturbance and avoidance behaviour of birds when, for instance, farmers and machines were operating in the area. Roads were found to have a significant negative influence on the presence of marsh harriers during the breeding period, but a positive effect during the non-breeding period, suggesting that the population they studied may be sensitive to this type of human pressure only during reproduction. Alves *et al*. (2014) (Ref. 8.100) suggest that the presence of other raptors using roadside habitats as a foraging resource may have led to territoriality or other

competition behaviours towards marsh harriers, possibly causing the observed negative influence during the breeding period. The degree of disturbance caused by other human constructions, such as houses or warehouses, showed little or no relevance in the results, but it is possible that disturbance factors associated with their presence (and human activity in general) could affect reproductive success (Ref. 8.98).

8.8.210. No information relating to potential disturbance of marsh harrier caused by lighting has been identified. However, as marsh harrier is diurnal and typically most active at around dawn and dusk, lighting is considered to be unlikely to constitute an important source of disturbance, even in the absence of any lighting mitigation.

Extent of predicted visual disturbance effects during construction - main development site

8.8.211. Visual disturbance effects could arise from construction activities occurring within the main development site in locations where screening around the main development site is not present. In these situations, it is possible that disturbance to marsh harrier (and potential displacement from foraging habitat) due to the visual stimuli could occur.

8.8.212. As detailed above in section 8.8 b iv of this report, **Figure 8.7**, much of the main development site is contained within the coniferous plantation of Dunwich Forest and this will provide screening around parts of the main development site (either because it extends beyond the boundary or will be retained along the border), whilst wooded field boundaries and small woodlands in other areas will also act to obscure visibility of the main development site from surrounding areas. However, some activities within the main development site will likely remain visible to foraging marsh harriers, including tall structures such as cranes and large stockpiles.

8.8.213. Although Ruddock and Whitfield (2007) (Ref. 8.62) indicated that buffer zones of 300 – 500m were appropriate for minimising disturbance to marsh harriers at their breeding locations (during egg-laying and chick-rearing), it is considered that applying a 150m buffer (subsequently termed the potential visual impact zone) around the main development site represents a realistic and sufficiently precautionary approach in relation to potential visual disturbance to foraging birds from construction activities. This is on the basis of the reported low sensitivity of marsh harriers to the potential displacement effects of wind farms (Ref. 8.99), in conjunction with the extent of screening that will occur around the main development site and the low flight heights that are typical of marsh harriers when foraging. However, no visual impact zone is applied around the water storage area in the north-east of the main development site (**Figure 8.10**) because the construction works for this part

of the development would be limited to the first winter of the construction period only as seen in section 8.8 b iv of this report.

8.8.214. This simple approach of applying a uniform buffer around the main development site is adopted because the exact area over which visual disturbance and potential displacement of birds might arise is clearly difficult to determine with any certainty due to factors such as variation in flight heights, flight directions and, over time, the habituation of birds to the presence of relatively static plant and structures.

8.8.215. The assumption is that foraging marsh harrier outside a potential visual impact zone which extends 150m around the main development site boundary will not be disturbed by the presence of human movement or infrastructure within the main development site. As displacement of harriers could also arise as a result of increased noise levels around the main development site, it is assumed that only in those locations where the zone of potential visual disturbance extends beyond the predicted footprint of the less than 70dB L_{Amax} noise contour is there potential for displacement as a result of visual stimuli (see **Figure 8.10**).

Construction and decommissioning: Assessment of the effects of noise and visual disturbance

Disturbance effects on nesting marsh harrier

8.8.216. The reedbeds at Minsmere that are used as a breeding site by marsh harriers are located over 1km away from the closest part of the boundary of the main development site. Noise levels (L_{Amax}) within the reedbed are predicted to be less than 55dB. Disturbance to birds within the breeding habitat as a result of increased noise levels is, therefore, considered highly unlikely to arise. The available noise monitoring data suggest that marsh harriers from the Minsmere-Walberswick SPA are commonly exposed to noise levels above 55dB L_{Amax} (see above).

8.8.217. As discussed above, potential sources of visual disturbance would be confined to within the main development site. Visible activity from outside the main development site would be confined to those areas where screening is not available and then the disturbance effect is considered to extend no further than 150m. The distance from the main development site to the reedbed at Minsmere is more than 1km and, therefore, significantly greater than the 150m potential visual impact zone. As stated in Ruddock and Whitfield (2007) (Ref. 8.62), the reedbed habitat itself also provides an important screening effect from potential sources of visual disturbance. No disturbance effects to marsh harriers within their breeding habitat is, therefore, predicted during construction or decommissioning.

Estimation of the loss of foraging habitat from noise and visual disturbance

8.8.218. Coastal grazing marsh, reedbed and agricultural land are likely to provide the three main foraging habitats for marsh harrier nesting at Minsmere. The extent of the assumed habitat loss to foraging marsh harrier as a result of noise and visual disturbance from construction of the Sizewell C has been calculated as follows:

- The distribution and extent of the broad habitat-types surrounding the Minsmere marsh harrier nesting area were mapped, using available land classification information from existing mapped and aerial data (**Figure 8.11**).
- The total areas of coastal grazing marsh, reedbed and agricultural land were extracted from the mapped data for a series of 1km concentric radii centred on the Minsmere marsh harrier nesting area, out to a distance of 4km (**Table 8.12**).
- The areas of coastal grazing marsh, reedbed and agricultural land assumed to be lost to foraging marsh harrier (i.e. due to being within either the 70dB L_{Amax} footprint, Sizewell Marshes or else the 150m potential visual impact zone) were calculated for each of the 1km concentric radii and expressed as a percentage of the total habitat area (**Table 8.12**).

8.8.219. On this basis, the percentage of each foraging habitat-type potentially 'lost' to marsh harriers at different distances out from the nesting area as a result of construction-related disturbance (from both visual and noise stimuli) was estimated (**Table 8.12**). The habitat areas assumed to be 'lost' were similar for the worst-cases for each of Phase 1 and Phase 2 (**Table 8.12**), as would be expected from the similar extents of their respective 70dB L_{Amax} contours (**Figure 8.3** and **Figure 8.4**); and Phases 1 and 2 represent the worst cases across all five development phases. Across the full 4km distance out from the Minsmere nesting area, the total areas assumed to be 'lost' to foraging marsh harrier were:

- Agricultural habitats: 261ha and 263ha based upon the Phase 1 and Phase 2 scenarios, respectively, of which 25ha and 34ha (for the Phase 1 and 2 scenarios, respectively) were attributed to the 150m potential visual impact zone (after accounting for the assumed displacement and barrier effect from noise disturbance).
- Coastal grazing marsh: 90ha and 85ha based upon the Phase 1 and Phase 2 scenarios, respectively, of which 0ha and 7ha (for the Phase 1 and 2 scenarios, respectively) were attributed to the 150m potential visual impact zone (after accounting for the assumed displacement and barrier effect from noise disturbance).

- Reedbed: 13ha for both Phase 1 and 2 scenarios, all of which was located within Sizewell Marshes (and hence accounted for by the assumed barrier effect from noise disturbance).

Table 8.12: Estimated areas of different habitat-types within 1km radii of the Minsmere nesting area which are assumed to be 'lost' to disturbance effects during the Sizewell C construction stage, based upon the worst-case for each of construction Phases 1 and 2 (with the 5m high fence in place); areas of 'lost' habitat are calculated on the basis of their occurrence within either one (or more of) the footprint of the 70dB L_{Amax} contour, Sizewell Marshes or the 150m potential visual impact zone

Ph	Habitat	Area (ha) Within 0-1km		Area (ha) Within 1-2km		Area (ha) Within 2-3km		Area (ha) Within 3-4km		Overall Area (ha) Within 0-4km	
		Total	Lost (%)	Total	Lost (%)	Total	Lost (%)	Total	Lost (%)	Total	Lost (%)
1	Arable	33.4	1.0 (3.0)	181.0	81.0 (44.8)	330.0	86.0 (26.1)	545.0	93.0 (17.1)	1089.4	261.0 (24.0)
	Coastal grazing marsh	70.0	0.0 (0.0)	146.0	19.0 (13.0)	68.0	39.4 (57.9)	68.0	31.8 (46.8)	352.0	90.2 (25.6)
	Reedbed / Fen	80.0	0.0 (0.0)	48.0	0.0 (0.0)	15.7	13.4 (85.4)	0.0	0.0 (0.0)	143.7	13.4 (9.3)
	Total wetland habitats	150.0	0.0 (0.0)	194.0	19.0 (9.8)	83.7	52.8 (63.1)	68.0	31.8 (46.8)	495.7	103.6 (20.9)
	All habitats	183.4	1.0 (0.5)	375.0	100.0 (26.7)	413.7	138.8 (33.6)	613.0	124.8 (20.4)	1585.1	364.6 (23.0)
2	Arable	33.4	0.1 (0.3)	181.0	79.2 (43.7)	330.0	87.4 (26.5)	545.0	96.6 (17.7)	1089.4	263.3 (24.2)
	Coastal grazing marsh	70.0	0.0 (0.0)	146.0	14.1 (9.7)	68.0	39.4 (57.9)	68.0	31.8 (46.8)	352.0	85.3 (24.2)
	Reedbed / Fen	80.0	0.0 (0.0)	48.0	0.0 (0.0)	15.7	13.4 (85.4)	0.0	0.0 (0.0)	143.7	13.4 (9.3)
	Total wetland habitats	150.0	0.0 (0.0)	194.0	14.1 (7.3)	83.7	52.8 (63.1)	68.0	31.8 (46.8)	495.7	98.7 (19.9)
	All habitats	183.4	0.1 (0.1)	375.0	93.3 (24.9)	413.7	140.2 (33.9)	613.0	128.4 (20.9)	1585.1	362.0 (22.8)

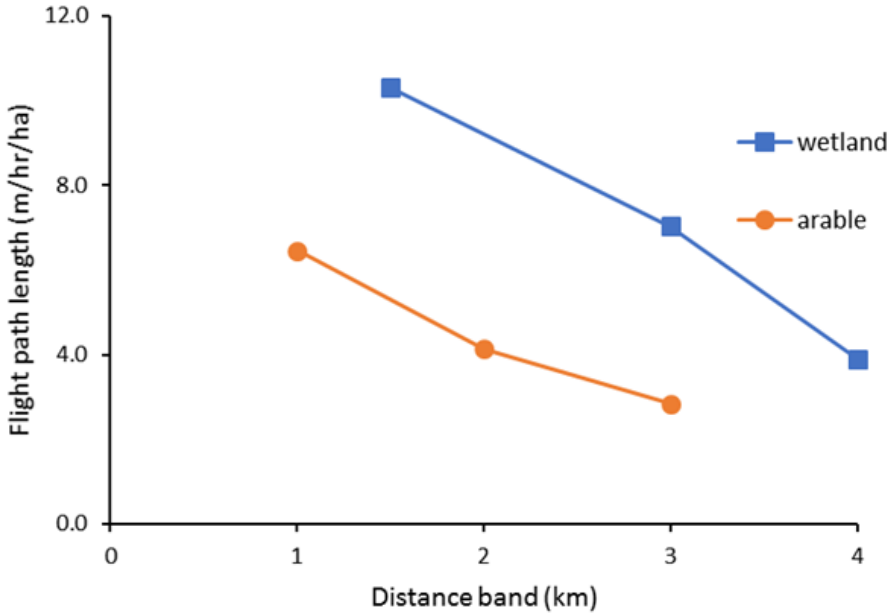
Estimating the potential loss of foraging resource

8.8.220. Determining the consequences of the potential loss of this area of foraging habitat on the marsh harrier population at Minsmere is complex and requires consideration of the potential foraging value of the habitat, the likely behavioural response of harriers to the loss of the habitat and the likely resulting effect on the population (productivity and mortality).

8.8.221. Several studies of foraging range and habitat usage (Ref. 8.100, Ref. 6.82 and Ref. 8.88) indicate that marsh harrier make greatest use of available foraging habitat closest to nesting sites. Cardador *et al*. (2009) (Ref. 8.93) found that 50% of foraging activity occurred closest to breeding sites and from within 10 - 28% of the total home range. The outputs from the intensity mapping exercise reflect these findings, with the greatest observed use of habitat by marsh harrier occurring closest to the breeding site at Minsmere North Levels and over areas of grazing marsh (Minsmere South Levels). Furthermore, for both the wetland (i.e. reedbed / fen and coastal grazing marsh combined) and arable habitats, the estimated flight activity intensity on the HVAs declines with increasing distance from the Minsmere nesting area, but with the flight activity intensity on wetland approximately twice that on arable for a given distance band. (The close proximity of individual nesting sites within the reedbed at Minsmere suggests that this is an aggregation / loose colony rather than birds with individual territories. As such, this is likely to mean that any of the birds present within the breeding area could make use of adjacent habitat for foraging and that there is a significant overlap of home ranges between birds (Ref. 8.93). Therefore, it is assumed that the loss of foraging habitat could affect all of the breeding birds at Minsmere equally; **Plate 8.11**).

8.8.222. The close proximity of individual nesting sites within the reedbed at Minsmere suggests that this is an aggregation / loose colony rather than birds with individual territories. As such, this is likely to mean that any of the birds present within the breeding area could make use of adjacent habitat for foraging and that there is a significant overlap of home ranges between birds (Ref. 8.93). Therefore, it is assumed that the loss of foraging habitat could affect all of the breeding birds at Minsmere equally.

Plate 8.11: The intensity of marsh harrier flight activity for HVAs on wetland and arable habitats in relation to distance from the Minsmere nesting area (HVAs are assigned to 1km distance bands, with mean values of flight activity intensity calculated for multiple HVAs within a distance band); the value for wetland for the 1 and 2km distance bands is combined and set at 1.5 because a single large HVA straddled these bands (i.e. HVA 3)



8.8.223. At Minsmere, wetland habitats, notably coastal grazing marsh, are likely to represent the main habitats used for foraging by marsh harrier. Birds are also likely to be utilising arable habitats where these provide suitable conditions for foraging (e.g. optimal vegetation structure and proximity to the breeding site). Based on the intensity of use analysis and published evidence, it is considered likely that habitats within 2km will represent the core foraging area, particularly as this area comprises the largest area of grazing marsh habitat in the vicinity of the breeding site.

8.8.224. Based on the worst-case scenarios for Phases 1 and 2, the calculations of the habitat areas potentially affected by disturbance (**Table 8.12**) show that a relatively small amount of wetland habitat (reedbed and grazing marsh) within 2km of the breeding site at Minsmere is assumed to be 'lost', along with approximately 40% of the agricultural land at this distance from the nesting area.

8.8.225. At 2 – 4km from Minsmere, the potential complete displacement of birds from Sizewell Marshes, as a result of an assumed barrier effect, gives rise to a relatively large 'loss' of available wetland foraging habitat within this distance band (equivalent to 56% of the total estimated wetland habitat between 2 -

4km from the nesting area). In total, the barrier effect could preclude marsh harrier from approximately 20% of all wetland habitat within 4km of the breeding site and 23% of all habitats likely to be utilised for foraging (i.e. inclusive of land under agricultural production).

8.8.226. Foraging ranges for marsh harrier are variable and are largely a function of habitat quality / prey availability in proximity to the breeding site. They may also vary through the breeding cycle (Ref. 8.90) and may from year to year, depending on the prey availability (Ref. 8.93). The effective loss of an area of habitat from within a foraging range may therefore vary in its potential consequences for breeding birds.

8.8.227. Displacement of breeding birds from foraging areas could affect breeding success and possibly also survival rates – e.g. if breeding birds are required to expend additional energy through travelling further or undertaking more foraging flights. If the area from which foraging birds are displaced represents an important component of the available foraging habitat for the breeding birds, then a reduction in breeding productivity could result because, as central-place foragers, the foraging range of breeding marsh harriers are constrained.

8.8.228. However, as a generalist predator, marsh harriers are able to exploit prey resources from a range of habitat types, including intensive agricultural habitats and, in this respect, it is considered to be less sensitive to habitat degradation than other, more specialist, raptor species (Ref. 8.86). In their study of marsh harrier breeding ecology within different levels of land-use intensification, Sternalski *et al*. (2013) (Ref. 6.84) found that although the four populations studied differed strongly in terms of breeding habitat and diet, there was virtually no consequences in terms of the total population productivity (i.e. numbers of fledglings per unit area of land). This finding suggests that, in certain situations at least, marsh harriers can adapt their foraging behaviour to take account of variation in habitat quality and prey availability without significantly affecting productivity.

8.8.229. The extent to which the above findings on the effects of variation in breeding habitat and diet apply to the situation at Minsmere is unclear, but it seems likely that the species is sufficiently adaptable to mean that the loss of areas of relatively low foraging value (e.g. agricultural land in intensive production) could be counteracted by an increase in foraging trips, changes in the home range to incorporate replacement habitat and / or selection of larger prey (if available) from existing habitats within the home range.

8.8.230. There are extensive areas of land in arable production in proximity to the Minsmere breeding site into which range expansion could be undertaken, and it seems unlikely that the availability of this relatively low-quality foraging habitat would be limiting. As documented by Cardador *et al*. 2009 (Ref. 8.93),

the home ranges of marsh harrier in landscapes dominated by intensive agriculture are significantly larger than those of harriers in less intensively managed landscapes, indicating some capacity, at least, for this species to adapt foraging ranges to meet the environmental circumstances. Furthermore, productivity may not necessarily differ significantly in relation to such differences in habitat types and, therefore, foraging regimes (Ref. 8.84, Ref. 6.85).

8.8.231. Therefore, it is considered likely that breeding marsh harriers at Minsmere would modify their foraging behaviour to use alternative areas of existing agricultural land and this would provide a buffer against potential displacement from the area of intensive agricultural land that occurs within the predicted existing foraging range and which may be affected by noise and/or visual disturbance (i.e. approximately 260ha – **Table 8.12**). Given this, only the potential 'loss' of the foraging resource from the wetland habitats has been considered in assessing potential impacts to breeding marsh harriers. However, calculations have also been undertaken to consider the foraging resource that is represented by the combined wetland and arable habitats from which foraging marsh harriers could theoretically be displaced (or excluded).

8.8.232. The potential loss of approximately 100ha of foraging habitats of higher quality (i.e. grazing marsh and reedbed), largely from Sizewell Marshes (which accounts for 78ha) and the southern parts of the Minsmere South Levels, is likely to be of greater significance to the breeding population. This is on the basis of the known habitat preferences of the species, the relative scarcity of these habitats in the wider landscape and (importantly) the recorded usage of these areas (albeit that this usage is lower than for the much of the remaining Minsmere South Levels, which are not predicted to be affected by noise and visual disturbance). Similar habitat types are rare outside of the coastal strip and within the likely foraging range of marsh harrier from Minsmere. Although there is no specific observational data, it is considered that the grazing marshes and wetland habitats along the Minsmere River, west of Eastbridge (i.e. at a similar distance to Sizewell Marshes from Minsmere) are already likely to be used by marsh harrier from Minsmere and, therefore, would be unlikely to act as a functional replacement for the 'loss' of the Sizewell Marshes.

8.8.233. The overall potential 'loss' of foraging resource amongst wetland habitats, however, would be less than the calculated extent of habitat area (*c.*20%) as shown in **Table 8.12**, due largely to the effect of distance from the breeding area on levels of flight activity (**Plate 8.11**). Thus, the usage by foraging marsh harriers of the areas that are predicted to be potentially 'lost' is estimated to be relatively low (as demonstrated by the flight activity analysis which estimates the use of Sizewell Marshes to be approximately 60% of that

for the Minsmere South Levels on average – **Table 6.7**, **Figure 6.3** to **Figure 6.5**).

8.8.234. To take account of this difference in usage with distance from the nesting area, the potential 'loss' of Sizewell Marshes with regard to the available foraging wetland resource has been calculated (**Table 8.13**). This is based on the total length of flight path divided by the number of hours of observation to determine a m/hr value (i.e. accounting for differences in survey effort but irrespective of the survey area). The resource usage of an area is then taken to reflect the flight distance over a certain area within a nominal period (in this instance one hour). The area of the individual units over which the observations have been made is not accounted for because, from a resource perspective, it is the total usage of the area in question which is of interest, as opposed to the intensity of this usage. Using this approach, it is calculated that 87.3% of the recorded marsh harrier flight activity occurred within the Minsmere South Levels HVA and 12.7% within the observed HVAs in Sizewell Marshes.

Table 8.13: Calculated percentage of overall observed flight path length (2014 to 2016 data combined) for individual HVAs with observation time normalised to VP (HVA) 3

VP/HVA	Flight Path Length	Hours Of Observation	Flight Path Length (m) / hr	% Of Total Flight Path Length m/hr
1	10264	140	73.3	4.6
2	11078	138	80.3	5.0
3	320094	228	1403.9	87.3
4	4309	113	38.2	2.4
6	1220	96	12.7	0.8

8.8.235. Similar flight path data are not available for areas of wetland habitat outside the observed HVAs that may be used for foraging within 4km of the breeding site. Therefore, the assumption has been made that the measured levels of foraging activity on the HVAs are representative of other wetland habitat at the same distance from the Minsmere breeding site. For unsurveyed wetland areas, the flight path distance per hectare per hour (as shown in **Table 6.7**) for the observed HVAs can be used to calculate representative flight path lengths for the total wetland resource within 1km bands from the Minsmere breeding site. As the HVA 3 for Minsmere South Levels straddles the 1 – 2km bands, the flight path length/ha/hr value for this HVA has been used to cover all wetland habitat up to 2km from Minsmere. This is considered to be a reasonable approach as the flight path value used is an average for

Minsmere South Levels, where it is apparent that there is considerable variation in the intensity of use across this area (**Figure 6.3** to **Figure 6.5**). The outputs from these calculations are presented in **Table 8.14.**

Table 8.14: Estimation of the wetland habitat flight path lengths for 1km radii from the marsh harrier breeding site at Minsmere that would be 'lost' as a result of the effects of disturbance; estimates are produced for both Phase 1 and 2 of construction

Distance From Minsmere	Area Of Wetland Habitat (ha)	HVAs Used To Calculate Usage	Applied Flight Path Length / Hr / Ha	Total Flight Path Length / Hr	Area (ha) Lost To Disturbance (Sizewell Marshes In Brackets)		Flight Path Length / Hr Lost (Sizewell Marshes In Brackets)	
					Ph1	Ph2	Ph1	Ph2
0-1km	150	3	10.3	1545	0	0	0	0
1-2km	194	3	10.3	1998	19 (0)	14 (0)	196 (0)	144 (0)
2-3km	84	1, 2, 6	7.04	591	53 (46)	53 (46)	373 (324)	373 (324)
3-4km	68	4	3.90	265	32 (32)	32 (32)	125 (125)	125 (125)
Total	496			4399	104 (78)	99 (78)	694 (449)	642 (449)

8.8.236. Based on extrapolation of the mean estimates of the intensity of flight activity from the 2014 - 2016 survey data, approximately 15% (i.e. 694 or 642 as a percentage of 4399) of the foraging resource available to marsh harriers within 4km of the Minsmere nesting area is estimated to be lost due to construction-related disturbance (**Table 8.14**). Sizewell Marshes alone (representing 78ha of wetland habitat within 4km of the nesting area) accounts for an estimated loss of 10% of this foraging resource.

8.8.237. If the arable habitat that is predicted to be 'lost' to foraging marsh harriers (i.e. as presented in **Table 8.12**) is incorporated with the wetland habitat, the extrapolation of the mean estimates of flight activity from the survey data give an estimate of a total flight path length of approximately 7,329 m/hr within 4km of the Minsmere nesting area (of which 2,930 m/hr is associated with arable habitat, as calculated using the flight activity estimates in **Table 6.8** and applying the same approach as for the wetland habitats). Approximately 759 - 761 m/hr of the estimated flight path length on arable habitats within 4km of the nesting area would theoretically be 'lost' as foraging resource (for

Phases 1 and 2 of the construction period, respectively). When combined with the wetland habitats this gives a total predicted 'loss' of 1,401 – 1,455 m/hr. The aggregated figure for wetlands plus arable loss equates to 19 - 20% of the foraging resource available to marsh harriers within 4km of the Minsmere nesting area.

Potential consequences of the loss of the foraging resource

8.8.238. The Minsmere-Walberswick SPA currently holds a breeding marsh harrier population of 17 pairs, with the reedbed complex at Minsmere supporting about 50% of the SPA population (**Table 6.6**). At a distance of over 7km from the reedbeds at Walberswick it is highly unlikely that the foraging ranges of marsh harrier from this part of the SPA would extend as far as the main development site. Therefore, potential effects of construction-related disturbance on this component of the SPA population are considered unlikely.

8.8.239. There is also the potential for functional linkage between the Minsmere-Walberswick SPA breeding population and the marsh harriers which breed at North Warren as seen in section 6.3 f of this report. However, the nesting area at North Warren is over 3km from the nearest areas of wetland habitat which occur within the 70dB L_{Amax} footprint or 150m potential visual impact zone. Therefore, it is unlikely that wetland habitat which is predicted to be affected by noise and visual disturbance from construction activities would be heavily used by the North Warren breeding birds. Furthermore, there is little (if any) potential for the main development site to act as a barrier to birds accessing the Sizewell Marshes from North Warren, given that this nesting area is to the south of the main development site.

8.8.240. However, as set out above, increased noise and visual disturbance associated with construction activities at the main development site may cause marsh harriers from the Minsmere nesting area to be displaced from parts of their existing foraging ranges. Given that there is likely to be significant overlap in the foraging ranges of birds breeding at Minsmere, this effective loss of habitat through displacement could affect all of the breeding population at Minsmere (i.e. approximately 50% of the SPA population).

8.8.241. Also as discussed above, marsh harriers show significant plasticity in foraging behaviour and can adapt to both changes in prey availability and habitat quality without showing marked reductions in breeding productivity. However, given the long-term duration (approximately 10 years) of the construction period, it is acknowledged that over this time period the potential loss of approximately 20% of wetland habitat (and an estimated 15% of the wetland foraging resource) within 4km of Minsmere could conceivably affect the overall breeding productivity.

8.8.242. It should be noted that a reduction in productivity does not necessarily translate into a reduction in population size, particularly for relatively long-lived species such as marsh harriers (which may have an average lifespan of 6 - 7 years[22]). However, given the duration of the construction period and the fact that young birds may otherwise recruit into the population (particularly as they often exhibit limited dispersal from the breeding areas - Ref. 8.90), then the potential exists for a reduction in the SPA population size to result from any reduction in breeding productivity.

8.8.243. In light of the above analysis, it is not possible to discount the possibility of an adverse effect on the marsh harrier population as a consequence of noise and visual disturbance from construction activities and, therefore, an adverse effect on the integrity of the Minsmere-Walberswick SPA cannot be excluded.

8.8.244. An adverse effect is not predicted to arise during the decommissioning phase given that the above affect would need to be compensated for in the construction phase[24], and this alternative habitat would be available for use during decommissioning and regularly used by marsh harrier rather than Sizewell Marshes for foraging.

Compensation for the potential effects of noise and visual disturbance on foraging marsh harriers

(i) Proposed compensatory measures – habitat improvement

8.8.245. The above conclusion on the potential for an adverse effect on integrity of the Minsmere-Walberswick SPA to arise is based upon estimation of the 'loss' of foraging resource, as derived from precautionary assumptions concerning the extent to which displacement and a barrier effect would operate to exclude marsh harriers from foraging habitat. Based on this estimate, habitat improvement measures have been proposed to compensate[25] for the predicted 'loss' of foraging resource.

8.8.246. To provide compensation, habitat management is currently being undertaken on a 48.7ha area of land which is immediately adjacent to the northern part of the Minsmere South Levels (**Figure 8.10**). This area was previously dominated by land intensively managed for crops, with many grown under plastic, and included a substantive area of acid rough grassland. The management measures being undertaken to increase prey availability for marsh harriers are detailed in Wood Environment & Infrastructure Solutions UK Ltd (2019) (Ref. 8.101).

[24] Without prejudice to the Secretary of State's determination with regard to Regulation 63(1) and Regulation 64(1) of the Habitats Regulations.
[25] As required under Regulation 68 of the Habitats Regulations. These measures are proposed without prejudice to the Secretary of State's decisions to be undertaken in accordance with Regulation 63(1) and Regulation 64(1) of the Habitats Regulations.

(ii) Extent to which the proposed measures can compensate for the 'lost' foraging resource

8.8.247. On the basis of the approach used in the assessment, approximately 100ha of grazing marsh and reedbed habitat (including 78ha at Sizewell Marshes) could become unavailable (through displacement and barrier effects) to marsh harrier.

8.8.248. As discussed above and set out in **Table 8.14**, it is estimated that 15% of the total wetland foraging resource within 4km of the Minsmere breeding site would be 'lost' (with the Sizewell Marshes alone accounting for 10% of this resource). Based on the averaged VP flight path length per hour, displacement of birds could equate to a loss of 642 – 694 m/hr of flight activity for the approximate 100ha of 'lost' wetland habitat (with Sizewell Marshes accounting for 449 m/hr of this flight activity).

8.8.249. In order to replace this function, the increase in marsh harrier flight activity on the compensation land would need to equate to a flight path length of 13 – 14 m/hr/ha (i.e. 642 or 694m of flight path length per hour across the 48.7ha area). The arable area in the vicinity of the compensation land currently provides an estimated resource of 5.3 m/ha/hr (as calculated from the average level of activity for the closest HVAs to the compensation area - i.e. A, C, D and E (**Table 6.8**). Therefore, provision of the additional 13 – 14 m/ha/hr required to fully replace the activity that is estimated to occur on habitat potentially 'lost' to disturbance effects would require the improved habitat to support an average flight activity level of 18 – 19 m/ha/hr.

8.8.250. This level of flight activity is greater than the average levels recorded on the Sizewell Marshes and the southern part of Minsmere South Levels (**Figure 6.3** to **Figure 6.5**). The recorded flight activity over the northern-central part of the Minsmere South Levels is substantially higher than that recorded over the Sizewell Marshes and the southern part of the Minsmere South Levels, with flight activity in this area tending to range from 15 – 50 m/hr/ha (**Figure 6.3** to **Figure 6.5)**. While this may in part reflect prey abundance and availability, the closer proximity of this part of the Minsmere South Levels to the reedbed breeding site is likely to be of critical importance in explaining the high usage (**Plate 8.11**). The close proximity of individual nesting sites within the reedbed at Minsmere suggests that this is an aggregation / loose colony rather than birds with individual territories. As such, this is likely to mean that any of the birds present within the breeding area could make use of adjacent habitat for foraging and that there is a significant overlap of home ranges between birds (Ref. 8.93). Therefore, it is assumed that the loss of foraging habitat could affect all of the breeding birds at Minsmere equally.

8.8.251. The proposed compensation land lies immediately adjacent to the northern part of the Minsmere South Levels and is, therefore, at a similar distance from the breeding site as this area.

8.8.252. Given this, it is considered highly likely that the compensation area would attract a greater level of usage than an equivalent area at the same distance from the Minsmere reedbed as the Sizewell Marshes or the southern part of the Minsmere South Levels. If the habitat management undertaken on the compensation land can deliver prey abundance and availability (via suitable vegetation structure) comparable to that on the Sizewell Marshes, then the proximity of the compensation land to the nesting area should enable it to deliver the necessary function (i.e. equivalent to the flight activity from the wetland habitat assumed to be 'lost' at Sizewell Marshes and elsewhere) and represent sufficient compensatory measures.

8.8.253. The above conclusion is based upon calculations which assume that displacement as a result of noise and visual disturbance and the barrier effect to Sizewell Marshes would operate at 100%. This is highly precautionary, particularly when considering that the predicted worst-case noise levels on which the assessment is based are likely to occur over a limited period only during both Phases 1 and 2, and that the extent of the 70dB L_{Amax} footprint is predicted to reduce from Phase 3 onwards. If displacement and (particularly) barrier effects operate at less than 100% then the overall functional replacement (and therefore compensation) requirement is also reduced. This is illustrated by the compensation requirement calculated (as flight path values in m/hr/ha) for a range of displacement/barrier effect values (**Table 8.15** – upper section). Similarly, the rate at which displacement and barrier effects operate interacts with the level of response in foraging activity by marsh harriers on the compensation area to affect the net loss or, under some scenarios, gain in the overall foraging resource that is available (**Table 8.15** – lower section).

8.8.254. In reality, it is difficult to determine at what point a potential foraging resource loss would translate into an absolute change in productivity and consequent population decline. However, given the plasticity that marsh harrier show in adapting their foraging range and behaviour to deal with changes in prey availability, it is considered that a small loss of wetland resource (less than 5%) would be unlikely to have an identifiable population impact.

8.8.255. As detailed above, the noise modelling for construction Phases 1, 2 and 5 shows encroachment of noise of 70dB L_{Amax} (or above) onto the western parts of the compensation area (**Figure 8.3**, **Figure 8.4** and **Figure 8.6**). This might be expected to reduce the potential for increased foraging activity by marsh harriers within this area (given that the basis for this assessment is that noise levels of 70dB L_{Amax}, or above, have the potential to displace harriers from foraging habitat). However, as described above, these

modelling outputs represent the worst-case predictions for the full duration of each phase and, as such, overestimate the length of time during which noise of these levels would arise. Modelling at finer temporal resolution (i.e. weeks or months) demonstrates that noise of 70dB L_{Amax} (or above) would be expected to encroach onto the compensation area for a relatively small number of weeks during each of these construction phases, with such encroachment predicted to affect relatively small areas (less than 5% of the compensation area in most, and less than 10% in all, instances). Therefore, noise from construction activities is expected to have little, if any, effect on the potential use of the compensation area by foraging marsh harriers.

Table 8.15: The effect of varying rates of displacement and barrier effect on the wetland habitats on (i) the required foraging activity response on the compensation area and (ii) the extent of foraging resource loss under variable foraging activity responses for the compensation area; for the purposes of these calculations, the values for flight path length on the compensation land and for the percentage of lost wetland foraging resource are taken as the mean of Phase 1 and 2 derived values

Compensation Land	Rate Of Displacement / Barrier Effect (%)					
	100	80	60	40	20	10
Required flight path length m/hr/ha to replace function of wetland resource	13.7	11.0	8.2	5.5	2.7	1.4
Total flight path length m/hr/ha inclusive of existing activity over compensation land (5.3 m/hr/ha)	19.0	17.1	14.1	11.2	8.2	6.8
Habitat Resource	**Rate Of Displacement / Barrier Effect (%)**					
	100	**80**	**60**	**40**	**20**	**10**
% of total wetland foraging resource lost assuming 0% increase in activity over compensation land	15.2	12.2	9.1	6.1	3.0	1.5
% of total wetland foraging resource lost assuming 50% increase in activity over compensation land	12.3	9.2	6.2	3.1	0.1	+1.4
% of total wetland foraging resource lost assuming 100% increase in activity over compensation land	9.3	6.3	3.2	0.2	+2.8	+4.3
% of total wetland foraging resource lost assuming 150% increase in activity over compensation land.	6.4	3.4	0.3	+2.7	+5.8	+7.3

8.8.256. As described above, it is only the potential 'loss' of the foraging resource from the wetland habitats that is considered in terms of assessing potential adverse effects on breeding marsh harriers from noise and visual disturbance during construction. This is because the relatively scarce wetland habitats of reedbed / fen and coastal grazing marsh provide the key foraging areas for the SPA breeding marsh harriers, whereas land in arable production is of relatively low value for foraging (**Plate 8.11**). The close proximity of individual nesting sites within the reedbed at Minsmere suggests that this is an aggregation / loose colony rather than birds with individual territories. As such, this is likely to mean that any of the birds present within the breeding area could make use of adjacent habitat for foraging and that there is a significant overlap of home ranges between birds (Ref. 8.93). Therefore, it is assumed that the loss of foraging habitat could affect all of the breeding birds at Minsmere equally and is widely available within the likely foraging range of the SPA breeding population (**Table 8.12**). Given the adaptability of marsh harriers in terms of their ability to exploit a range of prey resources and foraging habitats, it is considered likely that the SPA breeding marsh harriers would be able to counteract the predicted 'loss' of this low-quality foraging habitat via modifications in foraging behaviour (see above).

8.8.257. Notwithstanding these considerations, the foraging resource that is represented by the combined wetland and arable habitats from which foraging marsh harriers are assumed to be displaced (i.e. as presented in **Table 8.12**) represents 1401 to 1455 m/hr of flight activity (see above). In terms of the level of flight activity on the compensation land that would be required to replace this function, this equates to 29 – 30 m/hr/ha (i.e. 1401 or 1455m of flight path length per hour across the 48.7ha area). Therefore, direct replacement of the flight activity of wetland plus arable habitats potentially lost to disturbance effects would require the compensation land to support an average total flight activity level of 34 – 35 m/hr/ha, which is almost double that calculated to be required on the compensation land when considering the wetland habitats alone (at 18 – 19 m/hr/ha). This is close to, or above, the highest levels recorded during the baseline surveys, with such activity levels restricted to a relatively small area of the Minsmere South Levels (**Figure 6.3** to **Figure 6.5**). However, as outlined above, consideration of the low value of arable as a foraging habitat, its widespread availability and the adaptability of marsh harrier foraging behaviour, strongly suggests that incorporating arable habitats within the calculation of the foraging resource that is potentially required to be replaced is not warranted and produces estimates that are (highly) overly precautionary.

Conclusions on effects of noise and visual disturbance during construction

8.8.258. There is a high level of confidence that the habitat improvement measures proposed would be sufficient to compensate for the predicted 'loss' of the wetland foraging resource, on the basis that:

- The ongoing and planned habitat management on the compensation area is likely to increase both the abundance and availability of marsh harrier prey.
- The compensation area is located in close proximity to the Minsmere nesting area and is adjacent to those parts of the Minsmere South Levels which are most heavily used by foraging marsh harriers (and which are not predicted to be affected by noise and visual disturbance), so facilitating its use by the birds from the SPA population.

8.8.259. Based upon the known ecology of marsh harriers it is also considered that foraging birds would be able to counteract the potential 'loss' of the foraging resource on arable habitats, which is predicted to result from noise and visual disturbance. This is expected to occur via behavioural mechanisms, such as modifying foraging ranges to exploit alternative areas of arable habitat (which are widely available in the vicinity of Minsmere) or by increasing foraging effort.

8.8.260. In conclusion, the proposed habitat improvement measures are considered sufficient to compensate for the predicted effect on the marsh harrier population due to noise and visual disturbance during the construction phase.

Operation: Assessment of effects of noise and visual disturbance

8.8.261. As detailed above for breeding avocet, section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.262. The extent of artificial lighting associated with the operational period is also described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect the nesting areas used by the SPA marsh harrier population, whilst the species does not hunt at night. Therefore, no adverse effects on the SPA marsh harrier population are predicted as a consequence of noise and visual disturbance from operational activities.

vi. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.263. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, seen in section 8.8 b v of this report, also applies here.

8.8.264. As described above in section 8.8 d v of this report, marsh harriers using the Minsmere Walberswick SPA typically nest in reedbed / wetland vegetation and forage over reedbeds, coastal grazing marshes and agricultural land.

8.8.265. The main nesting areas within the SPA are the RSPB Minsmere Reserve, Hen Reedbed and Walberswick NNR (**Table 6.6**). As described in the assessment of recreational disturbance for bittern seen in section 8.8 c v of this report, these are all areas managed as nature reserves where access is restricted to established paths and where wildlife viewing facilities (hides etc.) are in place. Predicted increases in visitor numbers during the construction and decommissioning of Sizewell C are not considered likely to increase overall levels of recreational disturbance to habitats used by marsh harrier for nesting or foraging (including the proposed habitat compensation area described above), as visitors would be restricted to the existing path networks.

8.8.266. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding marsh harrier in the Minsmere-Walberswick SPA.

Operation

8.8.267. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA as seen in section 8.3 b vi of this report, also applies to breeding marsh harrier at the Minsmere-Walberswick SPA.

8.8.268. With a strategy in place to manage recreational use of areas within and around the EDF Energy Sizewell Estate, no adverse effects associated with increased recreational pressure are predicted on any qualifying feature of the Minsmere-Walberswick SPA, including breeding marsh harrier, either directly or indirectly via habitat change.

e) Breeding little tern, project alone

i. Alteration of coastal processes / sediment transport

8.8.269. As described above for Sandwich tern in relation to the Alde-Ore Estuary SPA as seen in section 8.3 b i of this report, and with reference to section 7.3 of this report, this effect refers to changes in coastal processes and sediment transport that may result from construction, operation and decommissioning of marine infrastructure associated with the main development site, namely the:

- construction discharge outfall;

- cooling water infrastructure (including cooling water intake and outfall headworks on the seabed, and the outfall associated with a FRR system);
- BLF to receive deliveries of AILs by sea throughout the power station's operational life; and
- flood defence and coastal protection measures.

8.8.270. Such changes could affect nesting, foraging and roosting habitats used by little tern during the breeding season, given their use of coastal and intertidal habitats, in particular coastal sand and shingle habitats; although the colony at the RSPB Minsmere reserve can use the coastal lagoon (or scrape) habitats for nesting, with these areas protected by the coastal sands and shingle habitats immediately to the east.

8.8.271. Based on supplementary advice from Natural England on the conservation objectives for the SPA as seen in section 6.3 f of this report, there were no nesting little terns at Minsmere in the six years up to 2018, with small numbers at Walberswick to the north of the SPA and further away from the main development site. In 2019, 10 pairs nested at Minsmere (RSPB, *unpublished data*).

8.8.272. The potential effects of increases in SSC associated with construction works are considered under water quality effects – marine environment, below.

Construction, operation and decommissioning

8.8.273. As noted above, historically, the coastline adjacent to the Sizewell power stations has been relatively stable.

8.8.274. Modelling results indicate that the construction of the main development site, including the construction discharge outfall, cooling water infrastructure, FRR system, BLF and flood defence and coastal protection measures, would not significantly affect coastal processes. Any impacts on sediment transport would be confined to coastline within 200m of the BLF in each direction, with negligible changes outside this area.

8.8.275. At the coast, the Minsmere-Walberswick SPA is situated adjacent to the northern boundary of the main development site. However, of the historical and current little tern colony locations within the Minsmere-Walberswick SPA, the Minsmere colony is the closest to the main development site and this colony is located on the coast 500 – 700m north of the Minsmere New Cut, making it a little over 1.5km from the main development site at its nearest point.

8.8.276. As minimal effects are predicted on the coastal processes and sediment transport as a result of the construction, operation and decommissioning of the main development site (where construction phase effects are taken to be a proxy), no changes are predicted in the extent of the supporting habitats of the qualifying features for which likely significant effect was identified.

8.8.277. Therefore, no adverse effects are predicted on the SPA breeding little tern population as a result of alteration to coastal processes or sediment transport during construction, operation or decommissioning.

ii. Water quality effects – marine environment

Introduction

8.8.278. The Minsmere-Walberswick SPA breeding little tern population would be subject to potential operational effects from thermal and chemical discharges which could affect the prey resource available to the population as seen in sections 8.3 b ii and 8.8 a of this report, in the same way as for the seabird qualifying features of the Alde-Ore Estuary SPA. In addition, discharges resulting from construction and (potentially) decommissioning activities at Sizewell C have also been screened in for assessment in relation to the Minsmere-Walberswick SPA breeding little tern population as seen in section 8.8 a of this report.

Construction and decommissioning

8.8.279. Discharges with the potential to have effects on the prey availability of SPA qualifying features are restricted to increases in SSC and hydrazine (during commissioning), with other sources (e.g. hazardous substances, metals, and BOD) predicted to remain within acceptable limits (e.g. as defined by annual load limits or EQS) (Ref. 8.1). Increases in SSC may arise as a result of the navigational dredging associated with the BLF and the removal by dredging of overlying soft sediment prior to installation of the CDO head, cooling water system intake and outfall headworks, and FRR outfall headworks. During cold flush testing (at commissioning), discharges of hydrazine may exceed the applied EQS concentrations.

8.8.280. The navigational channel and grounding area associated with the BLF occur in the nearshore zone, with the 20m wide channel and grounding surface likely to be profiled within the shallow subtidal zone (less than 6m water depth) by plough dredging. It is expected that the full dredge area would be reprofiled annually, with further, small scale maintenance dredging required at approximately monthly intervals (Ref. 6.1). The preparatory work for the installation of the headworks and connecting tunnels would occur within the shallow subtidal and relatively deep (more than 10m) subtidal zones. Full

details of the total dredge areas likely to be required are presented in BEEMS Technical Report TR483 (Ref. 8.1).

8.8.281. The predicted foraging ranges of the SPA little tern population show relatively small overlap with the maximum areas of the instantaneous plumes calculated for surface SSC above 100 mg/l for each of the different dredging activities, with the extent of overlap for any colony foraging range with any SSC plume being no greater than 6% (**Table 8.16**). Importantly, in tidally dominant systems the plume is also highly transient so that SSC returns to background concentrations within a few days (Ref. 7.1).

8.8.282. Any plumes associated with the decommissioning phase would be insignificant.

Table 8.16: Overlap of the predicted foraging ranges of SPA little terns breeding at the Minsmere and Dingle colonies with the maximum area of the plumes for instantaneous SSC above 100 mg/l for different construction dredging activities

Colony	Dredging Activity	Spring Tide		Neap Tide	
		Area (km^2)	%	Area (km^2)	%
Minsmere	Surficial sediments for cooling water intake	0.00	0	0.00	0
	Surficial sediments for FRR1	0.10	1	0.31	2
	BLF navigational channel	0.98	6	0.44	3
Dingle	Surficial sediments for CW intake	0.00	0	0.00	0
	Surficial sediments for FRR1	0.76	4	0.29	2
	BLF navigational channel	0.51	3	0.13	1

8.8.283. For the commissioning discharges of hydrazine, the resulting plume for levels above acute PNEC concentrations overlapped with the predicted foraging range of the Minsmere colony only. The peak instantaneous plume area encompasses 3.7% of the foraging range, whilst for the mean plume area the overlap is 0.18%. Additionally, the plume has a short duration, with concentrations exceeding the acute PNEC for periods of 0.5 to 4.5 hours only. Furthermore, the acute PNEC is considered to be highly precautionary, so that the extent of any effects on little tern prey availability is likely to be considerably smaller than indicated by this estimate (Ref. 8.1 and Ref. 8.102).

8.8.284. Based on the relatively small extent of overlap of the SPA little tern foraging ranges with the different predicted SSC plumes, and the commissioning discharge hydrazine plume, combined with the temporary and short-term duration of these plumes, no adverse effects on the Minsmere-Walberswick SPA little tern population are predicted as a consequence of construction (and decommissioning) related discharges.

Operation

Thermal discharges

8.8.285. For little tern, the thermal plumes associated with the 2°C and 3°C temperature uplifts are considered for May to August (as the period over which it is present as a breeding species in the SPA). Over this period, the areas encompassed at the sea surface by the existing 2°C and 3°C thermal plumes (for Sizewell B) extend to 16.7km^2 and 9.4km^2, respectively (whilst the equivalent plumes for Sizewell C, when considered alone, extend across 9.0km^2 and 2.5km^2, respectively). Incorporating the Sizewell C thermal plumes together with the Sizewell B plumes increases these areas to 36.9km^2 for the 2°C uplift and 15.3km^2 for the 3°C uplift (**Plate 8.12**).

8.8.286. As detailed in section 6.3 f of this report, numbers of breeding little terns at the Minsmere-Walberswick SPA have declined and, in recent years, breeding has been sporadic and has often involved relatively small numbers of pairs - but with higher numbers recorded in 2019 – see section 6.3 f of this report. For each of the two main breeding colonies within the SPA (Minsmere and Dingle), it is reasonable to assume that the main foraging areas for each of the colony populations would be defined by the area within 3.9km of the colony alongshore and 2.4km seawards as seen in section 6.3 a of this report (Ref. 6.43).

8.8.287. Based on the 98th percentile, the 2°C and 3°C thermal plumes for the combined effects of Sizewell B and Sizewell C encompass 61.5% and 41.3% of the foraging range of the Minsmere colony, respectively (**Plate 8.12**). This compares with overlaps of 48.9% (for the 2°C uplift) and 34.0% (for the 3°C uplift) for the existing thermal plumes that result from Sizewell B. For the Dingle colony foraging range, the equivalent percentage overlaps are 31.9% and 3.3% for the 2°C and 3°C uplifts, respectively, for the combined effects of Sizewell B and Sizewell C, and 11.7% and 0.1% for the 2°C and 3°C uplifts, respectively, for the existing thermal plumes resulting from Sizewell B.

8.8.288. For the combined effects of Sizewell B and Sizewell C, the instantaneous plumes (as calculated at hourly intervals from May to August), encompass a maximum of 57.3% (at any one point in time) and an average of 18.4% of the Minsmere little tern colony foraging range for the 2°C uplift, and a maximum of 39.0% and average of 7.4% for the 3°C uplift. This compares with

maximum and average overlaps between the existing Sizewell B plume and the foraging range of the Minsmere colony of 44.3% and 11.0%, respectively, for the 2°C uplift, and of 34.7% and 5.4%, respectively, for the 3°C uplift.

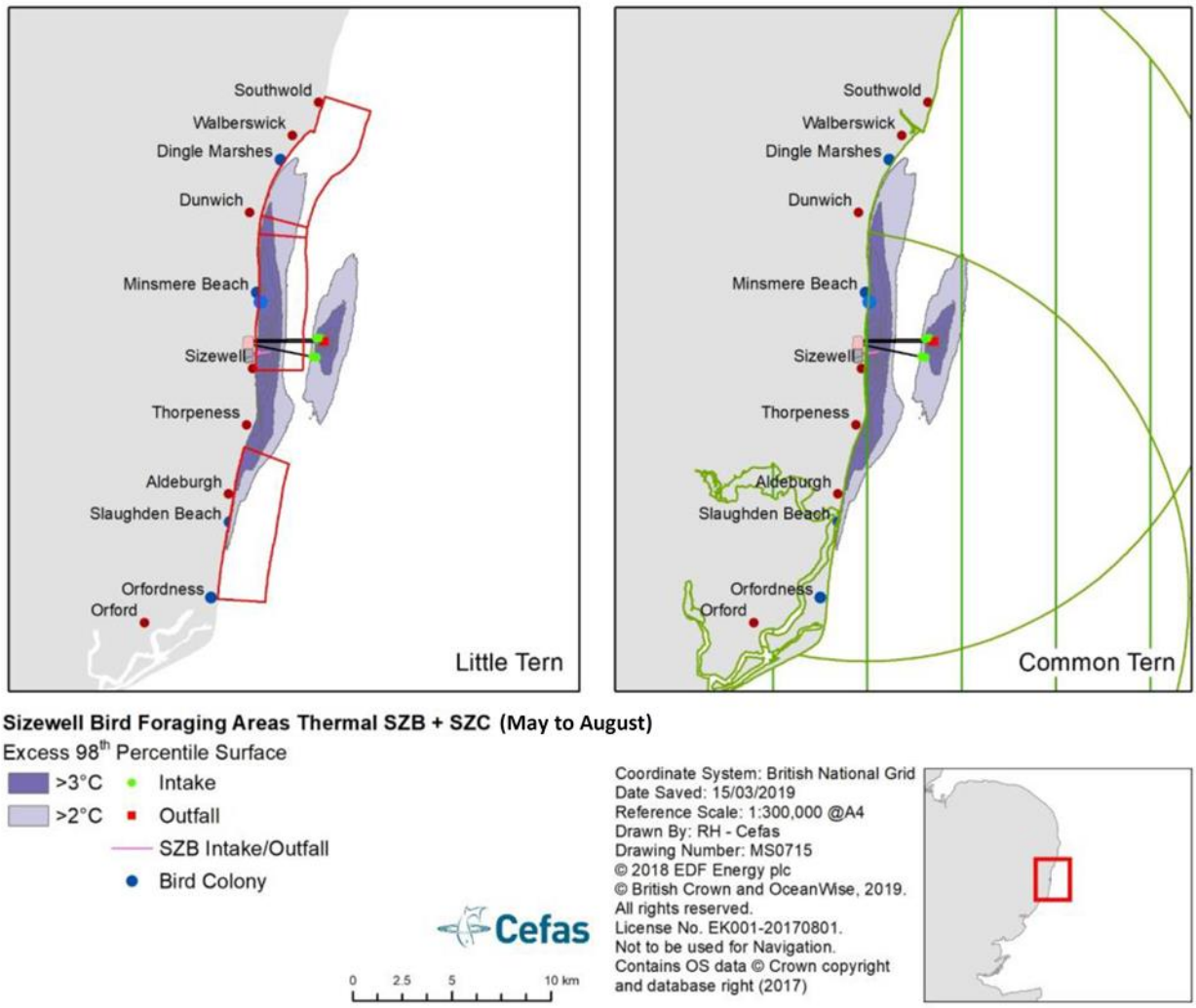
8.8.289. For the combined effects of Sizewell B and Sizewell C, the instantaneous plumes (as calculated at hourly intervals from May to August), encompass a maximum of 37.1% (at any one point in time) and an average of 3.3% of the Dingle little tern colony foraging range for the 2°C uplift, and a maximum of 8.5% and average of 0.2% for the 3°C uplift. This compares with maximum and average overlaps between the existing Sizewell B plume and the Dingle colony foraging range of 18.2% and 0.9%, respectively, for the 2°C uplift, and of 5.1% and 0.05%, respectively, for the 3°C uplift.

8.8.290. The project-specific survey data relating to the foraging activity of little terns within the vicinity of the Minsmere and Dingle colonies and elsewhere on the Sizewell coast show that the birds actively forage within areas encompassed by the existing 2°C thermal plume associated with Sizewell B (**Plate 6.6** to **Plate 6.9**).

8.8.291. Based on the above, it is clear that the existing 2°C thermal plume associated with the thermal discharges from Sizewell B currently encompasses substantial parts of the likely foraging ranges of the SPA little tern population, particularly for those birds nesting at the Minsmere colony. The thermal discharges which would arise from Sizewell C are predicted to increase the extent of overlap between the foraging ranges and the 2°C thermal plume, with this increase most marked for the Dingle colony foraging range. Overall, the discharges from Sizewell C are estimated to increase the overlap of the 2°C thermal plume (as determined by the 98th percentiles) with the combined foraging ranges of these two main SPA colonies from approximately 30% under existing conditions to approximately 47% (noting that there is a small area of overlap in the foraging ranges of the two colonies – **Plate 8.12**).

8.8.292. Over the course of the breeding period, the extent of overlap between the instantaneous 2°C thermal plume for Sizewell B with Sizewell C and the foraging ranges averages 18.4% for the Minsmere colony and 3.3% for the Dingle colony, with these percentages representing modest increases relative to the average overlaps with the existing 2°C plume associated with Sizewell B. Furthermore, for the reasons given in section 8.3 b ii of this report above, it is considered that the 2°C uplift is likely to represent an overly precautionary threshold. The 3°C uplift indicates considerably less overlap with the little tern foraging ranges and smaller absolute increases relative to the existing, baseline, conditions. Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of thermal discharges during the operational period.

Plate 8.12: The 2°C and 3°C uplifts (as a 98th percentile) for sea surface temperatures for Sizewell B together with Sizewell C for May to August, in relation to the breeding colony locations and predicted foraging ranges for little tern associated with the Alde-Ore Estuary, Minsmere-Walberswick and Outer Thames Estuary SPAs and for common tern associated with the Outer Thames Estuary SPA



Chemical discharges

8.8.293. There is no overlap of the predicted foraging ranges of the SPA breeding little tern population with the Sizewell C plumes (for the defined thresholds) for total residual oxidant, bromoform or hydrazine (**Plate 8.3,**

8.8.294. **Plate** 8.4 and **Plate 8.5**). Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of chemical discharges during the operational period.

iii. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.295. The assessment reported above for avocet, provided in section 8.8 b i of this report is also applicable to breeding little tern.

8.8.296. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of water quality in the terrestrial environment, during the construction, operational or decommissioning phase, and therefore no effect on the SPA qualifying features, including breeding little tern.

iv. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.297. As above, the assessment reported above for avocet, provided in section 8.8 b ii of this report is also applicable to breeding little tern.

8.8.298. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of local hydrology and hydrogeology, during the construction, operational or decommissioning phase, and therefore no effect on the SPA qualifying features, including breeding little tern.

v. Changes in air quality

8.8.299. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.8.300. The assessment reported above for avocet is also applicable to little tern.

8.8.301. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to air quality effects during the construction phase, and therefore no effect on the SPA qualifying features, including breeding little tern.

Operation

8.8.302. Again, the assessment reported above for avocet is also applicable to little tern.

8.8.303. The assessment of air quality (combustion) effects during operation concluded that there would be no adverse effect on the integrity of the SAC qualifying habitats and Ramsar habitats. As these habitats underpin the presence of SPA qualifying bird species, it is concluded that there would be no adverse effect on any SPA qualifying feature due to changes in air quality during the operational phase, including on breeding little tern.

vi. Disturbance effects on species populations

Construction and decommissioning

Disturbance at the colony

8.8.304. As noted above, of the historical and current little tern colony locations within the Minsmere-Walberswick SPA, the Minsmere colony is the closest to the main development site. This colony on the scrape is located 500 – 700m north of the Minsmere New Cut, making it a little over 1.5km from the main development site at its nearest point. Peak noise levels from construction activities are predicted to remain close to or below 54dB L_{Amax} at this location, which is considerably beyond the potential visual impact zone (**Figure 8.3** to **Figure 8.7**). As such, noise and visual disturbance from construction activities are unlikely to affect any nesting little terns when they are present at this colony, or indeed at any other historical or current colony locations within the SPA. This conclusion is also assumed to apply to the decommissioning phase.

8.8.305. It is considered likely that little terns nesting at the North Warren colony are functionally linked to those which nest within the Minsmere-Walberswick SPA (Ref. 6.66). Therefore, effects on the SPA population could conceivably arise through effects on birds nesting at North Warren. However, this colony is over 1.5km from the main development site at its nearest point and also outside the footprints of the 64dB L_{Amax} noise contours for all phases of construction and of the potential visual impact zone (**Figure 8.3** to **Figure 8.7**).

8.8.306. Given the above, no adverse effects on the SPA breeding little tern population are predicted as a consequence of noise and visual disturbance affecting birds when they are present at the breeding colony.

Disturbance effects in the marine environment

8.8.307. The SPA little tern population could also be affected by noise and visual disturbance when away from the nesting colony and foraging in the marine

environment. Such effects could occur as a result of direct disturbance to the birds themselves from increased vessel traffic or indirectly as a result of the effects of underwater noise on the fish prey species of little tern.

(i) Direct disturbance from vessel traffic

8.8.308. Delivery of rock armour and AILs by barges would cause increased vessel movements within the waters around Sizewell. The construction and installation of the cooling water intake and outfall headworks and construction of the BLF (including the navigational channel) would also be sources of underwater noise, which may affect the fish prey of little terns. Artificial lighting would be used at the BLF but this would be highly localised in its effects and, as little tern do not generally forage during the nocturnal period (Ref. 8.103, Ref. 8.104), is unlikely to affect foraging behaviour.

8.8.309. During the construction period, it is expected that there would be approximately 180 AIL deliveries to the BLF, most of which would occur between 31st March to 31st October and encompass the little tern breeding period (Ref. 8.1). This is likely to represent (at most) just over two vessel movements on average per day during the little tern breeding period (given that one delivery would require vessel movements both to and from the BLF).

8.8.310. Existing marine traffic in the waters adjacent to the main development site (out to 12nm) include various types of vessels, with the most frequent being cargo, recreational, fishing and wind farm support vessels. During surveys in the summer months an average of 72 vessels were observed per day (Ref. 8.105). Although this overestimates the numbers of vessels occurring within the little tern foraging range - because this is likely to extend to only 2.4km offshore – as provided in section 6.3 a of this report (Ref. 6.43), there is clearly existing vessel traffic within the waters around Sizewell and the increase would represent only a small number of additional daily movements. Furthermore, little terns foraging offshore are considered to be relatively insensitive to sources of anthropogenic disturbance, such as vessel traffic (Ref. 8.104).

(ii) Indirect effects via effects on prey species

8.8.311. Effects of underwater noise on the fish prey species of little tern could include direct mortality, recoverable injury, temporary threshold shifts (TTS)[26] or behavioural responses that could conceivably lead to temporary displacement (Ref. 8.106). The first two types of response are considered both in terms of the instantaneous and cumulative exposure to the noise

[26]Temporary hearing impairment, applicable to fish with swim bladders (which includes the main likely prey types of little tern in waters around Sizewell) and defined as any change in hearing of 6 dB or greater that persists at distances of 2 m to 100 m (Ref. 8.107).

source, whilst TTS is considered only in relation to cumulative exposure and behavioural responses only in relation to instantaneous exposure. The period for cumulative exposure has been defined as 24 hours (Ref. 8.106).

8.8.312. The criteria and thresholds used to define the different effects on fish vary according to the extent to which fish can detect sound, with three categories of fish identified in this regard. In decreasing order of susceptibility to the effects of underwater noise these are: fish with a swim bladder involved in hearing, fish with a swim bladder not involved in hearing and fish with no swim bladder (Ref. 8.107). The former category includes the main likely prey types (clupeids) of the Minsmere-Walberswick SPA little tern population as seen in section 6.3 f of this report.

8.8.313. The noise level thresholds that have been applied for mortality increase across these three categories of fish (from most to least susceptible). However, for recoverable injury, the thresholds are equivalent for the two categories of fish with a swim bladder but are higher for those with no swim bladder, whilst for TTS they are equivalent across all three categories of fish (Ref. 8.106). Equivalent quantitative thresholds have not been established for behavioural responses of fish to underwater noise but, based upon an assessment of the potential for behavioural responses, single-pulse sound exposure levels considered sufficient to cause startle responses have been determined for fish with a swim bladder involved in hearing and for fish with no swim bladder, with this level being lower in the former category (Ref. 8.106).

8.8.314. For all underwater noise impacts described below, the predicted effects are based upon the criteria and thresholds considered applicable to fish with a swim bladder involved in hearing (i.e. those most sensitive to the effects of underwater noise).

8.8.315. Of these, unexploded ordnance (UXO) clearance (by underwater detonation) has the potential to generate the greatest instantaneous impacts in terms of underwater noise (Ref. 8.106). However, at the time of writing it has not been confirmed if any UXOs are present in the vicinity of the site. Further assessments would be conducted (based on the size and number of the UXO devices to be detonated) should UXO detonations be required.

8.8.316. Amongst the remaining noise sources, drilling for the cooling water intakes and outfalls is predicted to cause effects which extend to within 25m of source only (**Table 8.11**). The greatest extent of instantaneous impacts would arise as a result of impact piling for the BLF, with the worst-case hammer energy indicating behavioural responses over an area of 9.68km^2 (although the predicted area of effect for the expected hammer energy is considerably smaller). Noise levels sufficient to cause recoverable injury or mortality as a

result of impact piling for the BLF would extend over relatively small areas only (**Table 8.11**).

Table 8.17: Effect of underwater noise from construction activities on fish prey of little tern, and overlap of response area with the predicted foraging area of little terns from the Minsmere colony[1]

Activity	Fish Response[2]	Worst-Case Fish Auditory Impact Areas (ha) And Maximum Ranges (m) For Different Exposures		Overlap With Foraging Range[3,4] (%)
		Instantaneous	Cumulative (24 h)	
Impact piling for BLF for likely hammer strike energy scenario (90kJ)	Mortality	17m	1ha 70m	Less than 0.1
	Recoverable injury	17m	3ha 111m	0.2
	TTS	N/A	46ha 556m	2.5
	Behaviour	525ha 2,111m	N/A	29.1
Impact piling for BLF for worst-case hammer strike energy scenario (200kJ)	Mortality	27m	2ha 111m	0.1
	Recoverable injury	27m	4ha 158m	0.2
	TTS	N/A	88ha 821m	4.9
	Behaviour	968ha 2,856m	N/A	46.5
Drilling (cooling water intakes and outfalls)	Mortality	No effect	Less than 0.25ha Less than 25m	Less than 0.1
	Recoverable injury	No effect	Less than 0.25ha Less than 25m	Less than 0.1
	TTS	N/A	Less than 0.25ha Less than 25m	Less than 0.1
	Behaviour	Less than 25m	N/A	-
	Mortality	No effect	2ha	0.1

Activity	Fish Response[2]	Worst-Case Fish Auditory Impact Areas (ha) And Maximum Ranges (m) For Different Exposures		Overlap With Foraging Range[3,4] (%)
		Instantaneous	Cumulative (24 h)	
Dredging - BLF construction	Recoverable injury	No effect	6ha	0.3
	TTS	N/A	435ha 1,843m	24.0
	Behaviour	682ha 2,352m	N/A	37.1
Dredging – cumulative[5]	Mortality	No effect	2ha	0.1
	Recoverable injury	No effect	7ha	0.3
	TTS	N/A	939ha	Less than 40.0
	Behaviour	2,131ha	N/A	43.3

[1]Data derived from BEEMS Technical Report TR312 (Ref. 8.106).

[2]TTS is considered in relation to cumulative exposure only and behavioural responses are considered in relation to instantaneous responses only.

[3]Estimates in relation to instantaneous or cumulative exposure, according to which present areas of effect.

[4]Foraging range as estimated by Parsons *et al.* (2015) (Ref. 6.43).

[5]The cumulative scenario assumes that dredging for the BLF construction coincides with dredging for the south cooling water intake (see text). The percentage overlap with the predicted little tern foraging range is not based upon the total auditory impact area because a proportion of the impact area resulting from dredging for the south cooling water intake is outwith the foraging range.

8.8.317. Dredging would occur for the purposes of construction and maintenance of the BLF, and for the construction of the CDO, FRR and the cooling water intakes (north and south) and outfall headworks. The assumed period of continuous exposure for these different dredging activities varies from seven hours over the 24-hour assessment period for the cooling water outfall to the full 24 hours for the BLF construction. These activities would not all occur simultaneously, with the BLF construction likely to be earlier in the construction programme than the activities associated with works associated with the intakes and outfalls. Dredging is anticipated to extend over two days for the BLF construction and 9.5 hours each for the CDO and FRRs. The monthly dredging which may be required for maintenance of the navigable channel near the BLF is anticipated to be of five hours duration (Ref. 8.106).

8.8.318. Mortality and recoverable injury as a result of noise from dredging are predicted to occur over small areas only, with the largest effects from any

single dredging activity (i.e. BLF construction) extending over 0.02km^2 and 0.06km^2, respectively (**Table 8.11**). Considerably smaller areas of effect (50% or less) for mortality and recoverable injury are predicted for each of the other dredging activities (Ref. 8.106). TTS is predicted to occur over larger areas, with dredging for BLF construction again associated with the greatest extent of effect (i.e. 4.35km^2 - **Table 8.11**). Other dredging activities are predicted to result in TTS effects that extend over areas from 0.69km^2 to 3.00km^2 (Ref. 8.106). By contrast, the areas over which instantaneous behavioural responses are predicted to extend are greatest for dredging associated with the intakes and outfall (at 11.56km^2 to 11.91km^2), with each of the remaining dredging activities predicted to cause behavioural responses across an area of similar size to that resulting from dredging for the BLF construction - Ref. 8.106, **Table 8.11**).

Based on what is considered to be a hypothetical worst-case for different dredging activities being undertaken simultaneously, underwater noise effects are also presented for dredging for the BLF construction together with dredging for the south cooling water intake (Ref. 8.106). Under this scenario, the areas over which mortality and recoverable injury are predicted to occur remain small (at 0.02km^2 and 0.07km^2, respectively), whilst TTS is predicted to extend across 9.39km^2 and behavioural responses across 21.31km^2 (**Table 8.11**).

8.8.319. The areas over which the effects of underwater noise on fish are predicted to occur overlap with the predicted foraging range of the little terns from the SPA colony at Minsmere but not with the foraging range of the SPA colony at Dingle (Ref. 8.1). For behavioural responses (resulting mainly from piling and dredging) and TTS (resulting from dredging mainly), the extent of overlap with the foraging range of the Minsmere birds is substantial (**Table 8.11**). However, mortality and recoverable injury of fish as a result of these activities are predicted to extend across small areas only, comprising a small part of the predicted foraging range of little tern from the SPA colony at Minsmere (less than 0.5% in each case).

8.8.320. Behavioural responses of fish (which could range from startle responses to displacement) only have the potential to temporarily affect prey availability to the SPA little tern population, with any reduction in prey availability within the affected area expected to be limited to the duration of the activity. It is unclear exactly how TTS might act to affect the availability of little tern prey. The extent of the duration and magnitude of TTS experienced by the affected fish may be variable, whilst fish experiencing TTS may have reduced fitness (including decreased ability to detect predators) (Ref. 8.107).

8.8.321. Impact piling for the BLF would involve a total of 12 piles only, with each pile being drilled in less than an hour and only five piles within a 24-hour period. Therefore, reductions in prey availability due to impact piling would extend

over a period of a few days only. Dredging for the BLF construction is considered (on a precautionary basis) to require continuous activity over the 24-hour period and is anticipated to take just over two days to complete. The dredging for other purposes would require continuous activity over considerably shorter periods of time (generally seven to ten hours - Ref. 8.106).

(iii) Conclusions on disturbance effects in the marine environment during construction and decommissioning

8.8.322. In relation to direct effects, increases in vessel traffic associated with the delivery of material to the BLF would represent only small increases in daily vessel movements within the waters around Sizewell, and little terns foraging offshore are considered to be relatively insensitive to such sources of anthropogenic disturbance.

8.8.323. In relation to the indirect effects of disturbance, underwater noise resulting from the proposed impact piling and dredging are predicted to cause TTS and behavioural responses in fish which may extend across relatively large parts of the predicted foraging range of little terns from the SPA colony at Minsmere. However, these effects would be temporary and the piling and dredging activities would also be of relatively short duration, with each activity being undertaken over a small number of days at most. In addition, mortality or recoverable injury of fish as a result of underwater noise would occur within very small parts of the little tern foraging range only.

8.8.324. On this basis, no adverse effects on the SPA breeding little tern population are predicted during construction (or decommissioning) as a consequence of noise and visual disturbance affecting birds from the SPA colonies when they are present within the marine environment.

Operation

8.8.325. As detailed above for breeding avocet, seen in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting. The levels of underwater noise predicted to be generated with Sizewell C and Sizewell B operational, are not expected to differ markedly from current baseline levels resulting from the operation of Sizewell B alone (Ref. 8.106).

8.8.326. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect the nesting areas used by the SPA little tern population.

8.8.327. Therefore, no adverse effects on the SPA little tern population are predicted as a consequence of noise and visual disturbance from operational activities.

vii. Disturbance due to increase in recreational pressure

Construction and decommissioning

Disturbance at the colony

8.8.328. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, provided in section 8.8 b v of this report, also applies here.

8.8.329. As described above, the number of little terns breeding within the Minsmere-Walberswick SPA has declined since classification (**Table 6.5**). A restore target has been set for a breeding population above 32 pairs (Ref. 6.66).

8.8.330. Historically, within Minsmere-Walberswick SPA, little tern breeding colonies have been located at Walberswick, Dingle, Dunwich Beach and Minsmere, using shingle beach habitats as well as islands in the Minsmere scrapes (managed saline lagoons 'scraped' out of coastal grazing marsh). During the period 2014-2018 breeding colonies were located on the Walberswick NNR and, in 2019, on the scrapes at the Minsmere RSPB reserve (RSPB, *unpublished data*).

8.8.331. Little tern breeding colonies on the Suffolk and Norfolk coast are part of a metapopulation which moves between colonies, depending on the availability of suitable nesting habitat and the abundance of food, thus numbers in a given area will fluctuate from year to year. The decline at Minsmere-Walberswick SPA coincides with increases at colonies in the Benacre to Easton Bavents SPA, and Kessingland, to the north; as well as North Warren within the Sandlings SPA to the south (Ref. 6.66). Levels of recreational disturbance affect the suitability of habitat for nesting.

8.8.332. Beach habitats used by little terns for nesting are vulnerable to trampling due to visitor pressure (including off-road vehicles and bikes) and recreational access during the breeding season may disturb and displace nesting birds. The site improvement plan for the Minsmere-Walberswick SPA (Ref. 8.108) identifies little tern as a feature affected by public access / disturbance to the shingle areas used for nesting. An investigation into public access and disturbance levels is recommended by the site improvement plan, as well as beach wardening.

8.8.333. Much of the SPA is managed directly for nature conservation, with reserves managed by Natural England, RSPB and SWT. Within these areas access to sensitive habitats – such as the scrapes within the RSPB Minsmere

reserve – is managed and controlled. While beaches are particularly popular areas for visitor access as seen in **Appendix E** of this report, management measures are in place to protect little terns. Since 2014, the little tern recovery project (Ref. 6.86[27]), has operated in this area to protect colonies from disturbance by people and predators, as well as monitoring numbers and breeding success.

8.8.334. Subject to the continuation of existing management measures to protect nesting little terns, increase in recreational pressure during the construction and decommissioning of Sizewell C is not predicted to adversely affect the ability to achieve the conservation objectives for breeding little tern within the Minsmere-Walberswick SPA, either directly or indirectly via habitat change.

Disturbance in the marine environment

8.8.335. As described above in section 6.3 f of this report, little terns forage over water, in brackish lagoons and saltmarsh creeks, and in marine areas from the advancing tideline up to 6km offshore. The mean maximum foraging extent from breeding colonies in the SPA is estimated as 3.9km alongshore and up to 2.4km seawards from a colony, based on surveys of foraging little terns at a range of colonies around the UK coastline.

8.8.336. The assessment of potential displacement of visitors during the construction of the Sizewell C Project, summarised in section 8.3 b vi of this report and full details in **Appendix E** of this report, considered visitors using terrestrial/coastal footpaths in the vicinity of the proposed development. Such visitors would not be expected to relocate to marine areas used by foraging terns (and indeed none of the survey respondents identified a potential marine location as a relocation area).

8.8.337. Displacement of visitors from terrestrial/coastal footpaths to other terrestrial/coastal footpaths potentially could result in increased disturbance to little terns foraging in coastal lagoons within the Minsmere-Walberswick SPA. However, as described above, such habitats are confined to the scrapes of the RSPB Minsmere reserve where access is managed to protect recreational disturbance to habitats and birds.

8.8.338. Little terns feeding in marine areas close to shore potentially could be disturbed by increased recreational disturbance to shingle beach areas in the Minsmere-Walberswick SPA. Overall increased visitor numbers at these locations are predicted to be between 1.3-6.7% - based on the nearest access locations, **Appendix E** of this report, **Table 4.1**, Access points H 1.3-4%, L 3.3-10.6% and Q 2.4-6.7%.

[27] https://littleternproject.org.uk/

8.8.339. Offshore foraging areas used by little terns as recorded in project specific surveys from coastal VPs are described in section 6.3 of this report (see **Plates 6.6, 6.7** and **6.8**). In all years foraging was reported to take place between 500-700m from shore, with peaks of up to 150 birds foraging or loafing on shingle beach areas in June and July in some years.

8.8.340. While it is possible that recreational use of shingle beaches might cause some disturbance to little terns foraging close to the shoreline, or birds loafing on beaches, it is considered that any disturbed birds would be able to relocate to alternative and undisturbed foraging or loafing habitats nearby without adverse effects.

8.8.341. As foraging takes place over water, no indirect effects of increase of recreational use of shingle beaches on foraging habitats are predicted.

8.8.342. Therefore, no adverse effects associated with increased recreational pressure during the construction or decommissioning phases are predicted for breeding little tern using marine habitats associated with the Minsmere-Walberswick SPA, or loafing areas away from nesting colonies, either directly or indirectly via habitat change.

Operation

Disturbance at breeding sites and in the marine environment

8.8.343. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, seen in section 8.3 b vi of this report, also applies to breeding little tern at the Minsmere Walberswick SPA.

8.8.344. As described above, subject to continuation of existing management measures for breeding sites, potential increases in recreational pressure during the construction (and decommissioning) of Sizewell C were not predicted to cause direct or indirect adverse effects on little terns at breeding sites or coastal/offshore foraging sites through direct disturbance. If the changes in visitor numbers predicted during construction continue into the operational phase, then no direct or indirect adverse effect would be predicted during this phase also. In this context it is noted that the size of the workforce at Sizewell C would be less during operation than construction, so that predicted recreational use of European sites by the operational workforce would also be less.

8.8.345. Thus, subject to continuation of existing management measures for breeding sites, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding little tern using the Minsmere-Walberswick SPA.

viii. Physical interaction between species and project infrastructure

Operation

8.8.346. As described in section 8.3 b vii of this report, during the operation of Sizewell C, populations of the fish and marine invertebrate prey of little terns may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

8.8.347. Information on the foraging behaviour and diet of little terns is provided above. Given that the Minsmere-Walberswick SPA is adjacent to (and north) of Sizewell C at the nearest point, even with a restricted foraging range (mean maximum of 3.9km alongshore and 2.4km seawards of breeding colonies), little terns nesting within the Minsmere-Walberswick SPA may forage offshore in the vicinity of Sizewell C.

8.8.348. The most important fish prey for little tern in the southern North Sea are herring and sprat. As described above in the assessment for Sandwich tern in the Alde-Ore Estuary SPA, provided in section 8.3 b vii of this report, combined impingement and entrainment mortality of herring and sprat is estimated at less than 1% of the relevant SSB and, consequently, impacts on these fish species, at the scale of the SSB populations and on local populations, are predicted to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

8.8.349. The likely effects of entrainment and impingement on marine invertebrates were assessed as negligible.

8.8.350. Impingement and entrainment of prey, therefore, is not predicted to result in depletion of prey resources for little terns breeding at the Minsmere-Walberswick SPA, and an adverse effect on the SPA conservation objectives for this species is not predicted as a consequence of physical interaction with project infrastructure.

f) Breeding gadwall, project alone

i. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.351. The assessment reported above for avocet, as provided in section 8.8 b i of this report, is also applicable to breeding gadwall.

8.8.352. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment, during the construction, operational or

decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding gadwall.

ii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.353. Again, the assessment reported above for avocet, provided in section 8.8 b ii of this report, is also applicable to breeding gadwall.

8.8.354. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of local hydrology and hydrogeology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding gadwall.

iii. Changes in air quality

Construction, operation and decommissioning

8.8.355. The assessment reported above for avocet, seen in section 8.8 b iii of this report, is also applicable to gadwall during the breeding season.

8.8.356. There is no likelihood of an adverse effect occurring on the conservation objectives for the qualifying feature breeding gadwall.

iv. Disturbance effects on species populations

Construction and decommissioning

8.8.357. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above in the section on breeding avocet and is taken to apply to breeding gadwall as well, as seen in section 8.8 b iv of this report. As for breeding avocet, the construction works associated with the water storage area in the northeast of the main development site are not predicted to affect the SPA breeding gadwall population because they would be limited to the first winter of the construction period only.

8.8.358. On the basis of the evidence detailed in section 8.8 b iv of this report, it is considered unlikely that noise and visual disturbance from the construction of the Sizewell C Project would affect gadwall, which breed within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable gadwall habitat[21] – **Figure 8.7**), whilst peak noise levels within the SPA (again excepting the south-eastern extremity) during the construction of the main development site are predicted to remain below the 64dB L_{Amax} threshold which is applied to breeding

waterbirds, as seen in section 8.8 b iv of this report, **Figure 8.3** to **Figure 8.6**)[28].

8.8.359. However, gadwall also breed within the Minsmere South Levels and Sizewell Marshes (**Table 6.9**), and the birds using these areas may be functionally linked to the SPA population. Both the potential visual impact zone and the 64dB L_{Amax} noise contour for Phase 1 of the construction period (i.e. the worst-case construction phase) encroach onto these areas, with 0.81km^2 and 0.99km^2 of the Minsmere South Levels and Sizewell Marshes, respectively, encompassed by their combined footprints (**Figure 8.8**, **Table 8.18**). Thus, the potential exists for impacts to arise on the SPA breeding gadwall population as a result of noise and visual disturbance to birds breeding on the Minsmere South Levels and Sizewell Marshes.

Table 8.18: The extent of encroachment of the 64dB L_{Amax} contour (for Phase 1 of the construction period) and potential visual impact zone onto the Minsmere-Walberswick SPA, Minsmere South Levels and Sizewell Marshes

Site	Area (km^2) Within:		
	64dB L_{Amax} Noise Contour	Visual Impact Zone	64dB L_{Amax} Noise Contour, Visual Impact Zone Or Both
Minsmere-Walberswick SPA	0.21	0.10	0.21
Minsmere South Levels	0.81	0.25	0.81
Sizewell Marshes	0.99	0.64	0.99

8.8.360. The current SPA population is estimated to be 84 breeding pairs (**Table 6.5**). If this estimate is assumed to refer to the period 2012 – 2016 (and not 2011-2015, as the stated start and end points straddle two years which is appropriate to winter seasons rather than breeding seasons), then the five-year mean peak count for an assumed wider SPA population which includes the Minsmere South Levels and Sizewell Marshes (on the basis of possible functional linkage) is 106 breeding pairs (see **Table 6.9**). This suggests that on average the Minsmere South Levels and Sizewell Marshes have held 16% and 5%, respectively, of this wider SPA population in recent years.

[28] Where construction phase effects are taken to be a proxy for decommissioning.

8.8.361. Given the extent of encroachment of the 64dB L_{Amax} noise contour (for Phase 1 of the construction period) across the Sizewell Marshes (**Figure 8.8**), it is assumed that most breeding gadwall within this area could be affected by construction noise disturbance. However, encroachment of this noise contour (in combination with the potential visual impact zone) affects only 40% of the area of the Minsmere South Levels (**Figure 8.8**). No data are available on the distribution of breeding gadwall within the Minsmere South Levels but there is no reason to believe that densities would be higher in the southern parts of the area potentially affected by noise and visual disturbance than elsewhere, particularly given that wet grassland habitat predominates across the entire extent of the Minsmere South Levels.

8.8.362. Based upon the above, it is considered that construction noise and visual disturbance could displace approximately 11% of the assumed wider SPA population. However, this is based upon applying the predicted noise emissions from Phase 1 of the construction period only; with noise levels predicted to be lower in other Phases and with considerably reduced encroachment of the 65dB L_{Amax} contour onto both the Sizewell Marshes and Minsmere South Levels during Phases 3 to 5 (**Figure 8.5** and **Figure 8.6**). Also, as detailed in section 8.8 d v of this report (in relation to modelling of noise emissions for the north-east part of the main development site over shorter time periods of weeks or months), noise modelling at the resolution of an entire construction phase results in overestimation, both in terms of the duration of the predicted worst-case noise levels and the likely extent of noise emissions at any particular time during the phase in question. Therefore, it is considered unlikely that the potential for displacement of breeding gadwall from the Minsmere South Levels and Sizewell Marshes would be as high as is estimated, nor is it be predicted to extend over the full duration of the construction period).

8.8.363. Further to this, it is the case that the potentially displaced birds may be functionally linked to the SPA, as opposed to being from the designated population. Thus, the predicted displacement of breeding pairs would not act to reduce the size of the designated SPA population; which is currently more than three times larger than the citation population size. This relatively low level of displacement affecting (albeit functionally linked) birds outside the SPA would not prevent achievement of the supplementary advice on the generic conservation objectives to maintain the SPA population size of this qualifying feature at above 24 breeding pairs, whilst avoiding deterioration from its current level (**Table 6.5**).

8.8.364. Therefore, no adverse effects on the SPA breeding gadwall population are predicted as a consequence of noise and visual disturbance from construction and (by proxy) decommissioning activities.

Operation

8.8.365. As detailed above for breeding avocet, provided in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.366. The extent of artificial lighting associated with the operational period is also described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect areas of the Minsmere South Levels and Sizewell Marshes that may be used by the SPA breeding gadwall population. Therefore, no adverse effects on the SPA gadwall population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.367. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, provided in section 8.8 b v of this report also applies here.

8.8.368. Gadwall nest on the ground usually in dense wetland vegetation within about 20m of water (Ref. 8.109). Breeding habitat within the SPA comprises coastal grazing marshes including the scrapes at Minsmere.

8.8.369. The majority (more than 80%, RSPB *unpublished* data) of the SPA breeding population occurs on the RSPB Minsmere Reserve. As described above for breeding avocet, access to the Minsmere RSPB reserve is controlled and restricted, and increase in recreational disturbance during the construction of Sizewell C is not predicted to increase disturbance levels to habitats for wetland birds, including breeding gadwall, in this area.

8.8.370. Outside the Minsmere RSPB Reserve, much of the remainder of the SPA is also within nature reserves managed by Natural England, the SWT and RSPB. Within these reserves access to sensitive habitats used by wetland breeding birds is managed and controlled. Predicted increases in visitor numbers during the construction of Sizewell C are therefore not considered likely to increase overall levels of recreational disturbance to habitats.

8.8.371. Breeding gadwall occurring outside the SPA on the Minsmere South Levels and Sizewell Marshes are considered to be functionally linked to the SPA. As described above for breeding avocet, seen in section 8.8 b v of this report, a footpath running south of the Minsmere New Cut between Eastbridge and the coast runs through areas of the South Levels - route R on Figure 005, **Appendix E** of this report. However, given the existing popularity of this

route, predicted increases in visitor numbers during the construction (and decommissioning) of Sizewell C are not considered likely to result in any additional recreational disturbance to birds in this area.

8.8.372. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding gadwall in the Minsmere-Walberswick SPA.

Operation

8.8.373. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report, also applies to breeding gadwall at the Minsmere Walberswick SPA.

8.8.374. The assessment above for breeding avocet, seen in section 8.8 b v of this report also applies to breeding gadwall. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding gadwall using the Minsmere-Walberswick SPA.

g) Breeding shoveler, project alone

i. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.375. The assessment reported above for avocet, seen in section 8.8 b i of this report is also applicable to breeding shoveler.

8.8.376. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding shoveler.

ii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.377. The assessment reported above for avocet, seen in section 8.8 b ii of this report, is also applicable to breeding shoveler.

8.8.378. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of local hydrology and hydrogeology, during the construction, operational and

decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding shoveler.

iii. Changes in air quality

Construction, operation and decommissioning

8.8.379. The assessment reported above for avocet, provided in section 8.8 b iii of this report, is also applicable to shoveler during the breeding season.

8.8.380. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature breeding shoveler.

iv. Disturbance effects on species populations

Construction and decommissioning

8.8.381. As for breeding gadwall, the evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above in the section on breeding avocet and is taken to apply to breeding shoveler also as seen in section 8.8 b iv of this report. The construction works associated with the water storage area in the north-east of the main development site are also not predicted to affect the SPA breeding shoveler population because they would be limited to the first winter of the construction period only.

8.8.382. On the basis of the evidence detailed in section 8.8 b iv of this report, it is considered unlikely that noise and visual disturbance from the construction of Sizewell C would affect shoveler which breed within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable gadwall habitat[21] – **Figure 8.7**), whilst peak noise levels within the SPA (again excepting the south-eastern extremity) during the construction of the main development site are predicted to remain below the 64dB L_{Amax} threshold which is applied to breeding waterbirds as provided in section 8.8 b iv of this report, **Figure 8.3** to **Figure 8.6**.

8.8.383. However, shoveler also breed within the Minsmere South Levels and Sizewell Marshes, although this appears to be a sporadic occurrence only within in the latter area (see **Table 6.9**), and the birds using these areas may be functionally linked to the SPA population. Both the potential visual impact zone and the 64dB L_{Amax} noise contour for Phase 1 of the construction period (i.e. the worst-case construction phase) encroach onto these areas, with 0.81km^2 and 0.99km^2 of the Minsmere South Levels and Sizewell Marshes, respectively, encompassed by their combined footprints (**Figure 8.8**, **Table 8.18**). Thus, the potential exists for impacts to arise on the SPA breeding

shoveler population as a result of noise and visual disturbance to birds breeding on the Minsmere South Levels and Sizewell Marshes.

8.8.384. The current SPA population is estimated to be 65 breeding pairs (**Table 6.5**). If this estimate is assumed to refer to the period 2012 – 2016, then the five-year mean peak count for an assumed wider SPA population which includes the Minsmere South Levels and Sizewell Marshes (on the basis of possible functional linkage) is 77 breeding pairs (**Table 6.9**). This suggests that on average the Minsmere South Levels and Sizewell Marshes have held 16% and 0.5%, respectively, of this wider SPA population in recent years.

8.8.385. The effects of noise and visual disturbance on the Sizewell Marshes would be of little consequence for the SPA breeding shoveler population, given their scarcity (and sporadic occurrence) within this area. However, as detailed above, provided in section 8.8 f iv of this report, noise and visual disturbance from construction activities are predicted to extend across 40% of the area of the Minsmere South Levels (based upon the encroachment of the 64dB L_{Amax} noise contour and the potential visual impact zone – **Figure 8.8**). As for gadwall, no data are available on the distribution of breeding shoveler within the Minsmere South Levels but there is no reason to believe that densities would be higher in the southern parts of the area potentially affected by noise and visual disturbance than elsewhere.

8.8.386. Based upon the above, it is considered that construction noise and visual disturbance could potentially displace approximately 7% of the assumed wider SPA population. However, this is based upon applying the predicted noise emissions from Phase 1 of the construction period; with noise levels predicted to be lower in other Phases and with considerably reduced encroachment of the 65dB L_{Amax} contour onto both the Sizewell Marshes and Minsmere South Levels during Phases 3 to 5 (**Figure 8.5** and **Figure 8.6**). Also, as detailed in section 8.8 d v of this report (in relation to modelling of noise emissions for the northeast part of the main development site over shorter time periods of weeks or months), noise modelling at the resolution of an entire construction phase results in overestimation, both in terms of the duration of the predicted worst-case noise levels and the likely extent of noise emissions at any particular time during the phase in question. Therefore, it is considered unlikely that the potential for displacement of breeding shoveler from the Minsmere South Levels would be as high as is estimated, nor would it be predicted to extend over the full duration of the construction period.

8.8.387. Further to this, it is the case that the potentially displaced birds may be functionally linked to the SPA, as opposed to being from the designated population. Thus, the predicted displacement of breeding pairs would not act to reduce the designated SPA population, which is currently almost three times larger than the citation population size. This relatively low level of displacement affecting (albeit functionally linked) birds outside the SPA

would not prevent achievement of the supplementary advice on the generic conservation objectives to maintain the SPA population size of this qualifying feature at above 23 breeding pairs, whilst avoiding deterioration from its current level (Ref. 6.66, **Table 6.5**).

8.8.388. Therefore, no adverse effects on the SPA breeding shoveler population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.389. As detailed above for breeding avocet, seen in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.390. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect areas of the Minsmere South Levels (and Sizewell Marshes) that may be used by the SPA breeding shoveler population. Therefore, no adverse effects on the SPA shoveler population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.391. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, provided in section 8.8 b v of this report, also applies here.

8.8.392. Shoveler nest on the ground in grass or rushes, sometimes in low scrub, usually close to water (Ref. 8.109). The distribution of breeding shoveler is similar to that of gadwall, with the majority of the SPA population on the RSPB Minsmere Reserve (**Table 6.5**), extending to functionally linked habitats south of the SPA on the Minsmere South Levels and Sizewell Belts.

8.8.393. As described previously, access to the Minsmere RSPB reserve is controlled and restricted, and increase in recreational disturbance during the construction of Sizewell C is not predicted to increase disturbance levels to habitats for wetland birds, including breeding shoveler, in this area.

8.8.394. Outside the Minsmere RSPB Reserve, much of the remainder of the SPA is also within nature reserves managed by Natural England, the SWT and RSPB. Here, predicted increases in visitor numbers during the construction

of Sizewell C are not considered likely to increase overall levels of recreational disturbance to sensitive habitats for breeding wetland birds.

8.8.395. A footpath running south of the Minsmere New Cut between Eastbridge and the coast runs through areas of the South Levels - route R on **Figure 005**, **Appendix E** of this report. However, given the existing popularity of this route, predicted increases in visitor numbers during the construction of Sizewell C are not considered likely to result in any additional recreational disturbance to birds in this area

8.8.396. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for breeding shoveler in the Minsmere-Walberswick SPA.

Operation

8.8.397. The information presented in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report, also applies to breeding gadwall at the Minsmere-Walberswick SPA.

8.8.398. The assessment above for breeding avocet, provided in section 8.8 b v of this report, also applies to breeding shoveler. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding shoveler using the Minsmere-Walberswick SPA.

h) Breeding teal, project alone

i. Water quality effects – terrestrial environment

Construction, operation and decommissioning

8.8.399. The assessment reported above for avocet, provided in section 8.8 b i of this report, is also applicable to breeding teal.

8.8.400. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including breeding teal.

ii. Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.401. The assessment reported above for avocet, as provided in section 8.8 b ii of this report, is also applicable to breeding teal and it is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to alteration of local hydrology and hydrogeology during the construction, operational or decommissioning phases. Therefore, no effect is predicted on the SPA qualifying features, including breeding teal.

iii. Changes in air quality

Construction. operation and decommissioning

8.8.402. The assessment reported above for avocet, seen in section 8.8 b iii of this report, is also applicable to teal during the breeding season.

8.8.403. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature breeding teal.

iv. Disturbance effects on species populations

Construction and decommissioning

8.8.404. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above in the section on breeding avocet and is taken to apply to breeding teal also, seen in section 8.8 b iv of this report. The construction works associated with the water storage area in the northeast of the main development site are also not considered to affect the SPA breeding teal population because they would be limited to the first winter of the construction period only.

8.8.405. On the basis of the evidence detailed in section 8.8 b iv of this report, it is considered unlikely that noise and visual disturbance from the construction of Sizewell C would affect teal which are breeding within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable teal habitat[21] – **Figure 8.7**), whilst peak noise levels within the SPA (again excepting the south-eastern extremity) during construction of the main development site are predicted to remain below the 64dB L_{Amax} threshold which is applied to breeding waterbirds, as seen in section 8.8 b of this report, **Figure 8.3** to **Figure 8.6**. Furthermore, teal are now virtually absent from the SPA as a breeding species (**Table 6.9**).

8.8.406. Teal are also essentially absent as a breeding species from the Minsmere South Levels and Sizewell Marshes, with no breeding records from the

former area since at least 2010 and one record of a single breeding pair (in 2013) since 2011 for the latter area (**Table 6.9**). Given this, the potential for noise and visual disturbance to occur within parts of these areas would not affect the SPA breeding teal population.

8.8.407. The above details of the potential construction-related disturbance effects are also assumed to represent a worst-case for the decommissioning phase.

8.8.408. Therefore, no adverse effects on the SPA breeding teal population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.409. As detailed above for breeding avocet, provided in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.410. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report above. Based on this information, light spillage is not predicted to affect areas that may be used by the SPA breeding teal population, particularly given their overall scarcity, and virtual absence from potentially functionally linked habitat outside the SPA. Therefore, no adverse effects on the SPA teal population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.411. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, provided in section 8.8 b v of this report, also applies here.

8.8.412. Teal nest usually on the ground in dense vegetation close to water. Breeding habitat within the SPA comprises coastal grazing marshes including the scrapes at Minsmere. As detailed above, the SPA breeding population has declined since the time of classification with a 5 year mean count of only 1 pair 2011-2016 (**Table 6.5**). A restore target has been set for a breeding population above 73 pairs, although it is unclear what is driving declines (Ref. 6.66).

8.8.413. As described above, much of the Minsmere-Walberswick SPA is managed directly for nature conservation, with reserves managed by Natural England, RSPB and the SWT. Within these areas access to sensitive wetland habitats used by breeding waterfowl, including teal, is managed and controlled.

Predicted increases in visitor numbers during the construction of Sizewell C are therefore not considered likely to increase overall levels of recreational disturbance to habitats.

8.8.414. Teal are essentially absent as a breeding species from the Minsmere South Levels and Sizewell Marshes so the potential for increased recreational disturbance in these areas would not affect the SPA population.

8.8.415. In addition, as described above, mitigation is proposed in the form of a Rights of Way and Access Strategy to minimise the ecological effects of increased recreational pressure on habitats and associated species.

8.8.416. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the ability to achieve the conservation objectives for breeding teal within the Minsmere-Walberswick SPA.

Operation

8.8.417. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, as provided in section 8.3 b vi of this report, also applies to breeding teal at the Minsmere Walberswick SPA.

8.8.418. The assessment above for breeding avocet, as seen in section 8.8 b v of this report, also applies to breeding teal. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on breeding teal using the Minsmere-Walberswick SPA.

i) Breeding nightjar, project alone

i. Changes in air quality

8.8.419. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction, operation and decommissioning

8.8.420. The assessment reported above for avocet is also applicable to nightjar during the breeding season.

8.8.421. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature breeding nightjar.

ii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.8.422. As described in section 6.3 f of this report, baseline surveys provided no evidence of breeding nightjar within or close to the areas encompassed by the main development site. It is also unlikely that SPA birds rely on suitable habitat near to the main development site for foraging because the main breeding sites within the SPA are over 1km from the main development site. Although nightjar have been recorded foraging at distances of up to 3.1km from their nests, most foraging is generally much closer to the nest and studies of radio-tracked birds in southeast England recorded a mean maximum distance of 747m from the territory centres (Ref. 8.110, Ref. 8.111, Ref. 8.112).

8.8.423. Therefore, no adverse effects on the Minsmere-Walberswick SPA nightjar population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iii. Disturbance effects on species populations

Construction and decommissioning

8.8.424. As detailed above, the main breeding areas for nightjar within the Minsmere-Walberswick SPA are over 1km from the main development site, where the predicted peak noise levels from construction activities are considerably below 64dB L_{Amax}. It is assumed that this would also represent a worst-case for decommissioning.

8.8.425. Baseline surveys of suitable non-SPA habitat within the vicinity of the main development site, including within areas where there is considered to be the potential for noise and visual disturbance effects to arise, revealed no evidence of breeding birds as seen in section 6.3 f of this report, whilst it is unlikely that SPA birds would use these areas for foraging.

8.8.426. Therefore, no adverse effects on the SPA breeding nightjar population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.427. As detailed above for breeding avocet, as provided in section 8.8 b iv of this report, noise and visual disturbance during the operation of Sizewell C are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.428. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report above and would not extend into any areas that are known to be used by nightjar for nesting (and which are also unlikely to be used by SPA birds for foraging due to their distance from the main nesting areas – see above). Therefore, no adverse effects on the SPA breeding nightjar population are predicted as a consequence of noise and visual disturbance from operational activities.

iv. Disturbance due to increase in to recreational pressure

Construction and decommissioning

8.8.429. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, seen in section 8.8 b v of this report, also applies here.

8.8.430. A review of the effects of recreational disturbance on nightjar populations is included in **Appendix E** of this report (section 3.2 of this report); studies have shown that birds occur at decreased densities in areas of increased human disturbance, and may sometimes but not always experience reduced breeding success.

8.8.431. The nightjar breeding population of the Minsmere-Walberswick SPA has declined by 45% since classification (**Table 6.5**). A restore target has been set for the SPA population to a level above 24 breeding pairs, whilst avoiding deterioration from the current level, although it is unclear what is driving the decline (Ref. 6.66). The site improvement plan (Ref. 8.108) identifies nightjar as a feature affected by public access / disturbance to the lowland heath and coniferous woodland areas used by breeding birds. An investigation into public access and disturbance levels is recommended by the site improvement plan.

8.8.432. The main nesting areas for nightjar within the SPA are on the Minsmere RSPB reserve, with smaller numbers in the Dunwich Forest area of the Dingle Marshes Reserve.

8.8.433. In relation to the RSPB Minsmere reserve, entry points via North Westleton, Westleton Heath and Minsmere Outer Periphery - locations M, N and O on Figures 001 and 005, **Appendix E** of this report give access to areas of heathlands and woodlands used by breeding nightjar, which include areas of open access land and land with permissive footpaths. At site M, north Westleton, there is also access to sections of Dunwich Forest outside the SPA boundary which are being restored to open habitat by the RSPB. These areas, which support breeding nightjar, are considered to be functionally linked to the Minsmere-Walberswick SPA habitat on Westleton Heath. Estimated increases in visits to these locations are 1.74-11.6% (M and N)

and 3.3-50.3% (0) - **Appendix E**, **Table 4.1** of this report. While recreational users are considered unlikely to stray off the defined paths, the open nature of heath habitats in these areas may encourage people to let dogs off the lead with the potential to disturb ground nesting birds such as nightjar.

8.8.434. It is proposed that existing recreational management measures at Westleton Heath and other heathland areas within the Minsmere (southern) section of the Minsmere-Walberswick SPA, are enhanced to minimise the potential for any increase in recreational disturbance pressure on breeding nightjar and other breeding birds of heathland habitats. This would be a monitoring and mitigation plan, to be agreed with land managers and would be aligned with the proposed Rights of Way and Access Strategy.

8.8.435. It is considered that Dunwich Forest – outside the SPA but with a functionally linked breeding population of nightjar - has the capacity to accommodate a significant level of recreational use without any adverse effects on this species.

8.8.436. Subject to the above enhancement of recreational management measures within the southern (Minsmere) section of the SPA, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the ability to meet the conservation objectives for breeding nightjar within the Minsmere-Walberswick SPA.

Operation

8.8.437. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report, also applies to breeding nightjar at the Minsmere-Walberswick SPA.

8.8.438. As described above, mitigation in the form of enhanced recreational management measures is identified for heathland areas within the southern (Minsmere) block of the SPA during the construction period. If the changes in visitor use predicted during construction continue into the operational phase, then it is considered that these mitigation measures should be continued. Subject to the above enhanced recreational management, no adverse effects associated with increased recreational pressure are predicted on breeding nightjar using the Minsmere-Walberswick SPA, either directly or indirectly via habitat change.

j) Non-breeding hen harrier, project alone

i. Water quality effects – terrestrial environment and Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.439. The assessment reported above for avocet, as provided in section 8.8 b i and 8.8 ii of this report, is also applicable to non-breeding hen harrier.

8.8.440. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment or of local hydrology and hydrogeology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including non-breeding hen harrier.

ii. Changes in air quality

Construction, operation and decommissioning

8.8.441. The assessment reported above for avocet, seen in section 8.8 b iii of this report, is also applicable to hen harrier during the non-breeding season.

8.8.442. There is no likelihood of an adverse effect occurring on the conservation objectives for non-breeding hen harrier.

iii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.8.443. As for marsh harrier, wetland habitats may be important as foraging areas for the Minsmere-Walberswick SPA non-breeding hen harrier population as provided in sections 6.3 f and 8.8 d of this report. Therefore, the loss of the 6.63ha of wetland habitat within the Sizewell Marshes to accommodate the SSSI crossing and the western part of the main platform could affect the SPA hen harrier population. However, baseline surveys recorded relatively little foraging activity by hen harriers within the vicinity of the main development site, including on the Sizewell Marshes as seen in section 6.3 f of this report. Furthermore, this area of habitat loss represents a small proportion of the wetland foraging habitat available to the SPA hen harrier population, as detailed in section 8.8 d of this report.

8.8.444. Therefore, no adverse effects on the Minsmere-Walberswick SPA hen harrier population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iv. Disturbance effects on species populations

Construction and decommissioning

8.8.445. Non-breeding hen harriers using habitats within the Minsmere-Walberswick SPA are unlikely to be affected by noise and visual disturbance from construction activities, given that (with the exception of the first winter of the construction period) potential visual impact zones do not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable hen harrier habitat[21] – **Figure 8.7** and **Figure 8.10**), whilst the peak noise levels within the SPA (again excepting the south-eastern extremity) during construction of the main development site are predicted to be considerably below 64dB L_{Amax} (**Figure 8.3** to **Figure 8.6**).

8.8.446. The Minsmere South Levels and Sizewell Marshes also provide suitable foraging habitat for hen harrier, whilst the species will sometimes hunt over agricultural habitats. However, non-breeding hen harriers have been scarce within, or absent from, the SPA in recent years, and baseline surveys provide little evidence for any substantial use of habitats in close proximity to the main development site, where potential effects of noise and visual disturbance could occur as seen in section 6.3 f of this report.

8.8.447. The above details of the potential construction-related disturbance effects are also assumed to represent a worst-case for the decommissioning phase.

8.8.448. In addition to the potential noise and visual disturbance effects described above, during the first winter of the construction period only there would also be the potential for noise and visual disturbance to arise from the construction works associated with the water storage area in the northeast of the main development site. This could result in disturbance effects encroaching onto a greater extent of the SPA and the Minsmere South Levels than at other times of the construction period, given their closer proximity to this part of the main development site. However, the extent of this encroachment is predicted to be relatively minor, seen in section 8.8 k below. This, together with the fact that these activities would extend over a single winter period only, would mean that this further construction activity would not cause any notable increase in disturbance to the SPA non-breeding hen harrier population.

8.8.449. Therefore, no adverse effects on the SPA non-breeding hen harrier population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.450. As detailed above for breeding avocet, see section 8.8 b iv of this report, noise and visual disturbance during the operation of Sizewell C is unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.451. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report and would not extend into any areas that would be used as night-time roosts by hen harriers. Therefore, no adverse effects on the SPA hen harrier population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.452. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet in section 8.8 b v of this report also applies here.

8.8.453. During the non-breeding season hen harriers typically roost in tall vegetation and forage over areas of open habitats. At this time, hen harriers may gather communally at traditional roosting sites used over many years (Ref. 8.113).

8.8.454. Specific details of roosting areas for hen harriers using the Minsmere-Walberswick SPA are not known. This species is vulnerable to illegal persecution – particularly in upland areas of Great Britain (Ref. 8.114) – and details of roosting areas (upland or otherwise) monitored under the hen harrier winter roost survey (Ref. 8.115) tend to be kept confidential. However potential roosting habitat in the form of tall wetland vegetation (coastal grazing marshes and reedbeds) is readily available within the SPA.

8.8.455. Non-breeding hen harriers at Minsmere Walberswick SPA will forage over reedbeds, coastal grazing marshes and surrounding agricultural land.

8.8.456. As described in section 6.3 f of this report, the SPA non-breeding population has declined from 15 individuals between 1985-1990, to a mean of less than 1 individual in the most recent five-year period (based on Ref. 6.66). There is no evidence to explain the declines at a site level, and they may reflect declines in the UK breeding population; a target has been set to restore the non-breeding population to a level which is above 15, whilst avoiding deterioration from the current level (Ref. 6.66).

8.8.457. Hen harriers were recorded in project specific surveys of the Minsmere South levels and Sizewell Marshes in 2011/12 and 2014/15. In the latter survey, observations included an adult male, adult females and ringtails (either

juveniles or adult females), indicating that several individuals were present over the survey period. Roosting areas of these individuals are not known and may be within the SPA or at some distance from the SPA. These birds would be likely to hunt also over the SPA and, therefore, could be considered functionally linked to the SPA population. Satellite tracking of hen harriers in Great Britain in recent years indicates that individual birds may range widely during the non-breeding season and use a number of different roosting areas over a given winter (e.g. see movements of tracked birds, Ref. 8.116).

8.8.458. While specific details of roosting locations used by hen harriers at the Minsmere-Walberswick SPA are not available, the SPA holds extensive areas of suitable roosting habitat within areas managed as nature reserves where access is limited to existing paths and increases in visitor numbers during the construction and decommissioning of Sizewell C are not predicted to result in an increase in disturbance levels. As non-breeding hen harriers forage over extensive areas of open habitat including coastal grazing marsh and agricultural land, increase in recreational disturbance at existing access locations and paths is not likely to reduce the available habitat.

8.8.459. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the ability to achieve conservation objectives for non-breeding hen harrier at the Minsmere-Walberswick SPA.

Operation

8.8.460. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report also applies to non-breeding hen harrier at the Minsmere-Walberswick SPA.

8.8.461. As described above, due to the availability of extensive areas of suitable roosting habitat within areas managed as nature reserves, potential increases in recreational pressure during the construction (and decommissioning) of Sizewell C were not predicted to cause adverse effects through direct or indirect disturbance. If the changes in visitor use predicted during construction continue into the operational phase, then no direct adverse effect would be predicted during this phase also. In this context it is noted that the size of the workforce at Sizewell C would be less during operation than construction, so that predicted recreational use of European sites by the operational workforce would also be less. Consequently, no adverse effects associated with increased recreational pressure are predicted on non-breeding hen harrier using the Minsmere-Walberswick SPA, including, either directly or indirectly via habitat change.

k) Non-breeding gadwall, project alone

i. Water quality effects – terrestrial environment and Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.462. The assessment reported above for avocet, provided in section 8.8 b i and 8.8 ii is also applicable to non-breeding gadwall.

8.8.463. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment of local hydrology and hydrogeology, during the construction, operational or decommissioning phase, and therefore no effect on the SPA qualifying features, including non-breeding gadwall.

ii. Changes in air quality

Construction, operation and decommissioning

8.8.464. The assessment reported above for avocet, seen in section 8.8 b iii is also applicable to gadwall during the non-breeding season.

8.8.465. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature non-breeding gadwall.

iii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.8.466. As described in section 6.3 f of this report, it is possible that the Minsmere-Walberswick SPA non-breeding gadwall population depends upon habitats in the Sizewell Marshes, so that there may be functional linkage with the Sizewell Marshes. Given this, it is possible that the loss of the 7.03ha of wetland habitat within the Sizewell Marshes SSSI could affect the SPA non-breeding gadwall population.

8.8.467. Baseline data indicate that numbers of non-breeding gadwall on the Sizewell Marshes may vary between different winters but that numbers are relatively low compared to those occurring in other areas of suitable habitat within, and in close proximity to, the SPA (**Table 6.12** and **Table 6.13**). Distributional data also suggest that the areas of habitat which would be lost are not of disproportionate importance to non-breeding gadwall relative to other parts of the Sizewell Marshes (**Figures 6.10** and **6.11**). Given this, it seems highly unlikely that the loss of this wetland habitat from the Sizewell Marshes would have any significant effects on the SPA non-breeding gadwall population (as it represents only 6.4% of the total area of the Sizewell Marshes).

8.8.468. Therefore, no adverse effects on the Minsmere-Walberswick SPA non-breeding gadwall population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iv. Disturbance effects on species populations

Construction and decommissioning

Introduction

8.8.469. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed in the section on breeding avocet, seen in section 8.8 b iv of this report and is taken to apply to wintering gadwall. On the basis of this evidence, it is considered unlikely that noise and visual disturbance from the construction of the Sizewell C Project would affect wintering gadwall when present within the Minsmere-Walberswick SPA. This is because (with the exception of the first winter of the construction period) the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable gadwall habitat[21] – **Figure 8.7**), whilst the peak noise levels within the SPA (again excepting the south-eastern extremity) during construction of the main development site are predicted to remain below the 70dB L_{Amax} threshold which is applied to wintering waterbirds as seen in section 8.8 b iv of this report, **Figure 8.3** to **Figure 8.6**).

8.8.470. However, both the Minsmere South Levels and Sizewell Marshes also provide suitable habitat for wintering gadwall and the SPA population may also depend upon these areas (e.g. for the provision of additional foraging resources); hence a functional linkage with the SPA exists (**Table 6.12, Table 6.13**, **Figure 6.10** and **Figure 6.11**). Both the potential visual impact zone and the 70dB L_{Amax} noise contour for Phase 1 of the construction period (i.e. the worst-case construction phase) encroach onto these areas, with 0.29km^2 and 0.80km^2 of the Minsmere South Levels and Sizewell Marshes, respectively, encompassed by their combined footprints (**Figure 8.8**,

8.8.471.

8.8.472. Table 8.19)[29]. Thus, the potential exists for impacts to arise on the SPA wintering gadwall population as a result of noise and visual disturbance to SPA birds which may rely on habitats within the Minsmere South Levels and Sizewell Marshes.

[29] This excludes consideration of the construction works for the water storage area, which would be limited to the first winter of the construction period as detailed below.

Table 8.19: The extent of encroachment of the 70dB L_{Amax} contour (for Phase 1 of the construction period) and potential visual impact zone onto the Minsmere-Walberswick SPA, Minsmere South Levels and Sizewell Marshes[29]

Site	Area (km^2) Within:		
	70 dB L_{Amax} Noise Contour	Visual Impact Zone	70 dB L_{Amax} Noise Contour, Visual Impact Zone Or Both
Minsmere-Walberswick SPA	0.12	0.10	0.12
Minsmere South Levels	0.22	0.25	0.29
Sizewell Marshes	0.64	0.64	0.80

Numbers and distribution on the Sizewell Marshes and Minsmere South Levels

8.8.473. The available WeBS data suggest that numbers of wintering gadwall on the Sizewell Marshes are low relative to the numbers occurring on the SPA, whereas the numbers occurring on the Minsmere South Levels can be as high, or higher, than those on the SPA (**Table 6.13**). If the birds using the SPA, Minsmere South Levels and Sizewell Marshes are regarded as being part of a wider SPA population (which follows from the assumption that the Sizewell Marshes and Minsmere South Levels are functionally linked to the SPA), the WeBS counts in **Table 6.13** suggest that the peak numbers of gadwall occurring within the Sizewell Marshes range from 4% to 8% of this population between years, whilst for the Minsmere South Levels the peak numbers range from 5% to 70% of this population between years (with an average value of 53%).

8.8.474. There are limitations to the WeBS Sizewell Belts data because the count sector does not encompass all areas of suitable waterbird habitat within Sizewell Marshes (**Figure 6.9**), and the project-specific survey data suggest that in some, but not all, years the peak gadwall numbers occurring on the Sizewell Marshes may be higher than indicated by the WeBS counts (**Table 6.12**). Relating the highest seasonal peak count from the project-specific surveys (i.e. 80 – **Table 6.12**) to the total mean peak WeBS count for the

'assumed wider SPA population' (i.e. 445 – **Table 6.13**), indicates that peak numbers on the Sizewell Marshes could represent approximately 18% of this population in certain years.

8.8.475. The distribution of gadwall records from the two winter periods of project-specific surveys shows that the main areas used by this species on the Minsmere South Levels occur outside the footprint for both the worst-case 70dB L_{Amax} contour and the potential visual impact zone (**Figure 8.12**, **Figure 6.10** and **Figure 6.11**). In terms of noise disturbance, the main area used by wintering gadwall on the Minsmere South Levels is likely to experience peak noise levels of approximately 64dB L_{Amax} during Phase 1 of construction (**Figure 8.3**), and of between 54 and 64dB L_{Amax} during Phases 2 to 5 (**Figure 8.4** and **Figure 8.6**). Therefore, few effects of construction-related disturbance are predicted on wintering gadwall using the Minsmere South Levels.

8.8.476. However, the project-specific surveys indicate that the main areas used by wintering gadwall on the Sizewell Marshes occur within, or close to, either the footprint for the worst-case 70dB L_{Amax} contour or the potential visual impact zone, or both (**Figure 8.12**, **Figure 6.10** and **Figure 6.11**). Therefore, a high proportion of the gadwall which use the Sizewell Marshes may be affected by construction-related disturbance, particularly as this species has previously been considered susceptible to human disturbance and tends to show avoidance of disturbed sites (Ref. 8.117, Ref. 8.49, Ref. 8.50).

Dependence of the SPA population on the Sizewell Marshes

8.8.477. As detailed above, wintering gadwall numbers on the Sizewell Marshes are considerably lower than those occurring on the Minsmere-Walberswick SPA. Across the different WeBS count sectors in Suffolk, the WeBS Sizewell Belts sector ranks sixteenth in terms of gadwall abundance (from a total of 25 count sectors in which the species has been recorded in recent years - Ref. 8.118). By contrast, the Minsmere count sector has the highest five year mean peak count amongst the Suffolk sites, albeit that this also includes the Minsmere South Levels which are outside the SPA (**Table 8.20**).

8.8.478. In general, gadwall are attracted to habitats such as freshwater marsh and lakes with high levels of macrophytes, which is their primary food resource (Ref. 8.49, Ref. 8.50). As surface feeders, they show a preference for waterbodies of shallow depth. To some extent, at least, the lower numbers on the Sizewell Marshes are likely to reflect the habitat conditions on this site, with suitable habitat largely restricted to the network of ditches which intersect the (predominantly) wet grassland fields comprising the bulk of the site. This differs from the more extensive open water bodies that occur in parts of the Minsmere-Walberswick SPA and the Minsmere South Levels.

8.8.479. There is limited empirical evidence regarding the winter movements and range size of gadwall, but they are known to undertake regular diurnal movements between sites during the winter period, in some situations and locations at least (Ref. 8.119, Ref. 8.50). Furthermore, in one study conducted across 67 waterbodies spanning a distance of approximately 20 miles, within-season movements to and from the study area were more frequent than movements between the different waterbodies within the study area (Ref. 8.49, Ref. 8.50).

8.8.480. Based on the available evidence, it is clear that gadwall regularly move between areas of suitable habitat during the non-breeding season. This supports the above assumptions that movements occur between the Minsmere-Walberswick SPA and Sizewell Marshes (and also Minsmere South Levels), and that a proportion of the SPA population will use the Sizewell Marshes. However, the evidence suggests that such movements and the interchange of birds are not limited to the sites within the immediate vicinity of the SPA but will occur across a wider range of the sites which support wintering gadwall within the region. For example, the Alde Estuary and North Warren and Thorpeness Mere WeBS count sectors are both within 10km of Sizewell Marshes and also hold moderate to high numbers of gadwall (**Table 8.20**).

8.8.481. Given the extent of between-site movements by gadwall during the non-breeding period, it is likely that the proportional importance of the Sizewell Marshes to the 'assumed wider SPA population' (as calculated above) is an overestimate (because some of the birds using the Sizewell Marshes will be associated with other sites further from the SPA). Similarly, birds from the Minsmere-Walberswick SPA are also likely to use other sites across the region, some of which will provide larger areas of alternative habitat than is found within the Sizewell Marshes.

Table 8.20: Mean annual peak counts of gadwall for the period 2013/14 to 2017/18 for WeBS count sectors in Suffolk; data are presented for the 10 sectors with highest counts

WeBS Count Sector	Mean Of Annual Peak Counts, 2013/14 – 2017/18[1]
Minsmere	342
Orwell Estuary	225
Alde Estuary	187
Leathes Ham	176
Lackford Lakes Nature Reserve	174
Lound Waterworks	103
Stour Estuary	96

WeBS Count Sector	Mean Of Annual Peak Counts, 2013/14 – 2017/18[1]
North Warren & Thorpeness Mere	91
Alton Water	88
Culford Lake	75

[1] Data derived from https://app.bto.org/webs-reporting/ (as at 14 August 2019).

Construction works associated with the water storage area

8.8.482. In addition to the potential noise and visual disturbance effects described above, during the first winter of the construction period only there would also be the potential for noise and visual disturbance to arise from the construction works associated with the water storage area in the northeast of the main development site. This could result in disturbance effects encroaching onto greater extents of the SPA and the Minsmere South Levels than at other times during the construction period, given their closer proximity to this part of the main development site.

8.8.483. The part of main development site within which the water storage area would be located is relatively discrete and in the north-east corner of the EDF Energy Estate (e.g. see **Figure 8.7**). In terms of potential noise and visual disturbance affecting the SPA and Minsmere South Levels, it is the northern and eastern boundaries of this location which are relevant (given the respective locations of the different sites). These boundaries are already effectively screened for much of their length by relatively dense woodland of the Grove and Sandy Pyrtle, and there would also be early plantings along some parts of the boundary which currently lack wooded screening.

8.8.484. Given that construction activities for the water storage area are assumed not to come to within 50m of the eastern boundary of the main development site boundary at this location, the visual impact zone for this part of the site is taken to extend out to 100m where existing wooded screening is present along the relevant boundaries and to 250m where it is currently absent (**Figure 8.7**). This is on the same basis as the visual impact zone which is applied elsewhere along the boundary of the main development site in relation to SPA waterbirds, as seen in section 8.8 b iv of this report.

8.8.485. Thus, the potential for visual disturbance effects from the construction of the water storage area is considered to be limited to a small part of the SPA only and to parts of the Minsmere South Levels which were not identified as being important for wintering gadwall during the project-specific surveys (**Figures 6.10** and **6.11**) and which are unlikely to provide suitable habitat for this qualifying feature (having relatively little standing water).

8.8.486. Noise modelling for the construction of the water storage area was undertaken on the assumption that excavators would be required in the site compound area, the water storage area and to south of this where pipes would be laid and a new wetland corridor created, immediately west of the Grove. Based upon the resulting predictions, the 70dB L_{Amax} contour extends a little more than 200m out from the northern and eastern boundaries of the site boundary in this location. As such, there is little encroachment onto the SPA, and (as for the visual impact zone) no encroachment onto parts of the Minsmere South Levels identified as being important for wintering gadwall or which are likely to provide suitable habitat for this qualifying feature.

8.8.487. Based upon the above considerations, the construction activities associated with the water storage area would be highly unlikely to increase the potential for construction-related disturbance at the main development site to affect the SPA wintering gadwall population.

Assessment of the effects of noise and visual disturbance

8.8.488. Based upon the above considerations, effects of construction-related disturbance on the Minsmere-Walberswick SPA population of wintering gadwall are likely to occur only when SPA birds are present on the Sizewell Marshes. Within the Sizewell Marshes there is the potential for construction-related disturbance to cause displacement of gadwall from a large part of the area currently used by the species in winter.

8.8.489. However, the numbers of gadwall recorded on the Sizewell Marshes during the non-breeding period are low compared to the total SPA population, and probably represent 4 to 18% of the peak winter numbers which occur on the SPA and the immediately adjacent habitats that are assumed to be functionally linked. Furthermore, as detailed above, although a proportion of the birds present on the Sizewell Marshes at any given time are likely to be from the SPA population, there is also likely to be interchange of birds between a wide range of sites within the region. Thus, at any given time, the proportion of Minsmere-Walberswick SPA birds present on the Sizewell Marshes will be less than the estimated 4 to 18%. Additionally, other sites outside the SPA also have the potential to provide more extensive areas of alternative (supporting) habitat for the SPA population than is to be found within the Sizewell Marshes.

8.8.490. Considering these factors in the context of a population which is currently more than three times larger than at the time of citation strongly suggests that the potential displacement of birds from Sizewell Marshes would not prevent achievement of the supplementary advice on the generic conservation objectives to maintain the non-breeding population at a level which is above 90 individuals, whilst avoiding deterioration from its current level (Ref. 6.66, **Table 6.5**).

8.8.491. The above details of the potential construction-related disturbance effects are also assumed to represent a worst-case for the decommissioning phase.

8.8.492. Therefore, no adverse effects on the SPA non-breeding gadwall population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.493. As detailed above for breeding avocet, provided in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.494. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report. Based on this information, light spillage is not predicted to affect areas of the Minsmere South Levels and Sizewell Marshes that may be used by the SPA non-breeding gadwall population. Therefore, no adverse effects on the SPA non-breeding gadwall population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.495. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, seen in section 8.8 b v of this report, also applies here.

8.8.496. Gadwall occupy similar habitats during and outside the breeding season - specific habitat preferences are described above in section 8.8 k iv of this report. Suitable habitats within the SPA comprise coastal grazing marshes and associated areas of shallow open water. Outside the breeding season, birds are not constrained by requirements to remain near nests or dependent young, and range widely. Thus, as also described above in section 8.8 k iv of this report, there is likely to be an interchange between birds present on the SPA and functionally linked habitats of Minsmere South levels and Sizewell Marshes, and other wintering sites in the wider region.

8.8.497. The majority of the SPA non-breeding population occurs on the RSPB Minsmere Reserve (**Table 6.13**). As described above for breeding avocet, seen in section 8.8 b v of this report, access to the Minsmere RSPB reserve is controlled and restricted, and increase in recreational disturbance during the construction of Sizewell C is not predicted to increase disturbance levels to habitats for wetland birds, including breeding gadwall, in this area.

8.8.498. Outside the Minsmere RSPB Reserve, much of the remainder of the SPA is also within nature reserves managed by Natural England, the SWT and RSPB. Within these reserves access to sensitive habitats used by wetland birds during the non-breeding season is managed and controlled. Predicted increases in visitor numbers during the construction of Sizewell C are therefore not considered likely to increase overall levels of recreational disturbance to habitats.

8.8.499. Non-breeding gadwall occurring outside the SPA on the Minsmere South Levels and Sizewell Marshes are considered to be functionally linked to the SPA. As described above for breeding avocet, seen in section 8.8 b v of this report, a footpath running south of the Minsmere New Cut between Eastbridge and the coast runs through areas of the South Levels - route R on **Figure 005**, **Appendix E** of this report. However, given the existing popularity of this route, predicted increases in visitor numbers during the construction of Sizewell C are not considered likely to result in any additional recreational disturbance to birds in this area.

8.8.500. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for non-breeding gadwall in the Minsmere-Walberswick SPA.

Operation

8.8.501. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report, also applies to non-breeding gadwall at the Minsmere-Walberswick SPA.

8.8.502. As described above, because of limited accessibility to habitats used by non-breeding gadwall, potential increases in recreational pressure during the construction (and decommissioning) of Sizewell C were not predicted to cause adverse effects through direct disturbance. If the changes in visitor use predicted during construction continue into the operational phase, then no direct adverse effect would be predicted during this phase also. In this context it is noted that the size of the workforce at Sizewell C would be less during operation than construction, so that predicted recreational use of European sites by the operational workforce would also be less. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on non-breeding gadwall using the Minsmere-Walberswick SPA.

l) Non-breeding shoveler, project alone

i. Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.503. The assessment reported above for avocet, provided in section 8.8 b i and ii of this report is also applicable to non-breeding shoveler.

8.8.504. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment or of local hydrology and hydrogeology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including non-breeding shoveler.

ii. Changes in air quality

Construction, operation and decommissioning

8.8.505. The assessment reported above for avocet, provided in section 8.8 b iii of this report, is also applicable to shoveler during the non-breeding season.

8.8.506. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature non-breeding shoveler.

iii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.8.507. As described in section 6.3 f of this report, it is possible that the Minsmere-Walberswick SPA non-breeding shoveler population depends upon habitats in the Sizewell Marshes, so that there may be functional linkage with the Sizewell Marshes. Given this, it is possible that the loss of the 6.63ha of wetland habitat within the Sizewell Marshes to accommodate the SSSI crossing and the western part of the main platform could affect the SPA non-breeding shoveler population.

8.8.508. Baseline data indicate that numbers of non-breeding shoveler on the Sizewell Marshes are relatively low compared to those occurring in other areas of suitable habitat within, and in close proximity to, the SPA (**Table 6.14** and **Table 6.15**). Distributional data also suggest that the areas of habitat which would be lost are unlikely to be heavily used by non-breeding shoveler, although records of shoveler were particularly scarce in the surveys providing distributional information (**Figures 6.12** and **6.13**). Given this, it seems highly unlikely that the loss of this wetland habitat from the Sizewell Marshes would

have any significant effects on the SPA non-breeding shoveler population (as it represents only 6.4% of the total area of the Sizewell Marshes).

8.8.509. Therefore, no adverse effects on the Minsmere-Walberswick SPA non-breeding shoveler population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iv. Disturbance effects on species populations

Construction and decommissioning

Introduction

8.8.510. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above in the section on breeding avocet and is taken to apply to wintering shoveler also – see section 8.8 b iv of this report. On the basis of this evidence, it is considered unlikely that noise and visual disturbance from the construction of the Sizewell C Project would affect wintering shoveler when present within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable shoveler habitat[21] – **Figure 8.7**), whilst the peak noise levels within the SPA (again excepting the south-eastern extremity) during the construction of the main development site are predicted to remain below the 70dB L_{Amax} threshold which is applied to wintering waterbirds - see section 8.8 b iv of this report, **Figure 8.3** to **Figure 8.6**.

8.8.511. However, both the Minsmere South Levels and Sizewell Marshes also provide suitable habitat for wintering shoveler and the SPA population may also depend upon these areas (e.g. for the provision of additional foraging resources), so that there is functional linkage with the SPA (**Table 6.14, Table 6.15**, **Figure 6.12** and **Figure 6.13**). As for gadwall, both the potential visual impact zone and the 70dB L_{Amax} noise contour for Phase 1 of the construction period (i.e. the worst-case construction phase) encroach onto these areas, with 0.29km^2 and 0.80km^2 of the Minsmere South Levels and Sizewell Marshes, respectively, encompassed by their combined footprints (**Figure 8.12**, **Table 8.19**). Thus, potential exists for impacts to arise on the SPA wintering shoveler population as a result of noise and visual disturbance to SPA birds which may rely on habitats within the Minsmere South Levels and Sizewell Marshes.

Numbers and distribution on the Sizewell Marshes and Minsmere South Levels

8.8.512. The available WeBS data suggest that numbers of wintering shoveler on the Sizewell Marshes are low relative to the numbers occurring on the SPA. By

contrast, the numbers occurring on the Minsmere South Levels can be as high, or higher, than those on the SPA; although they have been markedly lower during the more recent winter periods for which data are available (**Table 6.15**). If the birds using the SPA, Minsmere South Levels and Sizewell Marshes are regarded as being part of a wider SPA population (which follows from the assumption that the Sizewell Marshes and Minsmere South Levels are functionally linked to the SPA), the WeBS counts in **Table 6.15** suggest that the peak numbers of shoveler occurring within the Sizewell Marshes range from 4% to 10% of this population between years, whilst for the Minsmere South Levels the peak numbers range from 16% to 66% of this population between years (with an average value of 49%).

8.8.513. As detailed above for gadwall, provided in section 8.8 k of this report, there are limitations to the WeBS Sizewell Belts data because the count sector does not encompass all areas of suitable waterbird habitat within Sizewell Marshes (**Figure 6.9**). Despite this, shoveler were absent or near-absent in the records from the Sizewell Marshes during both years of project-specific surveys and numbers were considerably lower than as recorded by the WeBS counts (**Table 6.14**).

8.8.514. The distribution of shoveler records from the two winter periods of project-specific surveys shows that the main areas used by this species on the Minsmere South Levels occur outside both the footprint for the worst-case 70dB LA_{max} contour and the potential visual impact zone (**Figure 8.12**, **Figure 6.12** and **Figure 6.13**). In terms of noise disturbance, the main area used by wintering shoveler on the Minsmere South Levels is likely to experience peak noise levels of approximately 64dB LA_{max} during Phase 1 of construction (**Figure 8.3**), and of levels between 54 and 64dB LA_{max} during Phases 2 to 5 (**Figure 8.4** to **Figure 8.6**). Therefore, few effects of construction-related disturbance are predicted on wintering shoveler using the Minsmere South Levels.

8.8.515. The project-specific surveys provide little information on the distribution of wintering shoveler in the Sizewell Marshes. However, the WeBS counts suggest higher numbers occur on this site and it is possible (but not known) that the main areas used by shoveler are within, or close to, either the footprint for the worst-case 70dB L_{Amax} contour or the potential visual impact zone, or both. If this were the case, any shoveler using the Sizewell Marshes in winter could be affected by construction-related disturbance.

Dependence of the SPA population on the Sizewell Marshes

8.8.516. As detailed above, wintering shoveler numbers on the Sizewell Marshes are considerably lower than those occurring on the Minsmere-Walberswick SPA. Across the different WeBS count sectors in Suffolk, the WeBS Sizewell Belts sector ranks sixteenth in terms of shoveler abundance (from a total of 24

count sectors in which the species has been recorded in recent years – Ref. 8.118). By contrast, the Minsmere count sector has the third highest five year mean peak count amongst the Suffolk sites, albeit that this also includes the Minsmere South Levels which are outside the SPA (**Table 8.21**).

Table 8.21: Mean annual peak counts of shoveler for the period 2013/14 to 2017/18 for WeBS count sectors in Suffolk; data are presented for the 10 sectors with highest counts

WeBS Count Sector	Mean Of Annual Peak Counts, 2013/14 – 2017/18[1]
Alde Estuary	354
Orwell Estuary	255
Minsmere[2]	214
North Warren & Thorpeness Mere	140
British Sugar Pond East	66
Livermere & Ampton Water	66
Lakenheath Fen	62
Lackford Lakes Nature Reserve	58
Stour Estuary	54
Micklemere	28

[1]Data derived from https://app.bto.org/webs-reporting/ (as at 14 August 2019).

[2]The mean peak value for Minsmere differs from that calculated from the data presented in **Table 6.15** because the above counts encompass all months (with peak counts at Minsmere occurring in April in some years) whereas those in **Table 6.15** are restricted to the defined winter period (October to March – see **Section 6.3 f**).

8.8.517. The preferred habitats of shoveler include freshwater lakes and marshes, with a strong preference for vegetated but muddy shores in open, treeless habitats, although birds will also commonly winter on brackish lagoons and tidal mudflats (Ref. 8.49). At a larger scale, a key habitat preference of shoveler is to use waterbodies which have other waterbodies nearby (Ref. 8.50). Zooplankton provide the main food source of shoveler, although they may feed on benthic prey in shallow waters if zooplankton suspended nearer the surface of the water column become scarce (Ref. 8.120). As for gadwall, the low numbers of shoveler on the Sizewell Marshes is likely to reflect the habitat conditions and, in the case of shoveler, particularly the absence of more extensive open water bodies.

8.8.518. Compared to gadwall, shoveler are more likely to use multiple sites over a 24 hour period, and they also change their patterns of site use regularly over the course of the non-breeding season (Ref. 8.49). In a study involving 67 waterbodies, which spanned a distance of approximately 20 miles, shoveler

numbers within the study area were more variable between waterbodies, but less variable over the group of waterbodies as a whole, than were gadwall numbers. This was taken to suggest that the population was relatively discrete with little inter-change with birds from sites outside the study area (in contrast to gadwall) (Ref. 8.49, Ref. 8.50).

8.8.519. Based on the available evidence, it is clear that shoveler will regularly undertake movements between areas of suitable habitat during the non-breeding season. This supports the above assumptions that movements occur between the Minsmere-Walberswick SPA and Sizewell Marshes (and also Minsmere South Levels), and that a proportion of the SPA population will use the Sizewell Marshes. Although movements between sites may not extend over the same distances as for gadwall, it is also likely that there will be interchange of birds with several of the other sites within the region (so that such movements are not limited to the sites within the immediate vicinity of the SPA). In particular, the Alde Estuary and North Warren and Thorpeness Mere are within 10km of Sizewell Marshes, with the latter two having the highest and fourth highest shoveler counts, respectively, amongst the WeBS count sectors within Suffolk (**Table 8.21**).

8.8.520. Therefore, for the same reasons as already outlined for gadwall above, see section 8.8 k iv of this report, it is likely that the proportional importance of the Sizewell Marshes to the 'assumed wider SPA population' (as calculated above) is an overestimate (because some of the birds using the Sizewell Marshes will be associated with other sites further from the SPA). Similarly, birds from the Minsmere-Walberswick SPA are also likely to use other sites across the region, some of which will provide larger areas of alternative habitat than is found within the Sizewell Marshes.

Construction works associated with the water storage area

8.8.521. As detailed above for the SPA wintering gadwall population, provided in section 8.8 k iv of this report, during the first winter of the construction period only there would also be the potential for noise and visual disturbance to arise from the construction works associated with the water storage area in the northeast of the main development site (additional to the potential noise and visual disturbance effects described above). There is potential for noise and visual disturbance from these works to encroach onto the Minsmere South Levels and the SPA. However, neither the resulting visual impact zone nor the 70dB L_{Amax} noise contour for these construction works extend into areas which are considered to be important for wintering shoveler, as seen in **Figure 8.7** and section 8.8 k iv of this report above.

8.8.522. As such, the construction activities associated with the water storage area would be highly unlikely to increase the potential for construction-related disturbance at the main development site to affect the SPA wintering shoveler population.

Assessment of the effects of noise and visual disturbance

8.8.523. Based upon the above considerations, effects of construction-related disturbance on the Minsmere-Walberswick SPA population of wintering shoveler are likely to occur only when Minsmere-Walberswick SPA birds are present on the Sizewell Marshes. Within the Sizewell Marshes there may be the potential for construction-related disturbance to cause displacement of shoveler from the areas currently used by the species in winter (although data determining the areas of main usage within the Sizewell Marshes are lacking).

8.8.524. However, the numbers of shoveler recorded on the Sizewell Marshes during the non-breeding period are low compared to the total SPA population, representing 4 to 10% of the peak winter numbers which occur on the SPA and the immediately adjacent habitats that are assumed to be functionally linked. Furthermore, the project-specific surveys recorded a near-absence of the species within the Sizewell Marshes, suggesting that the occurrence of wintering shoveler within the Sizewell Marshes may be sporadic. Although a proportion of the birds present on the Sizewell Marshes at any given time are likely to be from the SPA population, this is likely to be less than the estimated 4 to 10%. This is because, as set out above, there is also likely to be interchange of birds between the Sizewell Marshes and several other sites in the region, some of which hold high numbers of wintering shoveler. Additionally, other sites outside the SPA also have the potential to provide more extensive areas of alternative (supporting) habitat for the SPA population than is to be found within the Sizewell Marshes.

8.8.525. Considering the above factors in the context of a population which is currently almost double the size of the population at the time of citation, strongly suggests that the potential displacement of birds from Sizewell Marshes would not prevent achievement of the supplementary advice on the generic conservation objectives to maintain the non-breeding population at a level which is above 100 individuals, whilst avoiding deterioration from its current level (Ref. 6.66, **Table 6.5**).

8.8.526. The above details of the potential construction-related disturbance effects are also assumed to represent a worst-case for the decommissioning phase.

8.8.527. Therefore, no adverse effects on the SPA non-breeding shoveler population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.528. As detailed above for breeding avocet, seen in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are

unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.529. The extent of artificial lighting associated with the operational period is also described in section 8.8 b iv of this report. Based on this information, light spill is not predicted to affect areas of the Minsmere South Levels and Sizewell Marshes that may be used by the SPA non-breeding shoveler population. Therefore, no adverse effects on the SPA non-breeding shoveler population are predicted as a consequence of noise and visual disturbance from operational activities.

v. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.530. The overview of the recreational assessment for the Minsmere-Walberswick SPA, presented above for breeding avocet, see section 8.8 b v of this report, also applies here.

8.8.531. Specific habitat preferences of shoveler are described above in section 8.8 l iv of this report. Suitable habitats within the SPA comprise coastal grazing marshes and associated areas of shallow open water. Outside the breeding season birds are not constrained by requirements to remain near nests or dependent young, and range more widely. Thus, as also described above in section 8.8 l iv of this report, there is likely to be an interchange between birds present on the SPA and functionally linked habitats of Minsmere South levels and Sizewell Marshes, and other wintering sites in the wider region.

8.8.532. The distribution of wintering shoveler is similar to that of overwintering gadwall, with the majority of the SPA non-breeding population on the RSPB Minsmere Reserve (**Table 6.15**), and extending to functionally linked habitats south of the SPA on the Minsmere South Levels and Sizewell Belts.

8.8.533. The assessment provided above for non-breeding gadwall, therefore, also applies to non-breeding shoveler. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for non-breeding shoveler in the Minsmere-Walberswick SPA.

Operation

8.8.534. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, seen in section 8.3 b vi of this report, also applies to non-breeding shoveler at the Minsmere-Walberswick SPA.

8.8.535. The assessment given above for non-breeding gadwall also applies to non-breeding shoveler. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on non-breeding shoveler using the Minsmere-Walberswick SPA.

m) Non-breeding white-fronted goose, project alone

i. Water quality effects – terrestrial environment; and Alteration of local hydrology and hydrogeology

Construction, operation and decommissioning

8.8.536. The assessment reported above for avocet, seen in section 8.8 b i and ii of this report, is also applicable to non-breeding white-fronted goose.

8.8.537. It is concluded that there would be no adverse effect on the integrity of the habitats used by SPA qualifying features due to the alteration of water quality in the terrestrial environment or of local hydrology and hydro-geology, during the construction, operational or decommissioning phases, and therefore no effect on the SPA qualifying features, including non-breeding white-fronted goose.

ii. Changes in air quality

Construction, operation and decommissioning

8.8.538. The assessment reported above for avocet, seen in section 8.8 b iii of this report, is also applicable to white-fronted goose during the breeding season.

8.8.539. There is no likelihood of an adverse effect arising for the conservation objectives for the qualifying feature non-breeding white-fronted goose.

iii. Disturbance effects on species populations

Construction and decommissioning

8.8.540. The evidence relating to the effects of noise and visual disturbance on waterbirds is detailed above in the section on breeding avocet and is taken to apply to wintering white-fronted goose also as detailed in section 8.8 b iv of this report. On the basis of this evidence, it is considered unlikely that noise and visual disturbance from the construction of the Sizewell C Project would affect wintering white-fronted goose when present within the Minsmere-Walberswick SPA. This is because the potential visual impact zone does not extend onto the SPA (other than in the south-eastern extremity, which does not include suitable white-fronted goose habitat[21] – **Figure 8.7**), whilst the peak noise levels within the SPA (again excepting the south-eastern

extremity) during construction of the main development site are predicted to remain below the 70dB L_{Amax} threshold which is applied to wintering waterbirds as seen in section 8.8 b iv of this report, **Figure 8.3** to **Figure 8.6**).

8.8.541. The baseline survey data demonstrate that white-fronted geese make little diurnal use of the Minsmere South Levels and Sizewell Marshes, with the main daytime feeding area being at North Warren, seen in section 6.3 f of this report. However, birds are reported to often roost at night on the Minsmere-Walberswick SPA, and sometimes Minsmere South Levels, which are considerably closer to the main development site, whilst direct flight paths between feeding and roosting areas may take birds over or close to the main development site.

8.8.542. As outlined above in section 8.8 b iv of this report, construction activities at the main development site would be limited during the night-time period so that noise levels would be considerably below those generated during the daytime period. The closest areas of open water which are likely to be used as roosts occur beyond the 64dB L_{Amax} contour for daytime noise levels during all construction phases (**Figure 8.3** to **Figure 8.6**), so that disturbance from noise impacts to the roosting birds is unlikely. Light spillage from the main development site would not extend to such sites.

8.8.543. The SPA white-fronted geese are reported to commute between their main feeding areas and the roosting sites at Minsmere after dusk and before dawn, so that effects of noise and visual disturbance on commuting birds are not predicted (for the reasons outlined above in relation to roosting birds). However, should any disturbance effects occur to these commuting birds, they would be likely to result in small deviations to the flight routes only, and are considered highly unlikely to prevent birds from using the roosting areas.

8.8.544. The above details of the potential construction-related disturbance effects are also assumed to represent a worst-case for the decommissioning phase.

8.8.545. As detailed above for the SPA wintering gadwall population, provided in section 8.8 k iv of this report, during the first winter of the construction period only there would also be the potential for noise and visual disturbance to arise from the construction works associated with the water storage area in the northeast of the main development site (additional to the potential noise and visual disturbance effects described above). There is potential for noise and visual disturbance from these works to encroach onto the Minsmere South Levels and the SPA. However, neither the resulting visual impact zone nor the 70dB L_{Amax} noise contour for these construction works extend into areas where there is extensive standing water, and which are likely to be used by roosting white-fronted geese (see **Figure 8.7** and section 8.8 k iv of this report shown above).

8.8.546. As such, the construction activities associated with the water storage area would be highly unlikely to increase the potential for construction-related disturbance at the main development site to affect the SPA wintering white-fronted goose population.

8.8.547. Therefore, no adverse effects on the SPA non-breeding white-fronted goose population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.8.548. As detailed above for breeding avocet in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.8.549. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report. Based on this information, light spill is not predicted to affect areas of the Minsmere South Levels that may be used by the SPA non-breeding white-fronted goose population. Therefore, no adverse effects on the SPA non-breeding white-fronted goose population are predicted as a consequence of noise and visual disturbance from operational activities.

iv. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.8.550. The overview of the recreational assessment for the Minsmere-Walberswick SPA presented above for breeding avocet, see section 8.8 b v of this report, also applies here.

8.8.551. As described above in section 6.3 f of this report, during the non-breeding season, white-fronted geese make little diurnal use of the Minsmere SPA and functionally linked areas of the Minsmere South Levels and Sizewell Marshes. They are however, reported to roost at night on the Minsmere-Walberswick SPA, and sometimes Minsmere South Levels, arriving at roosting areas after dark and departing before dawn.

8.8.552. The assessment given above for non-breeding gadwall using the Minsmere-Walberswick SPA and Minsmere South Levels is relevant here, with the additional proviso that these assessments are based on diurnal access, and visitor access during the hours of darkness is likely to be at much lower, if not negligible, levels.

8.8.553. Daytime feeding areas at North Warren (part of the Sandlings SPA, although the site is not classified for white-fronted goose) are understood to be within

the RSPB Reserve, where access is controlled to protect sensitive habitats for birds.

8.8.554. Consequently, direct and indirect effects due to an increase in recreational pressure during the construction and decommissioning of Sizewell C are not predicted to adversely affect the conservation objectives for white-fronted goose in the Minsmere-Walberswick SPA.

Operation

8.8.555. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, provided in section 8.3 b vi of this report, also applies to non-breeding white-fronted goose at the Minsmere Walberswick SPA.

8.8.556. The assessment given above for non-breeding gadwall using the Minsmere-Walberswick SPA and Minsmere South Levels is relevant here, with the additional proviso that these assessments are based on diurnal access, and visitor access during the hours of darkness is likely to be at much lower, if not negligible, levels. Consequently, no adverse effects associated with increased recreational pressure are predicted, either directly or indirectly via habitat change, on non-breeding shoveler using the Minsmere-Walberswick SPA. With a strategy in place to manage recreational use of areas within and around the EDF Energy Sizewell Estate, no adverse effects associated with increased recreational pressure are predicted on any qualifying feature of the Minsmere-Walberswick SPA, including non-breeding white-fronted goose, either directly or indirectly via habitat change.

n) Conclusion for the Minsmere-Walberswick SPA, project alone

8.8.557. It is concluded that it is not possible to discount the possibility of an adverse effect on the marsh harrier population occurring as a consequence of noise and visual disturbance from construction and decommissioning activities. With the exception of this effect, no other adverse effects on marsh harrier, or any other species are predicted. It is concluded, therefore, that an adverse effect on the integrity of the Minsmere-Walberswick SPA cannot be excluded due to noise and visual disturbance from construction and decommissioning activities.

o) In-combination effects

8.8.558. The screening exercise for plans or projects that potentially could cause a likely significant in-combination effect with the construction and operation of the Sizewell C Project identified possible likely significant in-combination effect on the Minsmere-Walberswick SPA in relation to the alteration of coastal processes, changes to marine water quality, disturbance effects on

species populations and disturbance due to changes in recreational pressure which is shown in **Appendix C** of this report.

8.8.559. The assessment for adverse effects on site integrity as a result of these potential in-combination effects is presented separately for each impact pathway in **Table 8.22, Table 8.23, Table 8.24,** and **Table 8.25**. No plans or projects are identified as having the potential to result in an adverse in-combination effect with the Sizewell C Project on the Minsmere-Walberswick SPA. For each impact pathway, this is the case when the different plans or projects identified in **Table 8.22, Table 8.23, Table 8.24,** and **Table 8.25** are considered individually and when the assessments for each plan or project in-combination with the Sizewell C Project are considered together.

8.8.560. Therefore, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C Project would not result in adverse in-combination effects on the integrity of the Minsmere-Walberswick SPA.

Table 8.22: In-combination assessment of plans and projects with the potential to affect birds within the Minsmere–Walberswick SPA due to changes in coastal processes

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Suffolk SMP	Adjacent	Alteration to coastal processes. The assessment in section 7.4 e of this report applies here.	None of the proposed management approaches in the Suffolk SMP have the potential to cause in-combination effects on coastal processes / sediment transport. The changes to coastal processes / sediment transport due to the Sizewell C Project would be very small, local to the Project, and too far away to interact with the proposed management approaches. Therefore, it is predicted that an in-combination effect on coastal processes / sediment transport would not arise due to the Sizewell C Project and the outcomes of the Suffolk SMP.	There would be no in-combination effect on any of the qualifying features of the Minsmere-Walberswick SPA.

Table 8.23: In-combination assessment of plans and projects with the potential to affect birds within the Minsmere–Walberswick SPA due to water quality changes

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-Combination Effect?
Sizewell B nuclear power station decommissioning; anticipated to commence in 2035. Current licence for de-silting and maintenance works.	0km to main development site	Water quality effects - marine	No information available. In-combination assessment is not possible.	No
Suffolk SMP	Adjacent	Water quality effects – marine	There is the potential for an in-combination effect with the Sizewell C Project on the SPA little tern population as a result of possible effects on marine water quality. The details of Suffolk SMP are described in section 7.4 e of this report. However, no adverse in-combination effect is predicted, as described for the Alde-Ore Estuary SPA in section 8.3 k of this report, because none of the proposed management approaches have the potential to cause an in-combination effect with the Sizewell C Project due to changes in marine water quality.	No

Table 8.24: In-combination assessment of plans and projects with the potential to affect birds within the Minsmere–Walberswick SPA due to disturbance effects

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Sizewell B nuclear power station decommissioning; anticipated to commence in 2035. Current licence for de-silting and maintenance works.	0km to main development site	Disturbance effects on species populations	No information available. In-combination assessment is not possible.	No

Table 8.25: In-combination assessment of plans and projects with the potential to affect birds within the Minsmere–Walberswick SPA due to recreational disturbance effects

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
DC/16/2104/OUT Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be reserved except for access).	0.9km	Potential for disturbance due to increased recreational pressure.	There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure. The assessment in section 7.7 e iii of this report above applies here: the proposed housing developments would be covered by the Suffolk RAMS Strategy, or by project-specific mitigation commitments, and therefore, there is no potential for an in-combination effect due to potential	No
DC/16/1961/OUT An outline planning application for up to 187 dwellings to include car	1.3km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
parking, open space provision with associated infrastructure and access.			increases in recreational pressure with the activities of the Sizewell C Project. Whilst the Suffolk RAMS is not directly applicable to the Sizewell C Project, SZC Co. would adopt a similar approach to mitigate for any potential impacts. Such an approach would be secured via a monitoring and mitigation plan/agreement with relevant organisations/site managers of the European site in question. Therefore, it is not predicted that an in-combination effect due to recreational disturbance upon the Minsmere-Walberswick SPA would arise.	
DC/16/1322/OUT Outline Application - 100 new residential units (C3) with employment floorspace (B1) (approx. 1000m2) and family orientated public house / restaurant (A3/A4) (approx.770m2)	0.4km	Potential for disturbance due to increased recreational pressure.		No
DC/18/2325/FUL Residential development of 40 dwellings, together with associated access roads, garaging and car parking	1.5km	Potential for disturbance due to increased recreational pressure.		No
DC/16/3947/OUT Erection of 14 sheltered/extra care dwellings, together with residents lounge/meeting room and parking area	4.5km	Potential for disturbance due to increased recreational pressure.		No
DC/18/2621/FUL Erection of 44 no. new dwellings with associated new access road.	6.0km	Potential for disturbance due to increased recreational pressure.		No
DC/18/0702/FUL Residential development of 59 residential dwellings and associated	6.7km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
landscaping and public open space, together with a new vehicular access from existing development and associated highway infrastructure				
DC/17/3981/OUT Outline Application (Some Matters Reserved) - Construction of up to 200 dwellings including car parking, open space provision with associated infrastructure and access	13.7km	Potential for disturbance due to increased recreational pressure.		No
DC/16/5410/OUT Outline Application (with all matters other than means of access reserved) for residential development of up to 160 dwellings with the provision of a new meadow, additional site wide open space and landscaping, land to enable an extension to the existing cemetery and vehicular accesses off Hill Farm Road	13.3km	Potential for disturbance due to increased recreational pressure.		No
DC/19/1141/OUT Outline Application - Development of up to 220 dwellings with associated open space	12.0km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Site Allocations and Area Specific Policies Development Plan Document - East Suffolk Kelsale cum Carlton 1.86ha of land south of Ambleside, Main Road Kelsale cum Carlton, is identified for residential use for approximately 30 units although a higher quantum of development may be appropriate subject to design and layout	6.4km	Potential for disturbance due to increased recreational pressure.		No
East Suffolk emerging Local Plan Benhall 1.76ha of land south of Forge Close between Main Road and Ayden, Benhall, as shown on the Policies Map, is identified for the development of approximately 50 dwellings	8.6km	Potential for disturbance due to increased recreational pressure.		No
East Suffolk emerging Local Plan Darsham 7.33ha of land to the south of Darsham Station, as shown on the Policies Map, is identified for the development of approximately 120 dwellings and open space.	4.1km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
East Suffolk emerging Local Plan Darsham 1.11ha of land north of The Street, Darsham, as shown on the Policies Map, is identified for the development of approximately 25 dwellings	2.5km	Potential for disturbance due to increased recreational pressure.		No
East Suffolk emerging Local Plan Westleton 0.73ha of land to the west of the B1125, Westleton, as shown on the Policies Map, is identified for the development of approximately 20 dwellings.	0.6km	Potential for disturbance due to increased recreational pressure.		No
1.21ha of land at Cherry Lee, Darsham Road, as shown on the Policies Map, is identified for the development of approximately 15 dwellings	0.8km	Potential for disturbance due to increased recreational pressure.		No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.1. Mixed use development. 22.05ha. Approx. 215	7.4km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
dwellings, health care/retirement 2.3ha, sports 8.6ha, education facility				
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.5. Land at Dairy Farm, Saxons Way, Halesworth (1.44ha) as identified on the Policies Map is allocated for a residential development of approximately 40 dwellings and a community centre and pre-school setting.	7.4km	Potential for disturbance due to increased recreational pressure.		No
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Halesworth and Holton Waveney Local Plan 4.4. Land west of Lodge Road, Holton (0.70ha) as identified on the Policies Map is allocated for a residential development of approximately 15 dwellings.	6.6km	Potential for disturbance due to increased recreational pressure.		No

In-Combination Plan Or Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect? -
Waveney Local Plan (still in force until the East Suffolk Plan is prepared) Wrentham Waveney Local Plan 7.8. Land north of Chapel Road, Wrentham. Residential. 4.82ha. Approx 60 dwellings and open space	6.2km	Potential for disturbance due to increased recreational pressure.		No

8.9 Assessment of effects: Minsmere-Walberswick Ramsar site

a) Summary of screening outcomes, project alone

8.9.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site for Ramsar criterion 2, an important assemblage of rare breeding birds associated with marshland and reedbeds:

- Alteration of coastal processes / sediment transport during construction, operation and decommissioning.
- Water quality effects, marine environment during construction, operation and decommissioning.
- Water quality effects, terrestrial environment during construction, operation and decommissioning.
- Changes in air quality during construction, operation and decommissioning.
- Alteration of local hydrology and hydro-geology during construction, operation and decommissioning.
- Direct habitat loss and fragmentation during construction, operation and decommissioning.
- Disturbance effects on species populations during construction, operation and decommissioning.
- Disturbance due to increase in recreational pressure during construction, operation and decommissioning.
- Physical interaction between species and project infrastructure during operation.

8.9.2. No potential effects were screened in for Appropriate Assessment in relation to the associated development sites.

b) Effects on qualifying features screened in, project alone

8.9.3. Although the Ramsar qualifying criteria are different from those of the SPA, there is considerable overlap in the species and populations covered by each designation.

8.9.4. The Ramsar Information Sheet (Ref. 8.121) lists the following species as being included as part of the important assemblage of rare breeding birds associated with marshland and reedbeds: bittern, gadwall, teal, shoveler, marsh harrier, avocet, and bearded tit. With the exception of bearded tit, all

of these species populations are identified as qualifying features of the Minsmere-Walberswick SPA. In addition, other breeding species which may be associated with marshland and reedbeds will also contribute to the assemblage, e.g. little tern, black-headed gull and Mediterranean gull as detailed in section 6.3 g of this report.

8.9.5. Thus, the assessment undertaken above (and the associated conclusions) for each effect pathway for the qualifying features of the Minsmere-Walberswick SPA which are associated with marshland and reedbeds is also considered to apply to the Ramsar site. As with these SPA qualifying features, the main breeding sites for other species associated with the Ramsar site assemblage are not predicted to be affected by the effects that have been screened in (on the basis of the reasons given for the SPA qualifying features).

8.9.6. Similarly, adverse effects are considered unlikely in relation to the foraging areas of the other species in the assemblage. Several of these other species have large marine foraging ranges (little tern) or exploit both terrestrial and marine foraging habitats (e.g. lesser black-backed gull and black-headed gull), so changes in marine water quality and indirect effects of underwater noise, and potential indirect effects from impingement and entrainment of prey within the cooling water system, would be the same or less than those assessed for the SPA breeding little tern population (Ref. 8.122, Ref. 6.65). Bearded tits are likely to occur widely within reedbed habitat within the Ramsar site and are highly unlikely to rely on foraging habitats outside the site.

c) Conclusion for the Minsmere-Walberswick Ramsar Site, project alone

8.9.7. It is concluded that it is not possible to discount the possibility of an adverse effect on the marsh harrier population occurring as a consequence of noise and visual disturbance from construction activities. With the exception of this effect, no other adverse effects on marsh harrier, or any other species are predicted, subject to mitigation as described for the Minsmere-Walberswick SPA as seen in section 8.8 of this report. It is concluded, therefore, that an adverse effect on the integrity of the Minsmere-Walberswick Ramsar site cannot be excluded due to noise and visual disturbance from construction activities.

8.9.8. As described in detail above for Minsmere-Walberswick SPA in section 8.8 d v of this report, habitat improvement measures are proposed for a 48.7ha area of land which is immediately adjacent to the northern part of the Minsmere South Levels, to provide compensation. There is a high level of confidence that the habitat improvement measures proposed would be sufficient to compensate for the predicted loss of foraging resource due to noise and visual disturbance during the construction phase. An adverse

effect is not predicted to arise during the decommissioning phase given this alternative habitat would be available for use during decommissioning and regularly used by marsh harrier for foraging.

d) In-combination effects

8.9.9. The conclusions of the in-combination assessment undertaken for the Minsmere-Walberswick SPA also apply to the Minsmere-Walberswick Ramsar site. Hence no in-combination effects are predicted.

8.10 Assessment of effects: Outer Thames Estuary SPA

a) Summary of screening outcomes, project alone

8.10.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site:

- Water quality effects – marine environment, during construction and operation for the qualifying features:
  - breeding populations of little tern; common tern
  - non-breeding populations of red-throated diver.
- Disturbance effects on species populations, during construction and operation, for the qualifying features:
  - breeding populations of little tern; common tern
  - non-breeding populations of red-throated diver.
- Physical interaction between species and project infrastructure, during operation for the qualifying features:
  - breeding populations of little tern; common tern
  - non-breeding populations of red-throated diver.

8.10.2. No potential effects were screened in for Appropriate Assessment in relation to the associated development sites.

b) Breeding little tern, project alone

i. Water quality effects – marine environment

Construction, operation and decommissioning

8.10.3. Of the little tern breeding colonies which contribute to the Outer Thames Estuary SPA little tern population, the marine water quality effects associated

with the Sizewell C Project have the potential to affect those colonies associated with the Alde-Ore Estuary SPA, Benacre to Easton Bavents SPA and Minsmere-Walberswick SPA (**Table 6.16**). The potential marine water quality effects on the foraging habitats of little terns during construction, operation and decommissioning are assessed for each of these breeding colony SPAs in the relevant sections above i.e. sections 8.3 c ii, 8.5 c ii and 8.8 e ii of this report. For each of these SPA populations, no adverse effects are predicted as a result of marine water quality effects during construction, operation and decommissioning.

8.10.4. It therefore follows that no adverse effects on the Outer Thames Estuary SPA little tern population are predicted as a consequence of marine water quality effects associated with the Sizewell C Project.

ii. Disturbance effects on species populations

Construction, operation and decommissioning

8.10.5. Of the little tern breeding colonies which contribute to the Outer Thames Estuary SPA little tern population, only those in (or close to) the Minsmere-Walberswick SPA have the potential to be affected by noise and visual disturbance from the construction, operation and decommissioning of the main development site. Currently, these colonies comprise a small proportion of the overall little tern population for which the Outer Thames Estuary SPA provides supporting habitat (**Table 6.5** and **Table 6.16**).

8.10.6. The potential effects of noise and visual disturbance on the Minsmere-Walberswick SPA little tern population during construction, operation and decommissioning are assessed in section 8.8 e vi of this report. This encompasses consideration of these effects on the SPA birds when they are away from the colony and using the marine environment, and includes assessment of the effects of underwater noise. For the Minsmere-Walberswick SPA little tern population, no adverse effects are predicted as a result of noise and visual disturbance during construction, operation and decommissioning.

8.10.7. It, therefore, follows that no adverse effects on the Outer Thames Estuary SPA little tern population are predicted as a consequence of the effects of noise and visual disturbance associated with the Sizewell C Project.

iii. Physical interaction between species and project infrastructure

Operation

8.10.8. As for water quality effects, of the little tern breeding colonies which contribute to the Outer Thames Estuary SPA little tern population, the

Sizewell C Project has the potential to affect those colonies associated with the Alde-Ore Estuary SPA, Benacre to Easton Bavents SPA and Minsmere-Walberswick SPA. The potential effects of impingement and entrainment of prey populations on the foraging habitats of little terns during operation are assessed for each of these breeding colony SPAs in the relevant sections above i.e. sections 8.3 c vii, 8.5 c iv and 8.8 e viii of this report. For each of these SPA populations, no adverse effects are predicted as a consequence of physical interaction with project infrastructure during operation.

8.10.9. It follows, therefore, that no adverse effects on the Outer Thames Estuary SPA little tern population are predicted as a consequence of physical interaction with infrastructure associated with the Sizewell C Project.

c) Breeding common tern, project alone

i. Water quality effects – marine environment

Introduction

8.10.10. Of the common tern breeding colonies which contribute to the Outer Thames Estuary SPA common tern population, marine water quality effects associated with the Sizewell C Project have the potential to affect those which occur within the Alde-Ore Estuary SPA and Minsmere-Walberswick SPA (**Table 6.17**). Common tern is not a qualifying feature of either of these SPAs, but the colonies are located at Orfordness (in the Alde-Ore Estuary SPA) and Minsmere (in the Minsmere-Walberswick SPA). Effects of marine water quality on the foraging habitat of common terns associated with these breeding colonies could arise via discharges during construction or operation.

8.10.11. The mean maximum foraging range of breeding common terns is estimated as 18.6km and, for the purposes of this assessment, the foraging range of birds from the Orfordness and Minsmere colonies is assumed to be encompassed by a radius of 18.6km from the colony location as seen in section 6.3 h of this report (Ref. 6.58). However, areas of concentrated foraging activity are likely to occur in those parts of the range which are closer to the colony as seen in section 6.3 h of this report (Ref. 6.58).

Construction and decommissioning

8.10.12. As outlined above for the Minsmere-Walberswick SPA breeding little tern population in section 8.8 e ii of this report, the effects of relevance during the construction period are SSC as a result of dredging and hydrazine from the cold flush testing at commissioning. The effects of relevance for the decommissioning phase just relate to SSC. The predicted foraging ranges of common terns from the Orfordness and Minsmere colonies show negligible

(1% or less in all cases) overlap with the maximum areas of the instantaneous plumes calculated for surface SSC above 100 mg/l for each of the different dredging activities (**Table 8.26**). For hydrazine (at levels above acute PNEC concentrations), the peak instantaneous plume area encompasses less than 0.1% of the foraging range of each of the Minsmere and Orfordness colonies (with the values for the overlap mean plume area being an order of magnitude lower).

Table 8.26: Overlap of the predicted foraging ranges of SPA common terns breeding at the Orfordness and Minsmere colonies with the maximum area of the plumes for instantaneous SSC above 100 mg/l for different construction dredging activities

Colony	Dredging Activity	Spring Tide		Neap Tide	
		Area (km^2)	%	Area (km^2)	%
Orfordness	Surficial sediments for CW intake	2.38	Less than 1	2.91	Less than 1
	Surficial sediments for FRR1	0.38	Less than 1	0.32	Less than 1
	BLF navigational channel	0.97	Less than 1	0.48	Less than 1
Minsmere	Surficial sediments for CW intake	2.65	1	2.06	Less than 1
	Surficial sediments for FRR1	0.89	Less than 1	0.54	Less than 1
	BLF navigational channel	0.98	Less than 1	0.48	Less than 1

8.10.13. Given the very small levels of overlap of the plumes from the construction (and decommissioning) related discharges with the predicted common tern foraging ranges, combined with the temporary and short-term duration of these plumes, no adverse effects on the Outer Thames Estuary SPA common tern population are predicted as a consequence of construction-related discharges from the Sizewell C Project.

Operation

Thermal uplift

8.10.14. For common tern, the thermal plumes associated with the 2°C and 3°C temperature uplifts are considered for May to August (as the period over which it is present as a breeding species at the colonies of interest). Over this period, the areas encompassed at the sea surface by the 98th percentiles

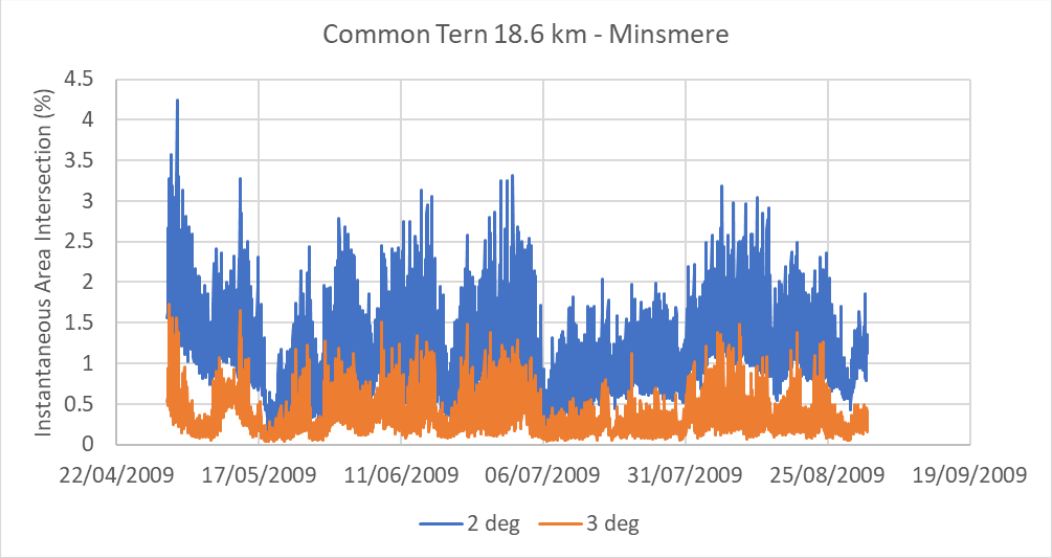
for the existing 2°C and 3°C thermal plumes (for Sizewell B) extend to 16.7km^2 and 9.4km^2, respectively (whilst the equivalent plumes for Sizewell C, when considered alone, extend across 9.0km^2 and 2.5km^2, respectively). Incorporating the Sizewell C thermal plumes together with the Sizewell B plumes increases these areas to 36.9km^2 for the 2°C uplift and 15.3km^2 for the 3°C uplift (**Plate 8.7**).

8.10.15. The 2°C and 3°C thermal plumes from the combined effects of Sizewell B and Sizewell C lie entirely within the foraging range of the Minsmere colony and almost entirely within the range of the Orfordness colony (**Plate 8.7**). Based on the 98th percentile, these plumes represent 7.2% (for the 2°C uplift) and 3.0% (for the 3°C uplift) of the assumed foraging range of the Minsmere colony when the combined effects of Sizewell B and Sizewell C are considered, and 3.3% (for the 2°C uplift) and 1.8% (for the 3°C uplift) when considering Sizewell B alone. The percentage overlaps of the equivalent thermal plumes with the assumed foraging range of the Orfordness colony are slightly smaller (with the largest difference being the 2°C uplift for Sizewell B and Sizewell C combined, for which there is a 4.9% overlap).

8.10.16. Given that areas of concentrated foraging activity are likely to occur closer to the colony, the area of overlap with the thermal plumes is also considered in relation to the area defined by a radius of 4.5km from the colony (equivalent to the mean foraging range for the species, as determined by Thaxter *et al.* 2012 (Ref. 4.8)). For the Minsmere colony, the 2°C and 3°C thermal plumes (defined by the 98th percentile) for the combined effects of Sizewell B and Sizewell C represent 55.7% (for the 2°C uplift) and 31.8% (for the 3°C uplift) of this smaller range, which compares with 32.5% (for the 2°C uplift) and 21.5% (for the 3°C uplift) for the existing thermal plumes associated with Sizewell B. For the Orfordness colony, only the 2°C thermal plume for the combined effects of Sizewell B and Sizewell C overlaps with this smaller foraging range (with this area of overlap representing 1.0% of the smaller range).

8.10.17. When the instantaneous plumes (as calculated at hourly intervals from May to August) for the combined effects of Sizewell B and Sizewell C are considered, the 2°C uplift encompasses a maximum of 4.2% and 3.3% of the Minsmere and Orfordness common tern foraging ranges, respectively, at any one point in time, and an average of approximately 1.0% for each colony during the breeding period (**Plate 8.13, Table 8.27**). These percentages are considerably lower (at approximately 1.5% and less than 0.5% for the maximum and average overlap, respectively, at each colony) when considering the 3°C uplift and represent small absolute increases on the existing baseline situation resulting from the Sizewell B thermal plume.

Plate 8.13: Instantaneous area of overlap of the Minsmere (upper) and Orfordness (lower) common tern colony foraging ranges with the 2°C and 3°C uplifts for Sizewell B together with Sizewell C for May to August



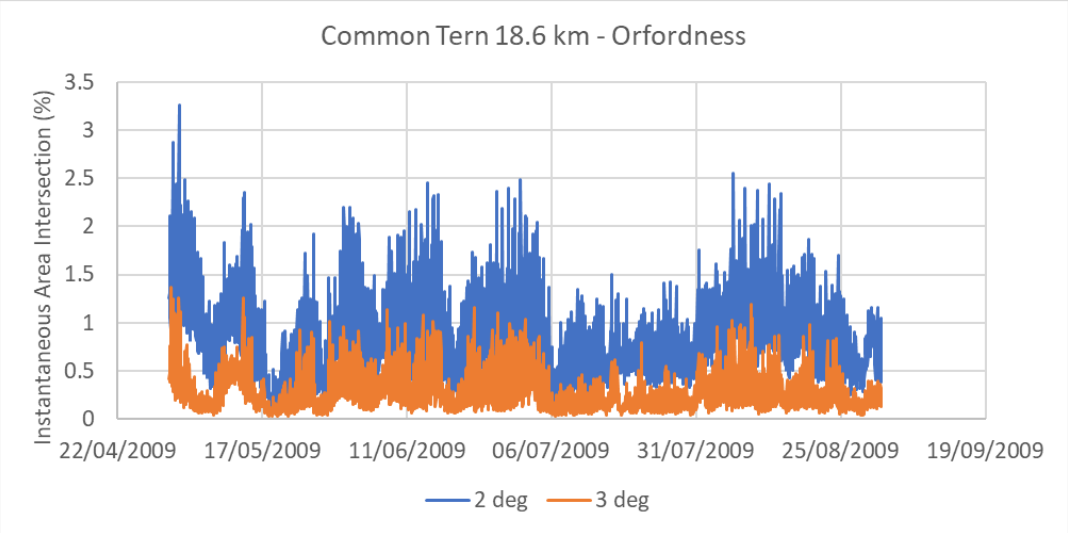


Table 8.27: The maximum and mean instantaneous areas of thermal plumes at the sea surface for the 2°C and 3°C uplifts for Sizewell B alone and for Sizewell B together with Sizewell C for May to August, with the percentage overlap with the predicted foraging ranges of the Orfordness and Minsmere common tern colonies

Colony	Temperature Uplift	Projects		Area (km^2)	Percentage Of Foraging Range
Orfordness	2°C	Sizewell B alone	Mean	2.6	0.4
			Maximum	10.5	1.5
		Sizewell B plus C	Mean	5.9	0.8
			Maximum	21.7	3.3
	3°C	Sizewell B alone	Mean	1.1	0.2
			Maximum	6.7	1.1
		Sizewell B plus C	Mean	1.9	0.3
			Maximum	8.8	1.4
Minsmere	2°C	Sizewell B alone	Mean	2.6	0.5
			Maximum	10.5	2.1
		Sizewell B plus C	Mean	5.9	1.1
			Maximum	21.7	4.2
	3°C	Sizewell B alone	Mean	1.1	0.2
			Maximum	6.7	1.3
		Sizewell B plus C	Mean	1.9	0.4
			Maximum	8.8	1.7

8.10.18. Considering the instantaneous plumes in relation to the marine area encompassed by the mean foraging range of common tern (as a proxy for the area in which foraging activity is more concentrated – see above), indicates considerably larger overlaps. Thus, for the Minsmere colony, the 2°C uplift for the combined effects of Sizewell B and Sizewell C accounts for a maximum of 41.6% and an average of 13.7% of this smaller range over the breeding period, which compares with maximum and average overlaps of 29.3% and 7.2%, respectively, under existing, baseline, conditions (resulting from Sizewell B). Similarly, for the 3°C uplift, the plume for the combined effects of Sizewell B and Sizewell C encompasses a maximum of 26.9% and average of 5.4% of this smaller range for the Minsmere colony, compared to 21.8% and 3.6%, respectively, under the existing conditions.

8.10.19. For the Orfordness colony, the 2°C uplift for the combined effects of Sizewell B and Sizewell C encompasses a maximum of 13.2% and an average of 0.2% of this smaller range over the breeding period, representing approximate two-fold and four-fold increases, respectively, on the existing extent of overlap resulting from Sizewell B. Similarly, the 3°C thermal plume for the combined effects of Sizewell B and Sizewell C encompasses a maximum of 3.6% and average of 0.02% of this smaller range, representing approximate one and a half-fold and three-fold increases, respectively, on the existing extent of overlap resulting from Sizewell B.

8.10.20. The project-specific survey data relating to the foraging activity of common terns within the vicinity of these two colonies and the Sizewell coast show that the birds actively forage within areas encompassed by the existing 2°C thermal plume associated with Sizewell B (**Plate 6.11**).

8.10.21. Based on the above, the thermal discharges from Sizewell C are predicted to cause moderate increases in the extent to which the 2°C thermal plume encroaches onto the likely foraging ranges of the Minsmere and Orfordness common tern colonies, which contribute to the Outer Thames Estuary SPA common tern population. For the Minsmere colony, the current 3.3% overlap (from existing discharges at Sizewell B) would increase to 7.2%, whilst for the Orfordness colony it would increase from 2.3% to 4.9% (as determined by the 98th percentiles). However, over the course of the breeding period, the average extent of overlap between the 2°C uplift plume (for Sizewell B combined with Sizewell C) and each of these colony foraging ranges approximates to only 1%. Furthermore, for the reasons given in section 8.3 b ii of this report, it is considered that the 2°C uplift is likely to represent an overly precautionary threshold. The 3°C uplift indicates a relatively small overlap with each of the common tern foraging ranges (3.0% or less for the 98th percentile of the thermal plume, and less than 0.5% for the average instantaneous overlap) and small absolute increases relative to the existing, baseline, conditions.

8.10.22. The 2°C and 3°C thermal plumes from Sizewell B and Sizewell C occur relatively close to shore (**Plate 8.7**). For the Minsmere colony, this means that any potential effects of the temperature uplift on common tern prey species may disproportionately affect those parts of the range where foraging activity is likely to be greatest (because range usage declines with distance from colony – Ref. 6.58). This is illustrated by the substantial overlaps between the thermal plumes and the marine area that lies within the mean common tern foraging range of the Minsmere colony, with the 98th percentile for the 2°C uplift for Sizewell B combined with Sizewell C encompassing 55.7% of this area. However, these more inshore parts of the Minsmere common tern foraging range currently overlap extensively with the existing 2°C and 3°C thermal plumes from Sizewell B (e.g. the 98th percentile for the 2°C uplift for Sizewell B encompasses 32.5% of the marine area within mean

foraging range of this colony). Therefore, it seems unlikely that the increased extent of the thermal uplift would greatly alter the existing baseline conditions for common terns foraging in relatively close proximity of the Minsmere colony. This consideration is less relevant to the common terns from the Orfordness colony because the 2°C and 3°C thermal plumes occur largely towards the extremity of the mean maximum foraging range from this colony (**Plate 8.7**).

8.10.23. Given the above, it is considered unlikely that the thermal discharges from Sizewell C would have detrimental effects on the common terns nesting at the Minsmere and Orfordness colonies. Furthermore, potential effects of the thermal plumes on the availability of foraging habitat are only relevant to a proportion of the Outer Thames Estuary SPA common tern population because other (currently larger) breeding colonies which contribute to this population will be unaffected due to their greater distance from the Sizewell C Project (**Table 6.17**). Therefore, no adverse effects on the Outer Thames Estuary SPA common tern population are predicted as a consequence of thermal discharges during the operational period.

Chemical discharges

8.10.24. The extents of the total residual oxidant, bromoform and hydrazine plumes (for the defined thresholds) at the sea surface within the predicted foraging ranges of both the Orfordness and Minsmere common tern colonies are as detailed above for the Alde-Ore SPA Sandwich tern population in section 8.3 b ii of this report, **Plate 8.3, Plate 8.4** and **Plate 8.5**). For each of the two colonies, the total residual oxidant plume for Sizewell C encompasses less than 0.7% of the foraging range, which is slightly less in each case than the percentage overlap with the existing Sizewell B total residual oxidant plume. When considered in relation to the marine area encompassed by the mean foraging range of common tern (as a proxy for the area in which foraging activity is more concentrated – see above), the percentage overlap with the total residual oxidant plume for Sizewell C represents 6.5% of this smaller foraging range for the Minsmere colony but does not overlap at all in the case of the Orfordness colony. As with the areas encompassed by the 2°C and 3°C thermal plumes for the Minsmere colony, this overlap should be considered within the context of a 9.7% overlap of this smaller range with the existing total residual oxidant plume for Sizewell B.

8.10.25. The bromoform plume encompasses 0.1% of the predicted foraging range of each colony, compared to 0.6% for the existing Sizewell B bromoform plume. When considered in relation to the marine area encompassed by the mean foraging range of common tern, the extent of overlap is 1.4% for the Minsmere colony (which compares with a 7.6% overlap with the existing plume for Sizewell B), whilst there is no overlap with this smaller foraging range in the case of the Orfordness colony.

8.10.26. The hydrazine plume for Sizewell C encompasses 0.3% of each colony foraging range for the chronic PNEC values and approximately 0.02% for the acute PNEC values. When considered in relation to the marine area encompassed by the mean foraging range of common tern, the extent of overlap is 3.2% and 0.4% for the chronic and acute PNEC values, respectively, for the Minsmere colony, whilst (again) there is no overlap with this smaller foraging range in the case of the Orfordness colony.

8.10.27. As with the thermal discharges, the project-specific survey data relating to the foraging activity of common terns within the vicinity of these two colonies and the Sizewell coast show that birds actively forage within areas encompassed by the existing total residual oxidant and bromoform plumes associated with Sizewell B (**Plate 6.11**).

8.10.28. The chemical discharges from Sizewell C would affect only a small proportion of the available foraging range for common terns from the Orfordness and Minsmere colonies. These areas are smaller, overall, than the areas of the foraging ranges which are potentially affected by the existing total residual oxidant and bromoform plumes associated with Sizewell B. Furthermore, potential effects of the chemical discharges on the availability of foraging habitat are only relevant to a proportion of the Outer Thames Estuary SPA common tern population because other (currently larger) breeding colonies which contribute to this population will be unaffected due to their greater distance from the Sizewell C Project (**Table 6.17**). Although these plumes would extend across a greater proportion of the marine area that lies within the mean foraging range of common tern from the Minsmere colony (as a proxy for the area in which foraging activity is likely to be more concentrated), the extent of overlap is considerably less than that which currently occurs as a result of the existing plumes from Sizewell B. Also, for the Orfordness colony, there is no overlap with these plumes when considering this smaller foraging range.

8.10.29. Given this, no adverse effects on the Outer Thames Estuary SPA common tern population are predicted as a consequence of chemical discharges during the operational period.

ii. Disturbance effects on species populations

Construction and decommissioning

8.10.30. As described above for the Minsmere-Walberswick SPA little tern population, disturbance from construction and decommissioning activities could affect birds foraging in the marine environment either directly via increased vessel traffic or indirectly via the effects of underwater noise on their fish prey species as seen in section 8.8 e vi of this report.

8.10.31. During the construction (and by assumption the decommissioning) period deliveries to the BLF are likely to represent (at most) just over two vessel movements on average per day during the common tern breeding period, which would cause a small increase in existing levels of vessel traffic within the waters around Sizewell (with surveys during the summer months recording an average of 72 vessels per day in these waters – Ref. 8.105). Such increases in vessel traffic are unlikely to affect foraging common terns to any extent, particularly given that common terns are considered to be relatively insensitive to sources of anthropogenic disturbance, such as vessel traffic (Ref. 8.123, Ref. 6.59).

8.10.32. The different sources of underwater noise which would occur during construction (and which are also assumed for decommissioning) are also described in section 8.8 e vi of this report, along with details of their potential effects on fish prey species (with clupeids also likely to be amongst the main prey types of common terns foraging in the waters around Sizewell, as is the case for little terns). Of the common tern breeding colonies which contribute to the Outer Thames Estuary SPA common tern population, only those at Minsmere and Orfordness have the potential to be affected as a result of underwater noise effects on fish. However, this potential is considerably lower for birds from the Orfordness colony because the effects are occurring at the margins of the predicted foraging range of birds from this colony (Ref. 8.1).

8.10.33. Mortality and recoverable injury of fish as a result of underwater noise from different construction-related activities are predicted to extend over small areas only (**Table 8.11**). Thus, the areas over which such effects would extend as a result of impact piling for the BLF construction would encompass less than 0.01% of the predicted foraging range of each of the Minsmere and Orfordness common tern colonies, whilst for the hypothetical worst-case scenario of different dredging activities being undertaken simultaneously the area of effect equates to just over 0.01% of the predicted foraging ranges.

8.10.34. TTS and behavioural responses in fish are predicted to occur over considerably greater areas as a result of underwater noise from the construction activities (**Table 8.11**). However, the largest predicted areas of effect for TTS and behavioural responses (both resulting from the worst-case simultaneous dredging scenario) represent only approximately 2% and 4%, respectively, of the predicted foraging range of each common tern colony. Furthermore, TTS and behavioural responses are temporary effects (with any reduction in prey availability within the affected area due to the latter response expected to be limited to the duration of the activity), and the different piling, drilling and dredging activities generating the underwater noise are anticipated to be of relatively short duration as seen in section 8.8 e vi of this report.

8.10.35. Therefore, noise and visual disturbance in the marine environment as a result of construction activities would represent small changes relative to the existing situation (in terms of vessel traffic) or would produce effects which extend over relatively small parts of the common tern foraging ranges only and which are largely of temporary nature and produced by activities which would be of relatively short duration. Furthermore, the effects of noise and visual disturbance have the potential to affect only a proportion of the common terns for which the Outer Thames Estuary SPA provides supporting habitat (currently approximately 30%).

8.10.36. Consequently, no adverse effects on the Outer Thames Estuary SPA common tern population are predicted as a consequence of noise and visual disturbance during construction and decommissioning.

Operation

8.10.37. As detailed above for breeding avocet in section 8.8 b vi of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting. The levels of underwater noise predicted to be generated with Sizewell C and Sizewell B operational, are not expected to differ markedly from current baseline levels resulting from the operation of Sizewell B alone (Ref. 8.106).

8.10.38. Therefore, no adverse effects on the SPA common tern population are predicted as a consequence of noise and visual disturbance from operational activities.

iii. Physical interaction between species and project infrastructure

Operation

Introduction

8.10.39. As described above in the assessment for Sandwich tern at the Alde-Ore Estuary SPA in section 8.3 b vii of this report, during the operation of Sizewell C, populations of the fish and marine invertebrate prey of common terns may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA population.

Predicted impingement of common tern prey

8.10.40. As above, of the common tern breeding colonies which contribute to the Outer Thames Estuary SPA common tern population, the Sizewell C Project has the potential to affect those which occur within the Alde-Ore Estuary SPA and Minsmere-Walberswick SPA, with the colonies located at Orfordness (in

the Alde-Ore Estuary SPA) and Minsmere (in the Minsmere-Walberswick SPA). Common tern is not a qualifying feature of either of these SPAs.

8.10.41. Information on the foraging behaviour and diet of common terns is provided in section 6.3 h of this report above. The mean maximum foraging range of breeding common terns is estimated as 18.6km and, for the purposes of this assessment, the foraging range of birds from the Orfordness and Minsmere colonies is assumed to be encompassed by a radius of 18.6km from the colony location. Thus, common terns from either colony may forage offshore of Sizewell C.

8.10.42. The likely effects of entrainment and impingement on marine invertebrates were assessed as negligible.

8.10.43. The most important fish prey for common tern in the southern North Sea are herring and sprat.

8.10.44. As described above in the assessment for Sandwich tern at the Alde-Ore Estuary SPA in section 8.3 b vii of this report, combined impingement and entrainment mortality of herring and sprat is estimated at less than 1% of the relevant SSB. Impacts on these fish species, at the scale of the SSB populations and on local populations, are considered to be so small as to be undetectable in the context of year to year variation in fish populations due to other environmental factors.

Potential effects on the SPA common tern population

8.10.45. Based on the above, the impingement and entrainment of prey by the cooling water system during the operation of Sizewell C is not predicted to result in depletion of prey resources for common terns within the Outer Thames Estuary SPA. Therefore, no adverse effects on the SPA population are predicted as a consequence of physical interaction with project infrastructure.

d) Non-breeding red-throated diver, project alone

i. Water quality effects – marine environment

Introduction

8.10.46. For the purposes of the assessment of potential effects on the Outer Thames Estuary SPA non-breeding red-throated diver population, the entirety of the SPA is taken to represent the foraging area available to this population, with the SPA extending across a total area of 3,924.5km^2.

Construction and decommissioning

8.10.47. As detailed above for the Minsmere-Walberswick SPA breeding little tern population in section 8.8 e ii of this report, the areas of the marine environment predicted to be affected by discharges of SSC and hydrazine during construction (including commissioning) and decommissioning are relatively small, with resulting plumes relatively short-lived. This is particularly the case when these are considered relative to the extent of the foraging area available to non-breeding red-throated divers within the Outer Thames Estuary SPA.

8.10.48. Given this, no adverse effects on the SPA non-breeding red-throated diver population is predicted as a consequence of construction-related discharges.

Operation

Thermal discharges

8.10.49. For red-throated diver, the thermal plumes associated with the 2°C and 3°C temperature uplifts are considered for September to March (as the period over which it is present within the SPA). Over this period, the area encompassed at the sea surface by the effects of Sizewell B combined with Sizewell C extend to 25.5km^2 for the 3°C thermal plume (based on the 98th percentile). The extent of the 2°C and 3°C thermal plumes for this winter period is little different to that as calculated for the full annual period (**Figures 7.3** and **7.4**).

8.10.50. The thermal plumes overlap with the north-western block of the SPA only, which is estimated to hold approximately 20% of the SPA red-throated diver population - compare **Figure 4.1** and **Figure 7.3**, seen in section 6.3 h of this report (Ref. 6.101). Therefore, any effects of the thermal plumes on foraging red-throated diver would affect a smaller proportion of the SPA population than indicated by the extent of spatial overlap between the plumes and the SPA.

8.10.51. The instantaneous plume sizes (as calculated at hourly intervals for the September to March period) show that for the combined effects of Sizewell B and Sizewell C, the 2°C uplift accounts for a peak of 62.0km^2 (or 1.6%) of the SPA area at any one point in time, and an average of 11.4km^2 (or 0.3%). These percentage overlaps with the SPA are considerably lower when considering the 3°C uplift and represent modest absolute increases only on the existing baseline situation, as represented by the Sizewell B thermal plume (**Plate 8.14**, **Table 8.28**).

Plate 8.14: Instantaneous area of overlap of the Outer Thames Estuary SPA with the 2°C and 3°C uplifts for Sizewell B together with Sizewell C for September to March

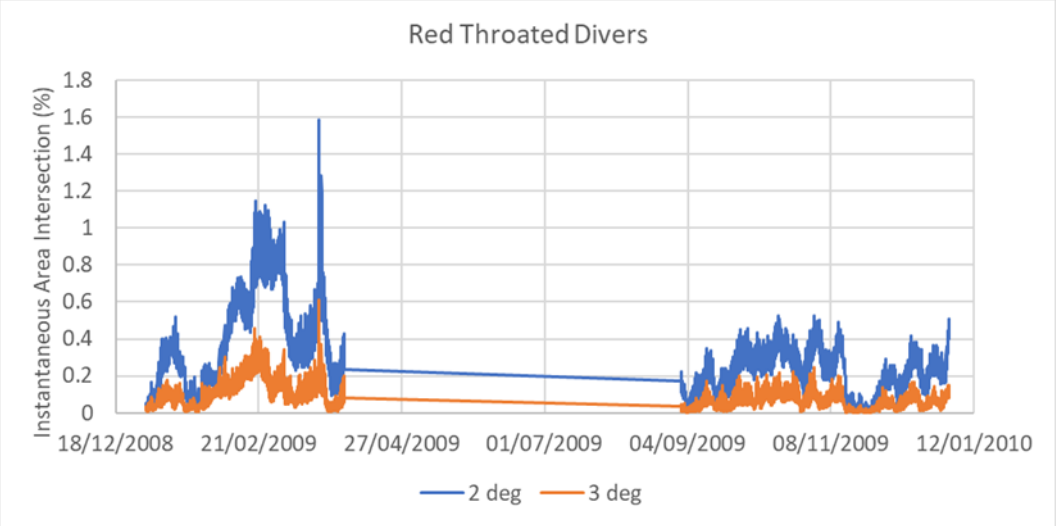


Table 8.28: The maximum and mean instantaneous areas of thermal plumes at the sea surface for the 2°C and 3°C uplifts for Sizewell B alone and for Sizewell B together with Sizewell C for September to March with the percentage overlap with the Outer Thames Estuary SPA

Temperature Uplift	Projects		Area (km²)	Percentage (%) Of The SPA Area
2°C	Sizewell B alone	Mean	4.5	0.1
		Maximum	13.9	0.4
	Sizewell B plus C	Mean	11.4	0.3
		Maximum	62.0	1.6
3°C	Sizewell B alone	Mean	1.8	0.04
		Maximum	10.4	0.3
	Sizewell B plus C	Mean	3.2	0.1
		Maximum	23.9	0.6

8.10.52. The project-specific survey data relating to the distribution of red-throated diver along the coast to the north and south of Sizewell show that relatively high densities of birds occur within areas encompassed by the existing 2°C thermal plume associated with Sizewell B (**Plate 6.13**).

Chemical discharges

8.10.53. The extents of the total residual oxidant and bromoform plumes (for the defined thresholds) at the sea surface for Sizewell C encompass areas of 3.4km^2 and 0.52km^2 of the SPA, representing 0.09% and 0.01% of the SPA, respectively. These compare to existing plume areas within the SPA from Sizewell B of 3.9km^2 for total residual oxidant and 3.1km^2 for bromoform, representing 0.10% and 0.08% of the SPA, respectively (**Plate 8.3** and **Plate 8.4**).

8.10.54. For hydrazine discharge from Sizewell C, the plume encompasses 1.6km^2 (0.04%) of the SPA for the chronic PNEC values and 0.1km^2 (less than 0.01%) for the acute PNEC values (**Plate 8.5**).

Conclusion

8.10.55. Based on the above considerations, the thermal and chemical discharges from the Sizewell C Project would occur across a small part of the SPA only and be restricted to the northern parts of the SPA, where the densities of red-throated diver are considerably lower than in the more southern parts, as seen in section 6.3 h of this report. Therefore, no adverse effects on the SPA red-throated diver population are predicted as a consequence of thermal and chemical discharges during the operational period.

ii. Disturbance effects on species populations

Construction and decommissioning

8.10.56. As for SPA tern populations, disturbance from the construction and decommissioning activities which would occur in the marine environment may affect the Outer Thames Estuary SPA population of non-breeding red-throated diver. This could be either directly via increased vessel traffic or indirectly via the effects of underwater noise on their fish prey species, as seen in sections 8.8 e vi, 8.10 b ii and 8.10 c ii of this report.

8.10.57. In relation to vessel traffic during the construction period (and as assumed for decommissioning), most of the deliveries to the BLF would occur between 31st March and 31st October. Thus, the main period of increased vessel activity would have little overlap with the period of the year in which red-throated divers are present within the SPA, with April being the only month when the main period of BLF deliveries may coincide with a relatively high abundance of red-throated diver within the waters around Sizewell as provided in section 6.3 h of this report. Also, as detailed in section 8.8 e vi of this report, deliveries to the BLF would represent a small increase only to the existing levels of vessel traffic in the waters around Sizewell.

8.10.58. In relation to indirect effects, the different potential sources of underwater noise disturbance during construction (and as assumed for decommissioning) and the extent of their effects on the fish prey of red-throated divers are detailed in section 8.8 e vi of this report. Mortality and recoverable injury of fish are predicted to extend over small areas only (**Table 8.11**), with the maximum extent of such effects from each of the proposed impact piling, drilling and individual dredging activities (including the worst-case scenario for different dredging activities occurring simultaneously) equating to less than 0.002% of the SPA area (which is assumed to represent the available foraging area for red-throated divers). TTS and behavioural responses in fish are predicted to occur over larger areas (**Table 8.11**), but these still equate to only approximately 0.2% and 0.5%, respectively, of the SPA area. Furthermore, as noted above, TTS and behavioural responses are temporary effects (with any reduction in prey availability within the affected area due to the latter response expected to be limited to the duration of the activity), and the different piling, drilling and dredging activities generating the underwater noise are anticipated to be of relatively short duration , as seen in section 8.8 e vi of this report.

8.10.59. Given the above, no adverse effects on the Outer Thames Estuary SPA red-throated diver population are predicted as a consequence of noise and visual disturbance during construction and decommissioning.

Operation

8.10.60. As detailed above for breeding avocet in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting. The levels of underwater noise predicted to be generated with Sizewell C and Sizewell B operational, are not expected to differ markedly from current baseline levels resulting from the operation of Sizewell B alone (Ref. 8.106).

8.10.61. Therefore, no adverse effects on the SPA red-throated diver population are predicted as a consequence of noise and visual disturbance from operational activities.

iii. Physical interaction between species and project infrastructure

Operation

Introduction

8.10.62. As described in section 8.3 b vii of this report, populations of the fish prey of red-throated divers may be affected by impingement and entrainment within

the cooling water intake, leading to potential indirect impacts on the SPA population.

Predicted impingement of red-throated diver prey

8.10.63. Information on diet and foraging behaviour and of red-throated divers is provided in section 6.3 h of this report. The diet of non-breeding divers in the North Sea includes clupeids (herring and sprat), gadoids (including whiting and cod), gobies, sandeels and smelt. As a non-breeding population, the red-throated divers associated with the SPA are not constrained by foraging range from a breeding colony, as is the case for the breeding seabird qualifying features of the SPA. Therefore, non-breeding red-throated divers may range widely and be relatively insensitive to localised changes in prey availability.

8.10.64. During the operation of Sizewell C, predicted annual impingement and entrainment mortality of herring and sprat is estimated to be less than 1% of the relevant SSB and impacts on these fish species are predicted to be negligible as seen in section 8.3 b vii of this report. Sandeels were insufficiently abundant in the available fish datasets for Greater Sizewell Bay to be considered a key species in the local fish assemblage. Combined impingement and entrainment mortality losses are not available. However, estimates of annual entrainment mortality for sandeel species (18,999 individuals per year) are equivalent to 0.0001% of SSB, and combined mean estimates of impingement (without mitigation in the form of low velocity side entry and FRR) for three species were less than 10.000 individuals, indicating that the combined effect of impingement and entrainment is likely to be considerably lower than 1% of SSB. For cod, whiting, smelt and sand goby respectively the estimated annual impingement and entrainment mortality was 1,395, 140,044, 6,959 and 2,922,306 equivalent adult values, equivalent to 0.00%, 0.03%, 0.01% and 1.41% of SSB (sand goby is an unexploited short-lived stock and, as such, the appropriate comparator for negligible effects is considered to be less than 10% of the SSB). For all these species, impacts at the scale of the SSB and on local populations were considered so small as to be negligible (Ref. 8.5).

Potential effects on the SPA red-throated diver population

8.10.65. Based on the above, the impingement and entrainment of fish by the cooling water system during the operation of Sizewell C is not predicted to result in the depletion of prey resources for red-throated divers in the Outer Thames Estuary SPA during the non-breeding season. Therefore, no adverse effects on the SPA population are predicted as a consequence of physical interaction with project infrastructure.

e) Conclusion for the Outer Thames Estuary SPA, project alone

8.10.66. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Outer Thames Estuary SPA.

8.10.67. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:

- affect the extent and distribution of the habitats of the qualifying features;
- adversely affect the structure and function of the habitats of the qualifying features;
- adversely affect the supporting processes on which the habitats of the qualifying features rely;
- adversely affect the populations of each of the qualifying features; and
- adversely affect the distribution of the qualifying features within the site.

f) In-combination assessment

8.10.68. The screening exercise for plans or projects that potentially could cause a likely significant in-combination effect with the construction and operation of the Sizewell C Project identified possible likely significant in-combination effect on the Outer Thames Estuary SPA in relation to changes to marine water quality and disturbance effects on species populations as seen in **Appendix C** of this report.

8.10.69. The assessment for adverse effects on site integrity as a result of these potential in-combination effects is presented separately for each impact pathway in **Table 8.29** to **Table 8.28** below. No plans or projects are identified as having the potential to result in an adverse in-combination effect with the Sizewell C Project on the Outer Thames Estuary SPA. For each impact pathway, this is the case when the different plans or projects identified in **Table 8.29** to **Table 8.28** are considered individually and when the assessments for each plan or project in-combination with the Sizewell C Project are considered together.

Table 8.29: In-combination assessment of plans and projects with the potential to affect birds within the Outer Thames Estuary SPA due to marine water quality effects

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Harwich Haven Approach Channel Deepening	36km to the main development site	Water quality effects - marine	There is potential for in-combination effects with the Sizewell C Project on the SPA qualifying features. This is due to sediment plumes produced as a result of dredging, which have the potential to affect the foraging efficiency of the SPA qualifying features. However, because sediment plume modelling for the Harwich Haven Approach Channel Deepening shows that the short term increase in suspended sediment experienced in the Outer Thames Estuary SPA would be within the range of the natural variation within the system (Rev. 8.124) no in-combination effect is predicted.	There is no potential for an adverse in-combination effect.
Extension of Inner Gabbard East Disposal site	39km to the main development site	Water quality effects - marine	The Extension of the Inner Gabbard East Disposal Site is over 10km from the SPA, and any sediment plumes resulting from the disposal of dredge material would not affect the SPA (Ref. 8.125).	There is no potential for an adverse in-combination effect with the Sizewell C project.
Sizewell B nuclear power station decommissioning. Planned decommissioning of Sizewell B power station. Decommissioning is anticipated to commence in 2035.	0km to main development site	Water quality effects - marine	No information available. In-combination assessment is not possible.	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Current licence for de-silting and maintenance works				
Great Yarmouth Third River Crossing	75km to the main development site	Water quality effects - marine	There is potential for an in-combination effect with the Sizewell C Project on the SPA qualifying features. Sediment deposition during construction and / or operation could affect water quality in the immediate environs of the development site within the River Yare, which is part of the SPA. This has the potential to affect the foraging efficiency of the qualifying features. However, any effects on water quality from sediment deposition would be localised (i.e. within the River Yare). Red-throated divers are highly unlikely to occur within the River Yare (using offshore areas of the SPA only), whilst the development site is beyond the likely foraging range of any of the little tern breeding colonies and no common terns were recorded during surveys of the areas adjacent to the development site. Furthermore, specific control measures would be incorporated (for both construction and operation) to reduce the risks of increased sediment loads (Ref. 8.126).	There is no potential for an adverse in-combination effect.
Lake Lothing Third Crossing	29km to the main development site	Water quality effects - marine	There is potential for an in-combination effect with the Sizewell C Project on the SPA non-breeding red-throated diver population as a result of water pollution arising from the construction, operation and / or decommissioning of the Lake Lothing Third Crossing project in the absence of control measures. However, specific standard pollution control measures would be	There is no potential for an adverse in-combination effect,

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
			incorporated within the crossing project via the **CoCP** (Doc Ref. 8.11) and in accordance with good practice. The risk of pollution from this project (which is 1.3km from the SPA at its closest point) affecting red-throated divers within the SPA is negligible (Ref. 8.127). There is no potential for such in-combination effects in relation to the breeding little tern and breeding common tern qualifying features because the closest colonies are 11km from the project site and would not be affected by pollution (Ref. 8.127).	

Table 8.30: In-combination assessment of plans and projects with the potential to affect birds within the Outer Thames Estuary SPA due to disturbance effects

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
Harwich Haven Approach Channel Deepening	36km to the main development site	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA non-breeding red-throated diver population because the dredge area passes to within 0.1km of the SPA at its closest point. Given the known sensitivity of red-throated divers to vessel activity, the increased vessel activity associated with the dredging could cause disturbance effects on red-throated divers to extend into parts of the SPA (Ref. 8.124). However, the proposed dredge area is an existing shipping route and it is considered that red-throated divers do not usually inhabit areas within 2km of the dredge area. Additionally, only a relatively small length of the dredge area approaches to within 1km of the SPA. Therefore, any	An adverse in-combination effect would not arise.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
			effect of the disturbance from the increased vessel activity on the SPA population would be small (Ref. 8.124). There is considered to be no potential for in-combination effects with the Sizewell C Project on the SPA breeding little tern and common tern populations as a consequence of disturbance. As noted above the dredge area is outside the SPA and foraging terns are considered less sensitive to sources of anthropogenic disturbance than are red-throated divers.	
Extension of Inner Gabbard East Disposal site	39km to the main development site	Disturbance effects on species populations	The Extension of the Inner Gabbard East Disposal Site is over 10 km from the SPA. Increased vessel movements associated with the transfer of dredge material to the disposal site would be restricted to existing shipping routes, which are already avoided by red-throated divers (Ref. 6.92), whilst the most direct routes from the dredge area to the disposal site do not transit the SPA. Given this, there is no potential for in-combination effects with the Sizewell C Project on the SPA (Ref. 8.125).	There is no potential for an adverse in-combination effect.
Sizewell B nuclear power station decommissioning Planned decommissioning of Sizewell B power station. Decommissioning is anticipated to commence in 2035. Current licence for de-silting and maintenance works	0km to main development site	Disturbance effects on species populations	No information available. In-combination assessment is not possible.	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
Operations and Maintenance Marine Licence applications for Generation and Transmission Assets. Licence to commence on 1st August 2019 and expire by May 2045	11km from cable corridor. 48km from windfarm site to nearest seaward point. 52km from wind farm site to main development site.	Disturbance effects on species populations This Operations and Maintenance Licence relates to the East Anglia ONE offshore wind farm.	The assessment for the construction, operation and decommissioning of the East Anglia ONE project (including non-material changes to the DCO) concluded no likely significant effects in relation to the Outer Thames Estuary SPA (Ref. 8.9). Therefore, there is no potential for in-combination effects with the Sizewell C Project in relation to this Licence.	There is no potential for an adverse in-combination effect.
East Anglia ONE Offshore Wind Farm An offshore wind farm consisting of up to 325 wind turbine generators and associated infrastructure, with an installed capacity of 1200MW.	9 km from cable corridor. 50km from windfarm site to the main development site.	Disturbance effects on species populations	There is potential for in-combination effects (during the operational phase of the wind farm only) with the Sizewell C Project on the SPA non-breeding red-throated diver population because the wind farm cable corridor passes through the SPA. Only vessel traffic associated with maintenance of the wind farm (and possibly the cable) is relevant and such movements will be infrequent and inconsequential relative to existing levels in this area. However, the effects of displacement from the East Anglia ONE project during the operational are predicted to be very small, with the **ES** and HRA concluding no adverse effect on the Outer Thames Estuary SPA.	An adverse in-combination effect would not arise.
East Anglia ONE North Offshore Wind Farm. An offshore wind farm which could consist of up to 115 turbines, generators and associated infrastructure, with	0km from cable corridor. 50km from windfarm site to the main	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA non-breeding red-throated diver population because the wind farm cable corridor passes through the SPA, and the 4km buffer surrounding the wind farm site (but not the wind farm itself) overlaps with the SPA (with the overlap area equivalent to 0.9% of the SPA). Therefore, disturbance from	An adverse in-combination effect would not arise. This conclusion is reached for the project alone and in-

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
an installed capacity of 600MW to 800MW	development site 45km to seaward extent		increased vessel traffic associated with the wind farm construction, and displacement due to cable-laying activity and directly from the wind farm (during its construction and operation) could result. However, the effects of displacement from the East Anglia ONE North project are predicted to be small (even when using precautionary worst-case scenarios). Also, vessel traffic associated with the East Anglia ONE North project and transiting the SPA will remain within existing shipping routes, which are already avoided by red-throated diver. Therefore, any increase in disturbance from this source would be small. The East Anglia ONE North HRA concludes that there is no likely significant effect for the SPA little tern and common tern populations, so there is no potential for in-combination effects with the Sizewell C Project on these qualifying features (Ref. 8.128).	combination assessments for the East Anglia ONE North project. At the time of writing this project (together with East Anglia TWO) is the most recent offshore wind farm application submitted to the Planning Inspectorate (Ref. 8.129).
East Anglia TWO Offshore Wind Farm An offshore wind farm which could consist of up to 115 turbines, generators and associated infrastructure, with an installed capacity of 600MW to 800MW	0km from cable corridor. 30 or 35km from windfarm site to the main development site	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA non-breeding red-throated diver population because the wind farm cable corridor passes through the SPA. Therefore, disturbance from increased vessel traffic associated with the wind farm construction, and displacement due to cable-laying activity could result. However, the effects of displacement from the East Anglia TWO project are predicted to be small (even when using precautionary worst-case scenarios). Also, vessel traffic associated with the East Anglia TWO project and transiting the SPA will remain within shipping routes, which are already avoided by red-throated diver. Therefore, any increase in disturbance from this source would be small. The East Anglia TWO HRA concludes that there is no likely significant effect for the SPA little tern and common tern	An adverse in-combination effect would not arise. This conclusion is reached for the project alone and in-combination assessments for the East Anglia TWO project. At the time of writing this project (together with East Anglia ONE North) is the most recent

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
			populations, so there is no potential for in-combination effects with the Sizewell C Project on these qualifying features (Ref. 8.130).	offshore wind farm application submitted to the Planning Inspectorate (Ref. 8.131).
East Anglia THREE Offshore Wind Farm Development of an offshore windfarm with an approximate capacity of 1200MW off the coast of East Anglia	11km from cable corridor. 80 or 85km from windfarm site to the main development site	Disturbance effects on species populations	As for East Anglia ONE and TWO (Ref. 8.132).	As for East Anglia ONE and TWO (Ref. 8.132; Ref. 8.133).
Norfolk Vanguard Offshore Wind Farm Norfolk Vanguard is a proposed offshore windfarm with an approximate capacity of 1800MW off the coast of Norfolk.	94 or 97km from wind farm site to main development site. 60km from cable route to the main development site	Disturbance effects on species populations	There is no potential for in-combination effects with the Sizewell C Project on the SPA qualifying features. The SPA little tern and common tern populations have no connectivity to the Norfolk Vanguard Project. The effects of disturbance to non-breeding red-throated divers as a result of increased vessel traffic during construction of the Norfolk Vanguard project are considered negligible because vessels would transit the northern edge of the SPA only, which is outside the area of main concentration of red-throated divers within the SPA. During operation, it is possible that maintenance vessels may transit the SPA, but mitigation measures would be applied to minimise risk of disturbance to red-throated divers. Therefore, the Norfolk Vanguard HRA concluded no likely significant effect for the Outer Thames Estuary SPA (Ref. 8.134, Ref. 8.135).	An adverse in-combination effect would not arise.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
Norfolk Boreas Offshore Wind Farm Maximum Capacity 1.8GW also associated infrastructure required to export the electricity to the National Grid substation at Necton in Norfolk	103 or 105km from wind farm site to the main development site. 60km from cable route to main development site	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA non-breeding red-throated diver population because the operation and maintenance port has not yet been identified, and it is possible that vessels associated with operation and maintenance may transit the SPA. This could increase disturbance to the SPA red-throated divers. However, the increase in vessels transiting the SPA due to operation and maintenance of the Norfolk Boreas project would be small relative to existing levels of vessel activity and would have a negligible effect in levels of shipping disturbance within the SPA. Furthermore (as agreed for the Norfolk Vanguard project), it is anticipated that mitigation measures would be applied to minimise vessel disturbance to red-throated divers (Ref. 8.136). The Norfolk Boreas HRA concludes that there is no likely significant effect for other pathways to disturbance / displacement effects on the SPA red-throated diver population, nor for effects on the SPA little tern and common tern populations (Ref. 8.137).	An adverse in-combination effect would not arise.
Thanet Extension Offshore Wind Farm An offshore wind generating station of capacity up to 340MW	82km to the main development site	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA non-breeding red-throated diver population as a result of disturbance and displacement. Such effects would result from increased vessel movements during construction of the Thanet Extension project and (potentially) from wind farm displacement effects extending into the SPA during operation (although the Thanet Extension project would be over 6km from the SPA). However, the increase in vessel activity during construction of the Thanet Extension is unlikely to extend into the SPA, whilst the effect of displacement during operation on the	An adverse in-combination effect is not predicted to arise. But note that during the examination, Natural England agreed with these conclusions for the project alone but considered that the Thanet Extension

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-combination Effect?
			SPA red-throated diver population is predicted to be very small (Ref. 8.138). The Thanet Extension HRA concludes that there is no likely significant effect for the SPA little tern and common tern populations in relation to disturbance effects, so there is no potential for in-combination effects with the Sizewell C Project on these qualifying features via this pathway (Ref. 8.138).	could make a small contribution to a potential in-combination adverse effect due to displacement. Any such potential in-combination effect would be due to existing operational wind farms located within the SPA (Ref. 8.138). However, over the period in which these wind farms have been operational, the SPA red-throated diver population appears to have increased as seen in section 6.3 h of this report.

8.10.70. In relation to disturbance effects on species populations, several of the plans or projects in **Table 8.28** are considered to have the potential to result in small effects on the SPA non-breeding red-throated diver population (under precautionary worst-case scenarios). However, the combined effect from these different projects is considered to remain small and would not result in an adverse in-combination effect with the Sizewell C Project, particularly given the very small effects of disturbance predicted to occur as a result of the Sizewell C Project as seen in section 8.10 d of this report.

8.10.71. Therefore, it is It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse in-combination effects on the integrity of the Outer Thames Estuary SPA.

8.11 Assessment of effects: Sandlings SPA

a) Summary of screening outcomes, project alone

8.11.1. The following potential effects were screened in for Appropriate Assessment in relation to the main development site and breeding populations of nightjar and woodlark:

- Changes in air quality during construction, operation and decommissioning.
- Direct habitat loss and fragmentation during construction, operation and decommissioning.
- Disturbance effects on species populations during construction, operation and decommissioning.
- Disturbance due to increase in recreational pressure during construction, operation and decommissioning.

8.11.2. No potential effects were screened in for Appropriate Assessment in relation to associated development sites.

b) Breeding nightjar, project alone

i. Changes in air quality

8.11.3. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.11.4. During construction and decommissioning, changes in air quality could result from the generation of dust from construction works. The Sandlings SPA however falls beyond the study area for the assessment of dust emissions and, consequently, no further consideration of construction or decommissioning dust is necessary.

8.11.5. The air quality assessment, provided in **Volume 2, Chapter 12** of the **ES** (Doc Ref. 6.3), screens in construction phase traffic effects for this European site.

8.11.6. Results of the road transport emissions modelling show that predicted concentrations of NO_x, maximum nutrient nitrogen deposition and maximum acid deposition are highest in the current baseline, represented by the 2018 reference case scenario when compared against the future baseline scenarios without the proposed development traffic. It is predicted that during construction of the proposed development, NO_x concentrations will be lower than the predicted current baseline. The transport contribution to the Critical Load of NOx in the 2023, 2028 typical day and 2028 busiest day increases relative to respective reference cases at the Sandlings SPA.

8.11.7. Locations where these values are highest are as a result of the European site being immediately adjacent to modelled roads. In these cases, it is important to acknowledge that this value is only representative of the portion of the European site immediately adjacent to the road.

8.11.8. It should be noted that the background levels of nutrient and acid deposition already exceed the Critical Load. Given the background rates of high chronic deposition, the PCs are unlikely to result in significant changes in species composition or habitat condition. Consequently, it is very unlikely that the increases predicted would lead to significant changes in species composition or to noticeable damage to the constituent plants, including any lichens and bryophytes.

8.11.9. In light of the above, it is concluded that the conservation objectives of the SPA would not be compromised and an adverse effect on the integrity of the European site would not occur.

Operation

8.11.10. The modelling of combustion scenarios indicated that during commissioning the annual average (long-term) NOx at the Sandlings SPA would be more than 1% of the Critical Level, although the PEC would be 27% of the Critical Level and therefore would not exceed this. During routine operation, the PC would be higher than the insignificance threshold of 10% of the Critical Level

for daily NOx, however the PEC is predicted to be 49% of the Critical Level (i.e. the Critical Level would not be exceeded).

8.11.11. During commissioning, the acid deposition is predicted to increase by 1.5% of the Critical load for NOx, and the PEC is predicted to exceed 70% of the Critical Load (96%). Contributions to acid deposition during routine testing, and nitrogen deposition for both commissioning and routine testing are predicted to be insignificant relative to the Critical Loads.

8.11.12. Given the highly conservative nature of the modelling scenario for long-term and daily NOx and the short-term nature of the effect, taken together with the prediction that the PEC would not exceed the Critical Level or Critical Load for nitrogen deposition, it is concluded that there would not be an adverse effect on the integrity of the Sandlings SPA due to the operation of the main development site.

8.11.13. Therefore, there is no likelihood of an adverse effect on the conservation objectives for the qualifying feature breeding nightjar.

ii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.11.14. As described in section 6.3 I of this report, baseline surveys provided no evidence of breeding nightjar within or close to the areas encompassed by the main development site. Therefore, no adverse effects on the Sandlings SPA nightjar population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iii. Disturbance effects on species populations

Construction and decommissioning

8.11.15. The bulk of the Sandlings SPA (and hence of the breeding nightjar habitat within the SPA) is over 9km from the main development site (**Figure 4.1**), and well beyond the distance at which effects of noise and visual disturbance associated with the construction of the main development site could occur. The extremity of a relatively small, discrete, block of the SPA approaches to within 0.7km of the main development site, with this discrete block likely to support approximately 3% of the SPA breeding nightjar population as seen in section 6.3 i of this report. The northwest corner of this block occurs within the potential visual impact zone but predicted noise levels during construction remain below 64dB L_{Amax} across its entirety (**Figure 8.8**).

8.11.16. As detailed in section 6.3 i of this report, project-specific surveys found no evidence of breeding nightjar on potentially suitable non-SPA habitat near to the main development site.

8.11.17. Given the above, no adverse effects on the SPA breeding nightjar population are predicted as a consequence of noise and visual disturbance from construction or decommissioning activities.

Operation

8.11.18. As detailed above for the Minsmere- Walberswick SPA breeding avocet population in section 8.8 b iv of this report, noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.11.19. The extent of artificial lighting associated with the operational period is described in section 8.8 b iv of this report and would not extend into any areas that are known to be used by breeding nightjar. Therefore, no adverse effects on the SPA breeding nightjar population are predicted as a consequence of noise and visual disturbance from operational activities.

iv. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.11.20. During the construction and decommissioning of the main development site, recreational users of the Sizewell C area may be displaced elsewhere, including to locations within and close to nearby European sites. The background to the assessment of potential increase in recreational pressure during the construction and operation of Sizewell C is described above in section 8.3 b vi of this report and the Recreational Disturbance evidence base, provided in **Appendix E** of this report includes further details.

Overview of recreational assessment for Sandlings SPA

8.11.21. The Sandlings SPA comprises several discrete areas of heathland, acid grassland and coniferous plantations. The closest part of the SPA to Sizewell C, to the south, encompasses the RSPB Aldringham Walks and North Warren Nature Reserve. Further south and east the SPA boundary includes areas at Snape Warren, Tunstall Forest and Rendlesham Forest.

8.11.22. Sandlings SPA has the following access points - letters refer to maps in **Figures 001, 006, 007, 009, 010** and **Table 4.1** in **Appendix E** of this report:

- Aldringham Walks (S)
- Thorpeness Village (T)
- Lay-by north of Aldeburgh (U)
- North Warren (X)

- Snape Warren (Z)
- Tunstall Forest (CC)
- Rendlesham Forest (FF)

8.11.23. Estimated increases in visitor numbers to locations associated with the SPA are shown in **Table 8.31**. The largest estimated increase is at Thorpeness Village. Most visitors relocating here might be expected to access the beach and village. Although there is access to the Sandlings SPA to the west (Aldringham Walks) this is a 4-5km round trip.

Table 8.31: Estimated additional visits to locations in the study area as a result of displacement of existing users from the Sizewell area and the construction workforce - Sandlings SPA

Location And Estimated Number Of Annual Visits	% Of Survey Visitors Who Gave As Alternative Location	Based On % Of Displaced Visitors[1]			Based On 500,000 Visits To Sizewell Area[2]		
		Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits	Inc. Visits / Year	Inc. Total Visits / Day	% Inc. Over Existing Visits
Sandlings SPA							
Aldringham Walks – 60,000	0.58%	915	2.5	1.5	3,467	9.5	5.8
North Warren – 60,000	0.58%	348	1.0	0.6	2,900	7.9	4.8
Rendlesham – 150,000	0.78%	1548	4.2	1.0	4,278	11.7	2.9
Sandlings Walk – 150,000	0.58%	870	2.4	0.6	2,900	7.9	1.9
Thorpeness – 60,000	3.89%	5168	14.2	8.6	22,284	61.1	37.1
Tunstall Forest – 150,000	1.36%	2418	6.6	1.6	7,178	19.7	4.8

1. 'Realistic' approach: involves determining the percentage of survey respondents who said that they would be displaced to each named location and then calculating the number of additional visits that would be generated by multiplying the estimated number of annual visits at each of the locations by the percentage of displaced users.
2. More precautionary approach: the same basic method as (1), except that the calculated number of additional visits to each specified location has been taken as a percentage of an estimated 500,000 annual visits to the Sizewell survey area as a whole (based on extrapolation of the 4214 visitors observed over the survey period).

Assessment of potential increased recreational disturbance on breeding nightjar

8.11.24. A review of the effects of recreational disturbance on nightjar populations is included in **Appendix E** of this report; studies have shown that birds may occur at decreased breeding densities in areas of increased human disturbance, although breeding success may not be related to disturbance levels. A study by Cruickshanks et al. (2010) (Ref. 8.139) at Sandlings SPA found that that nightjar density (described as individuals per hectare – it's not clear if this relates to breeding density) was highest in areas with the lowest visitor numbers (less than 11 per hour), although there was no clear relationship between increasing visitor numbers (divided into four categories of intensity) and nightjar density as seen in Figures from Ref. 8.139 reproduced in **Appendix E** of this report, **Figure 3.1**.

8.11.25. The nightjar breeding population of the Sandlings SPA declined from 109 breeding males in 1992 (as cited at classification in 2001) to 81 at the latest available count in 2004 (**Table 6.20**). More recent data are available from the RSPB North Warren and Aldringham Walks Reserve, overlapping with the SPA area closest to Sizewell C, which indicate an increase from two territories in 2010 to five in 2018 as seen in section 6.3 i of this report.

8.11.26. The supplementary advice on the generic conservation objectives for the SPA (Ref. 6.109) specifies a target to restore the size of the breeding nightjar population to a level consistently above 109 males, while avoiding deterioration from the current level as indicated by the latest mean count or equivalent. It is also stated that the population size at classification may have been unusually high due to the extensive area of open habitat suitable for nesting that was created following a gale in 1987 that felled most trees; and a more realistic target is being modelled. Disturbance due to human activity is identified as a potential issue for nightjar if an increase in development locally leads to an increase in recreational pressure (Ref. 6.109), suggesting it is not currently considered to be a limiting factor.

8.11.27. The Sizewell C visitor survey data and presence of several entry points to open access land indicate that the Sandlings SPA is already subject to considerable visitor use. There are extensive path networks and access to woodland and open habitats. The main activity undertaken by visitors is dog-walking (Ref. 8.139). Nevertheless, as described above RSPB data show that the nightjar population within the RSPB's Aldringham Walks and North Warren reserve has increased in recent years.

8.11.28. At worst, a less than 6% increase in visitor use of access points for Sandlings SPA is predicted during the construction of Sizewell C (**Table 8.31**), with the exception of Thorpeness Village, which is some distance from suitable habitats for nightjar and where most of the increase is predicted to take place

within the village and the beachfront. No change in the behaviour of users or the pattern of use is considered likely to arise. Existing visitor management measures that could reduce overall disturbance pressure on ecological interests are limited in some areas, being confined to the provision of information at some car parks, for example the RSPB reserve as seen in **Appendix E** of this report, **Table 4.1**.

8.11.29. Given the potential for increased recreational disturbance to adversely affect breeding nightjars, and limitations of on-site visitor management measures, on a precautionary basis it is considered there is the potential for increased recreational use to reduce the breeding density of nightjar at Aldringham Walks and North Warren. Hence it is proposed that existing arrangements to manage recreational access at Aldringham Walks and North Warren are enhanced in these areas to minimise the potential for any increase in disturbance pressure on breeding nightjar at the Sandlings SPA resulting from the construction of Sizewell C. This would form part of the Rights of Way and Access Strategy. Such measures may also serve to reduce existing levels of recreational disturbance.

8.11.30. As well as direct effects of recreational disturbance on nightjar, increased recreational use of an area has the potential to have indirect effects via habitat, through the physical trampling of habitats, and nutrient enrichment from urine and faeces of dogs. These effects could potentially affect habitat suitability for nesting nightjar.

8.11.31. The Sandlings SPA includes extensive areas of commercial forestry plantations on sandy soils which once supported extensive heathland (within the Sandlings Forest SSSI), where open areas such as young plantations and rotational clearfell provide suitable habitat for breeding nightjar. The SPA also includes a number of fragments of the once extensive Sandlings heaths of the Suffolk coast, consisting of characteristic dry acidic grass and heather-dominated heathland with much scrub, bracken and self-sown pine and birch (overlapping with SSSIs at Sutton and Hollesley Heaths; Blaxhall Heath; Leiston-Aldeburgh; Snape Warren and Tunstall Common) which also provide breeding habitats for nightjar.

8.11.32. Semi-natural heathland habitats within the Sandlings SPA are likely to be more sensitive to trampling and dog waste than clear-felled areas within forestry plantations, as the latter are more modified habitats. Studies of the effects of recreation on heaths have shown that they have some resistance to trampling, with the potential to recover if trampling is removed as detailed in the Plants and Habitats Synthesis Report in **Volume 2, Chapter 14, Appendix 14B1**. Most dog faeces are deposited within 400m of the start of a walk and 1m of a path, with urination at intervals during a walk but also close to paths. This localised enrichment may cause changes in vegetation cover at the fringes of paths, favouring more generalist species that can

outcompete more specialised plants, in the case of heathland, resulting in a change to a sward dominated by coarser grass species. Trampling effects are also most likely in the vicinity of paths and may exacerbate vegetation changes due to nutrient enrichment as detailed in Plants and Habitats Synthesis Report in **Volume 2, Chapter 14, Appendix 14B1**.

8.11.33. During the breeding season, nightjars nest and roost in open habitats adjacent to woodland edges and within woodland clearings, feeding at night on insects taken in the air. The presence of scattered trees and open scrub provides suitable nesting and roosting habitat and song posts (Ref. 6.109). A study of nesting birds in heathland, bog and open woodland (silver birch and Scot's pine) habitats in East Anglia (Ref. 8.140), found there was always a scattering of trees near the nest site, but dense areas of woodland were avoided. Heather (dense or sparse stands of 20-60cm height) was also considered to be a significant feature, used by young nightjars for cover. Nest sites were shallow scrapes in bare ground. A total of 18 located in the study were near or beneath a tree, all silver birch apart from one Scots pine. Optimum nesting habitat was described as areas where silver birch scrub is expanding across open heathland, or in glades of heather 80-100m in diameter, within denser birch woodland.

8.11.34. Coniferous plantations are also important habitats for nightjars. Within the Sandlings forest plantations, Ravenscroft (1989) (Ref. 6.88) found that nightjars used areas that had been felled and re-stocked for up to about 10 years after planting (although it was noted there were few suitable older areas available for study), preferably in the first five years. Important factors for nesting were the size of a clearing (birds were not found in areas below about 10ha), shape (more circular or square areas were preferred), the height of trees (between about 0.5 and 1.75m), and the presence of bare ground and heathers. Other studies (Ref. 8.141, Ref. 142) have similarly reported that nightjars show a preference for young (first rotation) or cleared forestry as these areas closely resemble the traditional scrub-land habitat occupied by the species.

8.11.35. Effects of recreational disturbance on habitats as described, resulting in local changes to vegetation at the fringes of paths, are unlikely to affect the availability of suitable nesting habitats for nightjar within the Sandlings SPA. Therefore, indirect effects of increased recreational pressure on nightjar are considered unlikely.

8.11.36. Subject to the implementation of enhanced management measures for recreational access at Aldringham Walks and North Warren, an increase in recreational pressure during the construction of Sizewell C is not predicted to adversely affect the ability of the Sandlings SPA to achieve the conservation objectives for breeding nightjar, either directly or indirectly, via effects on habitats.

Operation

8.11.37. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA, in section 8.3 b vi of this report also applies to breeding nightjar at the Sandlings SPA.

8.11.38. If the changes in visitor use predicted during construction continue into the operational phase, then similar potential effects on breeding nightjar would be predicted during this phase also (although in this context it is noted that the size of the workforce at Sizewell C would be less during operation than construction, so that predicted recreational use of European sites by the operational workforce would also be less).

8.11.39. Given the potential for increased recreational disturbance to adversely affect breeding nightjars, on a precautionary basis it is considered that the proposed enhancement to existing arrangements to manage recreational access at Aldringham Walks and North Warren should continue during the operational phase of Sizewell C. This would form part of the Rights of Way and Access Strategy**.**

8.11.40. For the reasons given above in the assessment for the construction and decommissioning phases, indirect effects of increased recreational disturbance via habitats are not predicted.

8.11.41. Subject to enhanced management measures for recreational access at Aldringham Walks and North Warren, increase in recreational pressure during the construction of Sizewell C is not predicted to adversely affect the ability to achieve the conservation objectives for breeding nightjar within the Sandlings SPA, either directly or indirectly, via effects on habitats.

c) Breeding woodlark, project alone

i. Changes in air quality

8.11.42. Changes in air quality would not have a direct effect upon SPA qualifying features but could cause effects via changes to vegetation (composition and structure) within the habitats upon which the qualifying features depend.

Construction and decommissioning

8.11.43. During construction and decommissioning, changes in air quality could result from the generation of dust from construction works. The Sandlings SPA however falls beyond the study area for the assessment of dust emissions and no further consideration of construction or decommissioning dust is therefore necessary.

8.11.44. With respect to construction phase traffic, the assessment reported for breeding nightjar as seen in section 8.11 b I of this report, applies to this qualifying interest feature. It is concluded, therefore, that the conservation objectives of the SPA would not be compromised and an adverse effect on the integrity of the European site would not occur.

Operation

8.11.45. The assessment reported above for nightjar is also applicable to woodlark during the breeding season.

8.11.46. The modelling of combustion scenarios indicates that there would not be an adverse effect on the integrity of the Sandlings SPA due to the operation of the main development site.

8.11.47. There is no likelihood of an adverse effect on the conservation objectives for the qualifying feature breeding woodlark.

ii. Direct habitat loss and fragmentation

Construction, operation and decommissioning

8.11.48. As described in section 6.3 i of this report, baseline surveys provided little evidence of any regular occurrence of breeding woodlark within or close to the areas encompassed by the main development site. Therefore, no adverse effects on the Sandlings SPA woodlark population are predicted as a consequence of habitat loss and fragmentation during construction, operation and decommissioning.

iii. Disturbance effects on species populations

Construction and decommissioning

8.11.49. As outlined above for nightjar in section 8.11 b iii of this report, the bulk of the Sandlings SPA (and hence of the breeding woodlark habitat within the SPA) is beyond the distance at which effects of noise and visual disturbance associated with the construction and decommissioning of the main development site could occur (**Figure 4.1**). The discrete block of the SPA which lies within 0.7km of the main development site, and onto which the potential visual impact zone encroaches (to a small extent) seems likely to support approximately 9% of the SPA breeding woodlark population as seen in **Figure 8.8,** section 6.3 i of this report.

8.11.50. As detailed in section 6.3 i of this report, project-specific surveys found little evidence of breeding woodlark on potentially suitable non-SPA habitat near to the main development site.

8.11.51. Given the above, no adverse effects on the SPA breeding woodlark population are predicted as a consequence of noise and visual disturbance from construction and decommissioning activities.

Operation

8.11.52. As detailed above for the Minsmere-Walberswick SPA breeding avocet population in section 8.8 b iv of this report, noise and visual disturbance during the operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting.

8.11.53. The extent of artificial lighting associated with the operational period is also described in section 8.8 b iv of this report and would not extend into any areas that are known to be used by breeding nightjar. Therefore, no adverse effects on the SPA breeding nightjar population are predicted as a consequence of noise and visual disturbance from operational activities.

iv. Disturbance due to increase in recreational pressure

Construction and decommissioning

8.11.54. During the construction and decommissioning of the main development site, recreational users of the Sizewell C area may be displaced elsewhere, including to locations within and close to nearby European sites. The background to the assessment of potential increase in recreational pressure during the construction and operation of Sizewell C is described in section 8.3 b vi of this report and the Recreational Disturbance evidence base seen in **Appendix E** of this report which includes further details.

8.11.55. The overview of the recreational assessment for the Sandlings SPA, presented above for breeding nightjar (section 8.11 b iv of this report) also applies here.

8.11.56. A review of the effects of recreational disturbance on woodlark populations is included in **Appendix E** of this report. As for nightjar, studies have shown that birds may occur at decreased breeding densities in areas of higher human disturbance, although breeding success may not be related to disturbance levels.

8.11.57. The woodlark breeding population of the Sandlings SPA declined since classification from 154 breeding pairs in 1997 (as cited at classification in 2001) to 73 at the latest available count in 2006 (**Table 6.20**). More recent data are available from the RSPB North Warren and Aldringham Walks reserve, overlapping with the SPA area closest to Sizewell C, which indicate an increase from three territories in 2010 to seven in 2018 as seen in section 6.3 i of this report.

8.11.58. The supplementary advice on the generic conservation objectives for the SPA (Ref. 6.109) specify a target to restore the size of the breeding woodlark population to a level consistently above 154 breeding pairs, while avoiding deterioration from the current level as indicated by the latest mean count or equivalent. It is also stated that the population size at classification may have been unusually high due to the extensive area of open habitat suitable for nesting that was created following a gale in 1987 that felled most trees; a more realistic target is being modelled. Disturbance due to human activity is identified as a potential issue for woodlark if an increase in development locally leads to an increase in recreational pressure (Ref. 6.109), suggesting it is not currently considered to be a limiting factor.

8.11.59. The Sizewell C visitor survey data and presence of several entry points to open access land indicate that the Sandlings SPA is already subject to considerable visitor use. There are extensive path networks and access to woodland and open habitats. The main activity undertaken by visitors is dog-walking (Ref. 8.139). Nevertheless, as described above, RSPB data show that the woodlark population within the RSPB's Aldringham Walks and North Warren reserve has increased in recent years.

8.11.60. At worst, a less than 6% increase in visitor use of access points for Sandlings SPA is predicted during the construction of Sizewell C (**Table 8.31**) (with the exception of Thorpeness Village, which is some distance from suitable habitats for woodlark and where most of the increase is predicted to take place within the village and the beachfront). No change in the behaviour of users or the pattern of use is considered likely to arise. Existing visitor management measures that could reduce overall disturbance pressure on ecological interests are limited, being confined to the provision of information at some car parks, for example the RSPB reserve.

8.11.61. A study of woodlarks nesting on heathland areas in Dorset modelled the effects of changes in recreational disturbance and found that impacts depend both on the number of people present and their spatial distribution; for a given increase in visitor numbers, predicted population declines were greater if visitors were redistributed than if access arrangements were unchanged (Ref. 8.143). The probability of settling on territory within an area of suitable habitat for nesting reduced below 50% at about eight disturbance events per hour. In developing their model for the effects of recreational disturbance on woodlark it is understood that Mallord *et al*. (2007) (Ref. 8.143) took this threshold visit number as a cut-off point, above which it was assumed that birds would decide not to breed in an area of suitable habitat.

8.11.62. If this assumption is correct, and a similar relationship between visitor numbers and settlement patterns of woodlark occurs at the Sandlings SPA, then it is possible that predicted increases in visitor numbers as a result of relocation from Sizewell C could tip visit levels in some areas from less than

to more than eight disturbance events per hour. Therefore, there could be a population level effect on woodlark within the SPA. Quantitative visitor intensity data are available for southern areas of the Sandlings SPA, gathered by Cruickshanks *et al*. (2010) (Ref. 8.139). This study found that woodlark density (described as individuals per hectare; it is not clear how this might relate to nesting densities) was highest in the lowest of four categories of visitor intensity, less than 11 people per hour within 100m, but there was no tendency for density to decline with four categories of increasing visitor intensity as detailed in figures from Cruickshanks *et al*. 2010 (Ref. 8.139), reproduced in **Appendix E** of this report, **Figure 3.1**. Within the Sandlings study area, woodlarks were apparently recorded in areas with all categories of visitor intensity, from the lowest to the highest intensity of 28-212 people per hour within 100m.

8.11.63. Although no change in the behaviour of users or the pattern of use is considered likely to arise at Sandlings SPA as a result of relocation of visitors during the construction of Sizewell C, on a precautionary basis it is considered there is the potential for increased recreational use to reduce the breeding density of woodlark. In this context it is noted that existing visitor management measures that could reduce overall disturbance pressure on ecological interests are limited in some areas.

8.11.64. As for nightjar, it is proposed that existing arrangements to manage recreational access at Aldringham Walks and North Warren, are enhanced to minimise the potential for any increase in disturbance pressure on breeding woodlark at the Sandlings SPA resulting from the construction of Sizewell C. This would form part of the Rights of Way and Access Strategy. Such measures may also serve to reduce existing levels of recreational disturbance.

8.11.65. As well as direct effects of recreational disturbance, increased recreational use of an area has the potential to indirectly effect woodlark through habitat suitability.

8.11.66. An overview of the potential effects of recreational use on the habitats within the Sandlings SPA is provided above for nightjar in section 8.11 b iv of this report.

8.11.67. Woodlark show similar habitat preferences to nightjar during the breeding season, occupying open habitats with scattered trees, including heathland and clearings in coniferous plantations (Ref. 8.134). Nests are placed at the base of tall vegetation, usually heather or grass (Ref. 8.143), and areas with a large proportion of bare ground and short vegetation are preferred for feeding (Ref. 8.144), as the main prey is ground-dwelling invertebrates.

8.11.68. Effects of recreational disturbance on habitats as described, resulting in local changes to vegetation at the fringes of paths, are unlikely to affect the availability of suitable nesting habitats for woodlark within the Sandlings SPA. Therefore, indirect effects of increased recreational pressure on woodlark are considered unlikely.

8.11.69. Subject to enhanced management measures being implemented at Aldringham Walks and North Warren, increase in recreational pressure during the construction of Sizewell C is not predicted to adversely affect the ability of the Sandlings SPA to achieve the conservation objectives for breeding woodlark either directly or indirectly via effects on habitats.

Operation

8.11.70. The information provided in the above assessment for Sandwich tern at the Alde-Ore Estuary SPA in section 8.3 b vi of this report also applies to breeding woodlark at the Sandlings SPA.

8.11.71. The operational assessment given above for breeding nightjar at the Sandlings SPA, also applies to breeding woodlark.

8.11.72. Subject to enhanced management measures for recreational access at Aldringham Walks and North Warren (as part of the Rights of Way and Access Strategy), increase in recreational pressure during the construction of Sizewell C is not predicted to adversely affect the ability to achieve the conservation objectives for breeding nightjar within the Sandlings SPA, either directly or indirectly, via effects on habitats.

d) Conclusion for Sandlings SPA, project alone

8.11.73. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Sandlings SPA.

8.11.74. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:

- adversely affect the extent and distribution of the habitats of the qualifying features;
- adversely affect the structure and function of the habitats of the qualifying features;
- adversely affect the supporting processes on which the habitats of the qualifying features rely;
- adversely affect the populations of each of the qualifying features; and

- adversely affect the distribution of the qualifying features within the site.

e) In-combination assessment

8.11.75. The screening exercise for plans or projects that potentially could cause a likely significant in-combination effect with the construction and operation of the Sizewell C Project identified possible likely significant in-combination effect on the Sandlings SPA in relation to disturbance effects on species populations and disturbance due to changes in recreational pressure as seen in **Appendix C** of this report.

8.11.76. The assessment for adverse effects on site integrity as a result of these potential in-combination effects is presented separately for each impact pathway in **Table 8.32,** and **Table 8.33** below. No plans or projects are identified as having the potential to result in an adverse in-combination effect with the Sizewell C Project on the Sandlings SPA. For each impact pathway, this is the case when the different plans or projects identified in **Table 8.32** and **Table 8.33** are considered individually and when the assessments for each plan or project in-combination with the Sizewell C Project are considered together.

8.11.77. Therefore, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C Project would not result in adverse in-combination effects on the integrity of the Sandlings SPA.

Table 8.32: In-combination assessment of plans and projects with the potential to affect birds within the Sandlings SPA due to disturbance effects

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-Combination Effect?
Sizewell B nuclear power station decommissioning Planned decommissioning of Sizewell B power station. Decommissioning is anticipated to commence in 2035. Current licence for de-silting and maintenance works	0km to main development site	Disturbance effects on species populations	No information available. In-combination assessment is not possible.	No
East Anglia ONE North Offshore Wind Farm. An offshore wind farm which could consist of up to 115 turbines, generators and associated infrastructure, with an installed capacity of 600MW to 800MW	0km from cable corridor. 50km from windfarm site to main development site 45km to seaward extent	Disturbance effects on species populations	There is potential for in-combination effects with the Sizewell C Project on the SPA qualifying features (i.e. breeding nightjar and breeding woodlark). This is because the onshore cable route for the East Anglia ONE North project would run alongside and potentially through the SPA. Therefore, disturbance to the SPA qualifying features may occur as a result of the excavation works (and other activities) during construction (which may overlap with the construction period of the Sizewell C Project) and routine maintenance and repairs during operation (Ref. 8.128). However, baseline data indicate that nightjar and woodlark breeding territories are confined to suitable habitat for the species within the SPA and do not occur within the onshore	An adverse in-combination effect is not predicted to arise. Where woodlark and nightjar territories are estimated to occur within 200m of the cable corridor, mitigation (including seasonal restrictions on construction works where the cable crosses the SPA) would reduce risks of disturbance to these territories. Mitigation incorporated into the design would also ensure that light spill would be minimised (Ref. 8.128).

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-Combination Effect?
			development area for the East Anglia ONE North project. Small numbers of nightjar nest within the likely maximum foraging range (c.750m) of the cable corridor but there is little suitable foraging habitat within the vicinity of the cable corridor. Only one woodlark and two nightjar territories are estimated to occur within 200m of the cable corridor, where effects of noise and visual disturbance might be predicted. During operation, routine maintenance of the cable route is not anticipated, and emergency repairs are expected to be infrequent and of short duration. Given that these activities are likely to occur beyond 200m of any nesting territories, no disturbance effects are predicted on the SPA nightjar or woodlark populations. Operational lighting would be required for maintenance activities at the onshore substation and National Grid substation only, and these would not be permanently lit.	
East Anglia TWO Offshore Wind Farm An offshore wind farm which could consist of up to 115 turbines, generators and associated infrastructure, with an installed capacity of 600MW to 800MW	0km from cable corridor. 30 or 35km from windfarm site to the main	Disturbance effects on species populations	The onshore cable route for the East Anglia TWO project is the same as for the East Anglia ONE North project. As such, there is potential for in-combination effects with the Sizewell C Project on the SPA qualifying features.	For the reasons outlined above for the East Anglia ONE North project, an adverse in-combination effect is not predicted to arise.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential for Adverse In-Combination Effect?
	development site			

Table 8.33: In-combination assessment of plans and projects with the potential to affect birds within the Sandlings SPA due to recreational disturbance effects

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Full planning application for residential development of 65 dwellings (including 21 affordable units) with associated vehicular access, landscaping, open space, car parking and pedestrian links	800m to main development site	Disturbance due to increased recreational pressure	Disturbance due to increased recreational pressure There is the potential for an in-combination effect with the Sizewell C Project relating to disturbance due to increased recreational pressure. The assessment in section 7.5 e iii of this report applies here: the proposed housing developments would be covered by the Suffolk RAMS Strategy, or by project-specific mitigation commitments, and therefore there is no potential for an in-combination effect due to potential increases in recreational pressure with the activities of the Sizewell C Project to arise. Whilst the Suffolk RAMS is not directly applicable to the Sizewell C Project, SZC Co. is committed to the principles outlined within the Strategy and would adopt a similar approach to mitigate for any potential impacts. Therefore, it is predicted that an in-combination effect due to	No
Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be reserved except for access).	927m to main development site	Disturbance due to increased recreational pressure		No
An outline planning application for up to 187 dwellings to include car parking, open space provision with associated infrastructure and access.	1.3km to main development site	Disturbance due to increased recreational pressure		No
Outline Application - 100 new residential units (C3) with employment floorspace (B1) (approx. 1000m^2) and	431m to main development site	Disturbance due to increased recreational pressure		No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
family orientated public house / restaurant (A3/A4) (approx.770m^2)			recreational disturbance upon the Sandlings SPA would not arise.	
Residential development of 40 dwellings, together with associated access roads, garaging and car parking	1.5km to main development site	Disturbance due to increased recreational pressure		No
Erection of 44 no. new dwellings with associated new access road.	6km to main development site	Disturbance due to increased recreational pressure		No
Residential development of 59 residential dwellings and associated landscaping and public open space, together with a new vehicular access from existing development and associated highway infrastructure	5.5km to main development site	Disturbance due to increased recreational pressure		No
1.86ha of land south of Ambleside, Main Road Kelsale cum Carlton, is identified for residential use for approximately 30 units although a higher quantum of development may be appropriate subject to design and layout.	6km to main development site	Disturbance due to increased recreational pressure		No
5.05ha of land west of Garden Square, Rendlesham, is identified for a mixed residential development and	14.2km	Disturbance due to increased recreational pressure		No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
greenspace provision for approximately 50 units.				
4.3ha of land to the east of Redwald Road, Rendlesham, is identified for residential use for approximately 50 units	13.7km to the main development site	Disturbance due to increased recreational pressure		No
Approximately 66.6ha of land for a garden neighbourhood is identified to the south of Saxmundham, which includes land within the parish of Benhall, for an education led development, comprising primary school provision, community facilities, employment land and open space alongside a variety of residential development. This new development will be delivered through a master plan approach brought forward through landowner collaboration and community engagement.	6.5km to the main development site	Disturbance due to increased recreational pressure		No
1.76ha of land south of Forge Close between Main Road and Ayden, Benhall, as shown on the Policies Map, is identified for the development of approximately 50 dwellings	6.8km to the main development site	Disturbance due to increased recreational pressure		No
3.47ha of land to the south of Eyke Church of England Primary School	17.2km to the main	Disturbance due to increased recreational pressure		No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Birds	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
and east of The Street, Eyke as shown on the Policies Map, is identified for a residential-led mixed use development incorporating approximately 65 dwelling.	development site			

8.12 Assessment of effects: Stour and Orwell Estuaries SPA

a) Summary of screening outcomes, project alone

8.12.1. No potential effects were screened in for Appropriate Assessment in relation to the main development site.

8.12.2. The following potential effect was screened in for Appropriate Assessment in relation to the Freight Management Facility:

- Disturbance effects on species populations, during construction, operation and decommissioning, for the qualifying features:
  - non-breeding populations of hen harrier; black-tailed godwit; dunlin; grey plover; pintail; redshank; ringed plover; shelduck; and turnstone; and the
  - assemblage of non-breeding waterbirds.

b) SPA qualifying features, project alone

i. Disturbance effects on species populations

8.12.3. Disturbance effects on Stour and Orwell Estuaries SPA qualifying features may arise via visual or noise disturbance associated with the construction, operation or decommissioning of the Freight Management Facility. These SPA populations could be affected as a result of disturbance to feeding, roosting or breeding birds, which could act to reduce the available foraging habitat, reduce foraging efficiency, increase energetic demands or reduce breeding success.

Construction, operation and decommissioning

8.12.4. The Freight Management Facility is adjacent to the A14 trunk road and located 1.6km to the north of the Stour and Orwell Estuaries SPA at its closest point, but considerably further from the vast majority of the full extent of this SPA (**Figure 8.1**).

8.12.5. The construction and decommissioning of the Freight Management Facility site (expected to last for approximately 12 to 18 months) would be a source of noise and visual disturbance but the distance of the site from the Stour and Orwell Estuaries SPA means that any effects of such disturbance on the SPA qualifying features are highly unlikely. In addition, construction activities would result in increased vehicle movements, estimated to total 224 per day, including 42 HGVs (Ref. 8.11), but within the context of the existing vehicle movements on the A14 trunk road which passes through the northern

extremity of the SPA, this is considered to be of little consequence in terms of disturbance to the SPA qualifying features.

8.12.6. During the operational phase of the Freight Management Facility (expected to be 10 years), it is estimated that 275 HGVs would arrive on the site on a typical weekday, with up to 425 HGVs during the busiest periods. Most of this activity is expected to occur during the morning, and the peak hourly rate of vehicle movements is expected to be approximately 40 in each direction (Ref. 8.11). As for construction of the Freight Management Facility, within the context of existing vehicle movements on the A14 and in conjunction with the considerable distance of the site from the bulk of the SPA area, this increase in vehicle movements is highly unlikely to result in any increase in disturbance effects on the SPA qualifying features.

8.12.7. Artificial lighting would also be in place during the construction, operational and decommissioning periods. However, lighting designs would ensure minimal light spillage at the site's boundaries (Ref. 8.11). Given the distance of the Freight Management Facility site to the SPA, it is considered that this would not lead to any effects on the SPA qualifying features.

8.12.8. Given the above, no adverse effects on the SPA qualifying features are predicted as a consequence of noise and visual disturbance from construction, operation and decommissioning of the Freight Management Facility.

c) Conclusion for the Stour and Orwell Estuaries SPA, project alone

8.12.9. It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Stour and Orwell Estuaries SPA.

8.12.10. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:

- affect the extent and distribution of the habitats of the qualifying features;
- affect the structure and function of the habitats of the qualifying features;
- affect the supporting processes on which the habitats of the qualifying features rely;
- adversely affect the populations of each of the qualifying features; and
- adversely affect the distribution of the qualifying features within the site.

d) In combination assessment

8.12.11. The screening exercise for plans or projects that potentially could cause a likely significant in-combination effect with the construction, operation and decommissioning of the Sizewell C Project identified no likely significant in-combination effects on the Stour and Orwell Estuaries SPA as seen in **Appendix C** of this report. Therefore, it is concluded that the Sizewell C Project would not result in adverse in-combination effects on the integrity of the Stour and Orwell Estuaries SPA.

8.13 Assessment of effects: Stour and Orwell Estuaries Ramsar site

a) Summary of screening outcomes

8.13.1. No potential effects were screened in for Appropriate Assessment in relation to the main development site.

8.13.2. The following potential effect was screened in for Appropriate Assessment in relation the Freight Management Facility:

- Disturbance effects on species populations, during construction, operation and decommissioning, for:
  - Ramsar criterion 3, waterfowl assemblage of international importance.
  - Ramsar criterion 6, bird species occurring at level of international importance.

b) Effects on qualifying features screened in, project alone

8.13.3. Although the Ramsar qualifying criteria are different from those of the SPA, the bird species cited as a qualifying feature under Ramsar criterion 6 and the waterfowl assemblage under criterion 3 are also qualifying features of the SPA. Thus, the assessment above for each impact pathway in relation to the Stour and Orwell Estuaries SPA, and the conclusion of no adverse effect is also considered to apply to the Ramsar site.

c) In combination assessment

8.13.4. As for the Stour and Orwell Estuaries SPA, the screening exercise for plans or projects that could cause a likely significant in-combination effect with the construction, operation and decommissioning of the Sizewell C Project identified no likely significant in-combination effects on the Stour and Orwell Estuaries Ramsar site as seen in **Appendix C** of this report. Therefore, it is concluded that the Sizewell C development would not result in adverse in-

combination effects on the integrity of the Stour and Orwell Estuaries Ramsar site.

9 Information for Appropriate Assessment: Marine Mammals

9.1 Introduction

9.1.1. This chapter presents the information required for Appropriate Assessment of the effects of the Sizewell C Project, alone and in-combination, on the SACs screened in for marine mammals. Section 9.2 of this report provides an introduction to these European sites and section 9.3 of this report considers potential effects. Sections 9.4 to 9.6 of this report assess the predicted effects for the three screened in European sites during the construction, operation and decommissioning phases of Sizewell C.

9.1.2. The following table sets out the structure of this section to assist in navigation.

9: MARINE MAMMALS	
9.1	**Introduction**
9.2	**Site information**
a)	Humber Estuary SAC
i.	Site information
ii.	Conservation objectives
b)	Southern North Sea SAC
ii.	Site information
iii.	Conservation objectives
iv.	Management measures
v.	Advice on activities
vi.	Potential effects on the conservation objectives
c)	The Wash and North Norfolk Coast SAC
ii.	Site information
iii.	Conservation objectives
9.3	**Potential effects**
b)	Description of effects
i.	Water quality effects – marine environment
ii.	Potential for habitat loss and fragmentation due to construction and decommissioning activities
iii.	Potential for habitat loss during operation
iv.	Underwater noise
v.	Physical interaction between species and project infrastructure

9: MARINE MAMMALS	
c)	In-combination effects
9.4	**Assessment of effects: Humber Estuary SAC**
a)	Water quality effects – marine environment
b)	Underwater noise effects on species populations
c)	Physical interaction between species and project infrastructure
d)	In-combination effects
e)	Summary of effects (alone and in-combination)
f)	Conclusions
9.5	**Assessment of effects: Southern North Sea SAC**
a)	Water quality effects – marine environment
b)	Direct habitat loss and direct / indirect habitat fragmentation
c)	Underwater noise effects on species populations
d)	Physical interaction between species and project infrastructure
e)	In-combination effects
f)	Summary of effects (alone and in-combination)
g)	Conclusions
9.6	**Assessment of effects: The Wash and North Norfolk Coast SAC**
a)	Water quality effects – marine environment
b)	Underwater noise effects on species populations
c)	Physical interaction between species and project infrastructure
d)	In-combination effects
e)	Summary of effects (alone and in-combination)
f)	Conclusions

9.2 Site information

a) Humber Estuary SAC

9.2.1. The Humber Estuary SAC is a designated European site for Annex II species grey seal (*Halichoerus grypus*).

i. Site information

9.2.2. The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. Grey seal are present as a qualifying feature, but not a primary reason for site selection (Ref. 9.1).

9.2.3. The Humber Estuary SAC is located approximately 184km from the Sizewell C site but was screened in to the HRA to take into account the movements of grey seal along the east coast of England.

ii. Conservation objectives

9.2.4. For the purposes of this assessment, potential effects are considered in relation to the Humber Estuary SAC conservation objectives; as outlined in **Table 9.1**.

Table 9.1: Potential effects of the Sizewell C Project in relation to the conservation objectives for Humber Estuary SAC

Conservation Objective	Potential Effect
The extent and distribution of qualifying natural habitats and habitats of qualifying species.	No potential for effect. There would be no change to the extent and distribution of the habitats of qualifying species in the SAC.
The structure and function (including typical species) of qualifying natural habitats.	No potential for effect. There would be no change to the structure and function (including typical species) of qualifying natural habitats in the SAC.
The structure and function of the habitats of qualifying species.	No potential for effect. There would be no change to the structure and function of the habitats of the qualifying species.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely.	No potential for effect. There would be no change to the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely within the site boundary. However, changes to water quality may affect the prey availability for foraging seals within the vicinity of the Sizewell C main development site and has been considered further.
The populations of qualifying species.	Increased collision risk with vessels may cause a potential likely significant effect which will be considered further.
The distribution of qualifying species within the site.	No potential for effect. There would be no change to the distribution of qualifying species within the SAC. However, significant disturbance and displacement as a result of increased underwater noise levels have the potential to have an effect on the seals foraging at sea and has been considered further.

b) Southern North Sea SAC

9.2.5. The Southern North Sea SAC is a designated European site for Annex II species harbour porpoise (*Phocoena phocoena*).

i. Site information

9.2.6. The majority of the SAC is less than 40m in depth, reaching up to 75m in the northern-most areas. The seabed is mainly sublittoral sand and sublittoral coarse sediment (Ref. 9.2). The site overlaps with a number of other European sites, including the Dogger Bank SAC, Margate and Long Sands SAC, Happisborough, Hammond and Winterton SAC and North Norfolk Sandbanks and Saturn Reef SAC, all of which have important sandbank and gravel beds.

9.2.7. The SAC has been recognised as an area with persistent high densities of harbour porpoise (Ref. 9.2). The SAC has an area of 36,951km^2, covering both winter and summer habitats of importance to harbour porpoise, with approximately 27,018km^2 of the site being important in the summer and 12,697km^2 of the site being important in the winter period. The Sizewell C main development site is located wholly within the winter area of the SAC.

9.2.8. The Southern North Sea SAC Site Selection Report (Ref. 9.2) identifies that the site supports approximately 18,500 individuals (95% CI = 11,864 - 28,889) for at least part of the year (Ref. 9.2). However, JNCC and Natural England (2019) (Ref. 9.3) states that because this estimate is from a one-month survey in a single year (the SCANS-II survey in July 2005) it cannot be considered as an estimated population for the SAC. It is therefore not appropriate to use site population estimates in the Appropriate Assessment, and the assessment needs to take into consideration population estimates at the management unit level, to account for daily and seasonal movements of the animals (Ref. 9.3).

ii. Conservation objectives

9.2.9. The conservation objectives for the Southern North Sea SAC are designed to ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely.

9.2.10. The conservation objectives for the site are (Ref. 9.3):

"*To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters.*

In the context of natural change, this will be achieved by ensuring that:

1. *Harbour porpoise is a viable component of the site;*
2. *There is no significant disturbance of the species; and*
3. *The condition of supporting habitats and processes, and the availability of prey is maintained."*

9.2.11. These conservation objectives "*are a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level*" (Ref. 9.3).

Conservation Objective 1: Harbour porpoise is a viable component of the site

9.2.12. This conservation objective is designed to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of such impacts on harbour porpoise using the site. Unacceptable levels can be defined as those having an impact on the Favourable Conservation Status of the populations of the species in their natural range.

9.2.13. Harbour porpoise are considered to a viable component of the site if they are able to live successfully within it. This site has been selected primarily based on the long term, relatively higher densities of porpoise in contrast to other areas of the North Sea. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies there is no exact value for the number of animals expected within the site (Ref. 9.3).

9.2.14. Harbour porpoise are listed as EPS under Annex IV of the Habitats Directive and are, therefore, protected from the deliberate killing (or injury), capture and disturbance throughout their range. Under the Habitats Regulations 2017 in the UK, it is deemed an offence if harbour porpoise are deliberately disturbed in such a way as to:

- impair their ability to survive, to breed or reproduce, or to rear or nurture their young; or
- to affect significantly the local distribution or abundance of that species.

9.2.15. The term deliberate is defined as any action that is shown to be any action "*by a person who knows, in the light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that*

their action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action" (Ref. 9.5).

9.2.16. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States "*shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned"*.

Conservation Objective 2: There is no significant disturbance of the species

9.2.17. The disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise, including activities such as seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.

9.2.18. As outlined above, JNCC and Natural England (2019) (Ref. 9.3) note that harbour porpoises in UK waters are considered part of a wider European population and that due the mobile nature of this species the concept of a 'site population' may not be appropriate for this species. JNCC and Natural England (2019) (Ref. 9.3) therefore advise that assessments of effects of plans or projects (i.e. HRA) need to take into consideration population estimates at the management unit level, to account for daily and seasonal movements of the animals.

9.2.19. Disturbance of harbour porpoise may lead to displacement from an area, and the temporary loss of habitat. As such, JNCC and Natural England (2019) (Ref. 9.3) suggest that activities within the Southern North Sea SAC should be managed to ensure that the animals' potential usage of the site is maintained, and any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.

9.2.20. The current draft Statutory Nature Conservation Body advice / guidance for the assessment of significant noise disturbance on harbour porpoise in the Southern North Sea SAC, as outlined in the conservation objectives (Ref. 9.3) is that:

9.2.21. "*Noise disturbance within an SAC from a plan/project individually or in-combination is significant if it excludes harbour porpoise from more than:*

1. 20% of the seasonal component of the Southern North Sea SAC in any given day, and

2. An average of 10% of the relevant area of the site over a season".

Conservation Objective 3: The condition of supporting habitats and processes, and the availability of their prey maintained

9.2.22. Supporting habitats, in this context, means the characteristics of the seabed and water column. Supporting processes encompasses the movements and physical properties of the habitat. The maintenance of these supporting habitats and processes contributes to ensuring that prey stays within the site and is available to harbour porpoise using the site. Harbour porpoise are strongly reliant on the availability of prey species year round due to their high energy demands, and their distribution and condition may strongly reflect the availability and energy density of prey.

9.2.23. This conservation objective is designed to ensure that harbour porpoise are able to access food resources year round, and that activities occurring in the Southern North Sea SAC will not affect this.

iii. Management measures

9.2.24. Specific management measures are yet to be developed for the Southern North Sea SAC, however JNCC and Natural England (2019) (Ref. 9.3) advise that "*the maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site"*.

9.2.25. JNCC and Natural England (2019) (Ref. 9.3) also state that "*management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate"*.

iv. Advice on activities

9.2.26. JNCC and Natural England (2019) (Ref. 9.3) have provided advice on activities that specifically occur within or near to the Southern North Sea SAC site that could be expected to impact on the site's integrity. The activities that JNCC and Natural England (2019) (Ref. 9.3) consider having the greatest impact on the population of UK harbour porpoise and, therefore, the Southern North Sea SAC are:

- removal of non-target species by commercial fisheries with by-catch of harbour porpoise (predominantly static nets);
- increased contaminants from discharge / run-off from land fill, terrestrial and offshore industries;
- increased anthropogenic underwater noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity;
- death or injury by collision from shipping, recreational boating and tidal energy installations; and
- reduction in prey resources by commercial fisheries.

9.2.27. The aim is that the advice should help identify the extent to which existing activities are, or can be made, consistent with the conservation objectives, and thereby focus the attention of relevant and competent authorities and monitoring programmes to areas that may need management measures (Ref. 9.3). For the Sizewell C main development site, the activities of relevance are; increased contaminants from discharge / run-off, increased anthropogenic underwater noise, and death or injury by collision.

v. Potential effects on the conservation objectives

9.2.28. This latest Statutory Nature Conservation Body advice has been used in the assessments and potential effects are considered in relation to the Southern North Sea SAC Conservation Objectives; as outlined in **Table 9.2**.

Table 9.2: Potential effects of the Sizewell C Project in relation to the Conservation Objectives for the Southern North Sea SAC

Conservation Objective	Potential Effect
Harbour porpoise is a viable component of the site.	Lethal effects and permanent auditory injury underwater noise associated with the construction of the proposed Sizewell C Project has the potential to have an effect on the European site and has been considered further. Disturbance and displacement as a result of increased underwater noise levels from construction of the Sizewell C Project has the potential to have an effect on the European site and has been considered further. Increased collision risk with vessels has the potential to have an effect on the European site and has been considered further.
There is no significant disturbance of the species.	Significant disturbance and displacement as a result of increased underwater noise levels from construction of

Conservation Objective	Potential Effect
	the Sizewell C Project has the potential to have an effect on the European site and has been considered further.
The condition of supporting habitats and processes, and the availability of prey is maintained.	Changes in water quality in the marine environmental has the potential to affect the European site and has been considered further. Direct habitat loss has the potential to affect the site and has been considered further. Changes in prey availability have potential to affect the site and has been considered further.

c) The Wash and North Norfolk Coast SAC

9.2.29. Harbour seal are a primary reason for selection of this European site (Ref. 9.6).

i. Site information

9.2.30. The Wash, on the east coast of England, is the largest embayment in the UK. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for harbour seal breeding and hauling-out.

9.2.31. The Wash and North Norfolk SAC is located approximately 107km from the Sizewell C main development site and is screened in to the HRA to take into account the movements of harbour seal along the east coast of England. No potential exists for any direct effects on the SAC itself due to the Sizewell C main development site.

ii. Conservation objectives

9.2.32. For the purposes of this assessment, the potential effects are considered in relation to The Wash and North Norfolk Coast SAC conservation objectives; as outlined in **Table 9.3**:

Table 9.3: Potential effects of the proposed Sizewell C main development site in relation to the conservation objectives for The Wash and North Norfolk Coast SAC

Conservation Objective	Potential Effect
The extent and distribution of qualifying natural habitats and habitats of qualifying species.	No potential for effect. There would be no change in the extent and distribution of the habitats of qualifying species in the SAC.
The structure and function (including typical species) of qualifying natural habitats.	No potential for effect. There would be no change to the structure and function (including typical species) of qualifying natural habitats in the SAC.

Conservation Objective	Potential Effect
The structure and function of the habitats of qualifying species.	No potential for effect. There would be no change to the structure and function) of the habitats of the qualifying species.
The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely.	No potential for effect. There would be no change to the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely within the site boundary. However, changes to water quality may affect the prey availability for foraging seals within the vicinity of the Sizewell C Project and has been considered further.
The populations of qualifying species.	Increased collision risk with vessels may cause a potential likely significant effect which has been considered further.
The distribution of qualifying species within the site.	No potential for effect. There would be no change to the distribution of qualifying species within the SAC. However, significant disturbance and displacement as a result of increased underwater noise levels have the potential to have an effect on the seals foraging at sea and has been considered further.

9.3 Potential effects

a) Introduction

9.3.1. This section describes the potential effects on marine mammals and their prey from:

- changes in water quality;
- direct habitat loss or direct / indirect habitat fragmentation;
- underwater noise; and
- physical interaction with vessels or project infrastructure.

9.3.2. Potential effects from the introduction of artificial light during construction, operation and decommissioning have not been assessed here, as marine mammals are not sensitive to visual disturbance from artificial light and (as assessed in the **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) it is predicted to have a negligible, if any, effect.

9.3.3. **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) also considers the potential effect of organic enrichment from FRR discards; which is predicted to have a negligible effect on harbour porpoises and minor positive effects on seal species. The effects predicted were not assessed to be significant at the population level and, therefore, have not been considered further in the Shadow HRA.

b) Description of effects

i. Water quality effects – marine environment

9.3.4. Potential effects on marine mammals due to changes in water quality in the marine environment could result from:

- Construction and decommissioning
  - surface water drainage;
  - effluent from the treatment of sewage and from potable supply (black and grey water) by the on-site treatment works;
  - water pumped from both groundwater and excavations during construction dewatering activities;
  - wash water from cleaning concrete production equipment;
  - waste water from horizontal cooling water system tunnelling operations (during construction); and
  - an increase in SSC and contaminant re-mobilisation during dredging and disposal activities.
- Operation
  - surface drainage from across the developed site;
  - grey and black water drainage from on-site purification plants;
  - effluent from demineralisation plant;
  - the thermal elevation of the cooling water;
  - chemicals discharged during operation; and
  - discharges associated with chlorination.

9.3.5. On a very precautionary basis, the assessments of water quality effects during construction, operation and decommissioning have been based on the change in water quality that would have the largest area of effect; which would be from the operational total residual oxidant plume for both Sizewell B and C in-combination, predicted to affect an area of 7.26km^2. This area for potential water quality effect is greater than any other potential water quality effects assessed within **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) and, therefore, would include within it any changes to water quality as a result of other water quality effects, including any changes in SSC and other sources outlined above.

Changes to water quality due to construction and decommissioning discharges

9.3.6. Section 7.7 of this report outlines the changes to water quality that are predicted to occur due to construction phase discharges. An H1 Environmental Risk Assessment, provided in **Volume 2, Chapter 21, Appendix 21G** (Doc Ref. 6.3) was carried out and shows that all envisaged discharges, except for chromium and zinc, would pass the H1 Environmental Risk Assessment; indicating that there is very little potential for any effect on qualifying features.

9.3.7. Chromium and zinc failed the H1 Environmental Risk Assessment because they were predicted to be discharged at levels above the relevant EQS when combined with existing, high background levels. The discharges of these metal pollutants were, therefore, further investigated to determine the potential zone of effect. Modelling of the discharge of these metals shows that the chromium plume would fall below the EQS less than 25m from the CDO outfall, and the zinc plume at less than 3m. Therefore, it is unlikely that there would be a significant effect on the qualifying features of the relevant European sites.

9.3.8. The construction phase effects are assumed to represent a worst-case for the decommissioning phase. Hence, the conclusions drawn for construction also apply to decommissioning.

Changes to water quality during dredging and disposal activities

9.3.9. Section 7.3 and section 7.7 of this report outline the effects predicted to arise from dredging activities associated with the construction of the BLF and cooling water intakes. SSC have the potential to affect sensitive fish that are prey for marine mammals. The assessment shows that the average mean suspended particulate matter value at Sizewell from April to August would be 31 mg/l (an average monthly maximum of 80 mg/l) and, during September to March, 73 mg/l (an average monthly maximum of 180 mg/l) (see Ref. 7.4). Fish are tolerant of suspended particulate matter values up to 180 mg/l around Sizewell, therefore, a 100 mg/l suspended particulate matter value above the background threshold has been applied as this uplift would be similar to the 180 mg/l maximum suspended particulate matter value experienced during winter at Sizewell.

9.3.10. Dredging impacts arising from the construction of the cooling water intakes would also be temporary and short-lived as detailed in section 7.7 of this report. Therefore, it is considered that there would not be a significant effect on fish.

Changes to water quality due to operational discharges

Thermal and chemical plumes

9.3.11. Section 7.4 of this report outlines the changes to water quality predicted to occur due to discharges during the operation of the power station. **Figures 7.1** to **7.4** show the predicted extent of the thermal plume. **Figures 7.6** to **7.8** show the predicted extent of the chemical plumes, consisting of total residual oxidant, bromoform and hydrazine.

9.3.12. Thermal standards for transitional waters specify that an estuary's cross section should not have an area larger than 25% with a temperature uplift of more than 2°C, for more than 5% of the time (Ref. 7.3).

9.3.13. Thermal and chemical plumes can act as barriers to migration for marine mammals and fish.

Effects on prey species

9.3.14. A review of the available evidence on thermal effects on fish concluded that the adverse effects associated with cooling water outfalls are localised and restricted to the immediate area of the thermal plume (Ref. 6.148). The review also found that temperature rises of up to 3°C are acceptable for fish species, and that temperatures of below 27°C have no lethal effect. However, the thermal plume may have effects on local fish populations if they are exposed over an extended period of time. Fish species may show different survival, growth and reproduction behaviours as they become further exposed to a thermal plume. Fish species may also become habituated to the thermal plume.

9.3.15. Depending on the prey species, temperature may have a positive, negative or neutral effect on fish. Langford (1990) (Ref. 9.7) examined data from power plant studies around the world and found no instance of direct fish mortalities associated with a power plant outfall. Therefore, the potential effects are active thermal avoidance or attraction, changes in growth rate or the modification of community structure resulting from warm-water species being favoured over cold-water species.

9.3.16. Displacement of fish through thermal avoidance is likely to be driven by displacement of their prey. Pelagic species utilise the full water column and, therefore, are more able to move to new feeding grounds when compared with demersal species that may be more reliant on specific habitat types.

Marine mammal prey species

9.3.17. Important marine mammal (and bird) prey species include sandeels, whiting, Atlantic herring and European sprat. Sandeel and herring have been found

to occur in sea temperatures of up to 24°C (Ref. 6.147; Ref. 6.148), however, are most likely to be in areas with temperatures ranging from 8.5°C and 9.5°C and 9°C and 11°C respectively (Ref. 6.149; Ref. 6.150). Whiting are most likely found in sea temperatures of 6 to 9°C for whiting (Ref. 6.151, *cited in* Ref. 6.152) and sprat between 8°C and 14°C (Ref. 6.153).

9.3.18. Other marine mammal prey species include cod, saithe, haddock, plaice and Dover sole. Cod are predominately found in water temperatures of 7 to 15°C (Ref. 6.154) and have been found to avoid temperatures of above 15°C (Ref. 6.155). The preferred temperature range for haddock and saithe is 11.3°C – 16.1°C and 10.7°C – 16.1°C, respectively (Ref. 6.156). Juvenile plaice have been found to tolerate temperatures ranging up to 20°C (Ref. 6.157), and in the Thames Estuary, 14.17°C is reported as the optimal temperature for growth of adult sole (Ref. 6.159 *cited in* Ref. 6.148).

ii. Potential for habitat loss and fragmentation due to construction and decommissioning activities

9.3.19. No habitat would be permanently lost (or lost in the long-term) during the construction phase of the Sizewell C Project, however, there would be some habitat changes due the jack-up barge required to construct the BLF. This would be restricted to within the red line boundary of the Sizewell C main development site. Effects associated with marine infrastructure are considered in the operational phase.

9.3.20. As above, these construction phase effects are taken to represent a worst-case for the decommissioning phase.

9.3.21. Dredging to create a navigational channel to the BLF, and a grounding area for barges, would result in long-term change to habitats in these areas. The total volume of material to be dredged during the construction of the BLF would be 4,600m^3. The proposed method of dredging (plough dredging) would not remove material, however, the redistribution of sediments would occur in the local vicinity. The habitat area that would be affected the by dredging works would be 9,068m^2; this includes the grounding area for the barge and tug (Ref. 6.1). Dredging would not occur in the decommissioning phase.

iii. Potential for habitat loss during operation

9.3.22. The construction of the BLF, cooling water infrastructure and FRRs would lead to direct habitat loss for the duration of the operational phase (60 years). Considering the time frame of this habitat loss, it is considered to be a long-term effect.

9.3.23. Once constructed, the BLF jetty, fenders and dolphin piles would generate scour. Predictions of the potential for scour effects are that the total area that could be affected by scour development and the presence of the piles, and therefore undergo a long-term habitat change, would be 852m^2 - see Ref. 7.2 and section 7.3 of this report.

9.3.24. For the cooling water intakes and outfall head structures, the area of habitat that would experience long-term effects would be 1,552m^2 per structure, and 6,209m^2 for the four intake tunnels. Scour protection would 'take' a further 2,565m^2 for each of the outfall structures; amounting to 5,130m^2 in total. The total long-term habitat loss as a result of the intake and outfall structures, therefore, would be 11,339m^2 - see Ref. 7.2 and section 7.3 of this report.

9.3.25. The area of long-term habitat loss from the FRR and CDO would be broadly elliptical due to tidal currents affecting the scour area, with a 7.2m extent north and south, and 4.1m east to west. The total area of long-term loss would be 207m^2 per structure (including the 9m^2 footprint of each), or 621m^2 in total for the three structures and estimated scour area (see Ref. 7.2).

9.3.26. Dredging of the navigational channel would continue through the operational phase of the project, to allow continued use of the BLF. The area of habitat that would be affected would be the same as that for the construction period; 9,068m^2.

9.3.27. The total area of long-term habitat loss and potential changes to the habitat as a result of the installation of the intake and outfall tunnels, the BLF and associated infrastructure, the FRR and CDO structures, including areas of scour (or scour protections), and dredging the navigation channel to the BLF would be 0.02km^2.

iv. Underwater noise

9.3.28. Underwater noise can have both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) effects on marine mammals and their prey species. High peak pressure sound levels very close to the source have the potential to cause death or physical injury, with any severe injury potentially leading to death.

9.3.29. High exposure levels from underwater sound sources can cause auditory injury or hearing impairment, taking the form of a permanent loss of hearing sensitivity (permanent threshold shift (PTS)) or a temporary loss in hearing sensitivity (TTS). The level of impact on an individual is a function of the sound exposure level (SEL) that an individual receives as a result of underwater noise.

9.3.30. Marine mammals and prey species may exhibit varying intensities of behavioural response at lower noise levels. For marine mammals, these can include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases panic, flight stampede or stranding, sometimes resulting in injury or death. The response can vary due to exposure level, the hearing sensitivity of the individual, context, previous exposure history or habitation, motivation and ambient noise levels.

9.3.31. The construction (and decommissioning) of the Sizewell C Project would include a number of activities that are expected to generate noise. These include both impulsive noise sources (for the impact piling and any UXO clearance) and continuous noise sources (for drilling, dredging and vessel noise). That is:

- impact piling for the construction of the BLF;
- wet drilling for the construction of the cooling water intakes and outfall;
- dredging for the construction of the cooling water intakes and outfall, the BLF navigational channel, and the FRR and CDO;
- vessel noise from the construction and decommissioning vessels and deliveries via the BLF;
- UXO clearance (if required).

9.3.32. The operation of Sizewell C would also generate noise.

Noise sources

Impact piling

9.3.33. Pile driving activities can generate loud, impulsive sounds, at low frequencies and high source levels (Ref. 9.8).

9.3.34. As set out in section 2 of this report, the BLF would be constructed from an 85m long piled jetty, with an additional 11m of fenders and a ramp. Four of the pile pairs would be positioned landward of low tide, one pair would be close to the low tide mark and three pairs would be seaward of low tide. Two piles would also be installed for fenders, as well as two mooring dolphins. In total, 12 piles would need to be installed in the water, below MHWS (Ref. 6.1).

9.3.35. The marine piling would be undertaken from either a temporary rock platform or by a walking jack-up barge.

Wet drilling

9.3.36. Drilling is a continuous (i.e. non-impulse) noise source. Very few studies have been published on the underwater noise emitted during drilling operations or on the potential effects of drilling noise, and these have mostly been from drillships (e.g. Ref. 9.9; Ref. 9.10). Other methods, e.g. semi-submersible rigs and jack-ups (as would be used for the Sizewell C Project), have the majority of their machinery well above the waterline, generating lower levels of underwater noise.

9.3.37. Drilling works for the Sizewell C main development site are expected to be via a jack-up rig. Given that the drilling machinery would, therefore, be out of the water, noise source levels are likely to be similar to those generated by a drilling platform.

Dredging

9.3.38. Overall, dredging activities emit sounds that are continuous in nature and comparatively low in frequency and intensity, although occasionally higher frequencies are emitted (Ref. 9.11).

9.3.39. Dredging activities undertaken in the construction phase for the two FRRs and the CDO are anticipated to take approximately 9 hours to complete in each case. It is estimated that dredging for the cooling water intake headworks would take approximately 8 hours, and for the cooling water outfall structure would take 7 hours. Dredging for the BLF is anticipated to take approximately two days to complete.

UXO detonations

9.3.40. If UXOs are discovered at the site and alternative disposal methods or relocation are not possible, underwater detonations may be required. Underwater explosions generate some of the highest peak sound pressures of all anthropogenic underwater sound sources (Ref. 9.12), and are considered a high energy, impulsive sound source.

9.3.41. At the time of writing, it has not been confirmed if any UXOs are present in the vicinity of the site, thus specific details are not available. The noise propagation modelling has, therefore, been conducted for two different explosive charges: 250lb and 500lb of Trinitrotoluene (TNT) equivalent. Further details on the underwater noise modelling are provided below. Indicative assessments have been conducted for grey seal from the Humber Estuary SAC, harbour porpoise from the Southern North Sea SAC and harbour seal from The Wash and North Norfolk Coast SAC.

9.3.42. However, it should be noted, if UXO detonations are required, further assessments would be conducted based on the size and number of the UXO devices that are required to be detonated. At this time the requirements of any EPS licence would be completed and a mitigation plan prepared.

Vessels

9.3.43. The proposed routes for deliveries to Sizewell include transhipment from the UK ports of Great Yarmouth and Harwich, and from the Netherlands ports of Rotterdam and Vlissingen. In order to cover the four proposed transhipment routes, and the potential sources of ambient noise affecting the locations along these routes, a model domain covering the southern North Sea region between 51°N -53.5°N latitude and 0°E - 5°E longitude was defined (see Ref. 8.106 for further information).

9.3.44. Baseline noise levels were investigated in order to understand the potential increase in noise from vessels associated with the Sizewell C project. Long-term passive acoustic recordings were made over a two-year period, allowing for a thorough characterisation of ambient noise levels in the area (see Ref. 8.106 for more information). Baseline noise levels were found to be 101dB re 1 µPa sound pressure level (SPL), based on the median 1/3 octave band level, with a frequency range of 0.1-1kHz).

9.3.45. Four modelling scenarios were considered, corresponding to the four possible transhipment routes. At a nominal speed of 6 knots, the transit times are approximately 4.5 hours from both Great Yarmouth and Harwich, while from Rotterdam and Vlissingen transit times are approximately 15 hours and 14 hours, respectively. As the North Sea Barges can access the BLF only at high water, these durations imply a hypothetical maximum rate of 2 round trips (deliveries) per 24.8h tidal cycle from Great Yarmouth or Harwich, or 1 single trip per 24.8h tidal cycle from Rotterdam or Vlissingen.

9.3.46. For all four transhipment scenarios, similar statistical outputs were calculated, and the noise maps generated were very similar to the baseline case outputs (Ref. 8.106).

9.3.47. In the case of transhipment from Great Yarmouth or Harwich to the Sizewell C Project, the increase in median sound levels is approximately 1dB or less at the main development site and along the transhipment route for the 50th percentile vessel noise levels, or between 3dB (at the main development site) and 5dB (along the transhipment routes) for the 90th percentile vessel noise levels. These predictions are based on the use of every available high tide and are therefore considered to be conservative assessments (Ref. 8.106).

9.3.48. In the case of transhipment from the two Netherlands ports, sound levels from the vessels travel further offshore, due to the longer shipping distances

compared to the two UK ports, however the magnitude of these increases is smaller due to the reduced shipping frequency. The increase in noise levels from the 50th percentile vessel noise is predicted to be less than 0.5dB, and for the 90th percentile is expected to be less than 1.5dB.

9.3.49. The modelling indicates that the potential increase in ambient noise levels associated with the BLF vessel traffic during the construction period is likely to be very modest (compared to the baseline noise levels) and is well within the typical variability at the site. Therefore, the effect of vessel noise has not been assessed further for marine mammals.

Operation of the Sizewell C Project

9.3.50. Ambient noise recordings from the existing Sizewell B nuclear power station show that the station generates tonal noise that is 20 to 30dB above background noise levels (Ref. 8.106). The most prominent tonal noise was recorded at a frequency of 50Hz, with several harmonics and sub-harmonics at multiples of this frequency. It is therefore reasonable to expect that the new nuclear build at Sizewell C would emit similar operational noise into the marine environment. However, the complexity of the noise generating mechanisms, and propagation paths through the substrate and into the water column, preclude predictive modelling of operational noise.

9.3.51. Under the assumption that a similar amount of acoustic energy would be emitted into the marine environment by the Sizewell C Project, the additional noise generated with both power stations (Sizewell B and Sizewell C) in operation would be around 3dB above existing ambient noise levels. It is, therefore, anticipated that the additional effect of the operational noise from Sizewell C would be minimal and adaptation rapid. In addition, the increase in noise levels of 3dB in the vicinity of the Sizewell C main development site would increase the ambient noise levels to 104dB re 1 µPa (SPL), using the representative ambient noise level recorded at the site of SPL 101dB re 1 µPa - Ref. 8.106, section 3 of this report.

9.3.52. Given the small predicted increase in noise levels due to the operation of the Sizewell C Project, and that this noise level is below any threshold of effect for marine mammal (and prey) species, the effects of operational noise from the Sizewell C Project have not been considered further.

Underwater noise modelling

9.3.53. The potential effects of underwater noise depend on a number of factors, which include the following:

- source levels and characteristics of noise;
- noise attenuation within the environment;

- receptor species;
- frequency relative to the hearing bandwidth of the animal;
- duration of exposure;
- distance of the animal to the source; and
- ambient noise levels.

9.3.54. The spatial footprint of the effect as a feature of noise propagation conditions is also dependant on several factors, including, but not limited to:

- sediment and sea floor composition;
- water depth; and
- sensitivity of marine mammal species present in the area.

Modelling methodology

9.3.55. A validated underwater sound propagation model and receptor specific noise exposure thresholds were used to 'map' auditory effect zones over which certain responses are predicted for marine mammals and fish due to different activities (Ref. 9.13). The model takes into account the bathymetry, sediment properties, water column properties, and tidal cycle, leading to more detailed and reliable predictions of sound level. Effect zones are activity and receptor specific, but may include mortality in the worst instance, permanent auditory damage (PTS), temporary hearing impairment (TTS) or behavioural change. Each activity was assessed for both instantaneous and cumulative noise exposure.

9.3.56. Model predictions of sound transmission were compared to the field noise propagation measurements undertaken at Sizewell (Ref. 9.13). The model parameters were then optimised to maximise the agreement between the model and the measurements.

9.3.57. In all of the modelling, a conservative estimate of water level was used; sound propagates further in deeper water, so a relatively high water level was used. This was the average of highest astronomical tide and MHWS, which corresponds to 1.39m Ordnance Datum (Newlyn) (ODN) (1.26m above the mean sea level at Sizewell).

9.3.58. The criteria and thresholds used to assess any potential effects of underwater noise on harbour porpoise, grey seal and harbour seal were taken from the U.S. National Marine Fisheries Service; a part of the National Oceanic and Atmospheric Administration. The National Oceanic and

Atmospheric Administration criteria provide acoustic thresholds for the onset of PTS and TTS for marine mammals exposed to acute anthropogenic noise (Ref. 9.14).

9.3.59. The National Oceanic and Atmospheric Administration (2018) (Ref. 9.14) criteria consist of thresholds formulated using two metrics: the weighted cumulative sound exposure level (SEL_{cum}) and the peak sound pressure level (SPL_{peak}). Each threshold is further categorised by (i) sound type (pulse or non-pulse sound) and (ii) functional hearing group (four broad categories of marine mammal with regard to hearing ability). Both criteria require the application of an auditory weighting to account for the frequency sensitivity of hearing for each functional hearing group. These threshold criteria are shown in **Table 9.4** and **Table 9.5**.

Table 9.4: Noise exposure thresholds applied to the assessment of PTS onset in marine mammals

Species	Sound type	PTS	
		SPL_{peak} (db re 1 µPa)	SEL_{cum} (db re 1 µPa²s)
Harbour porpoise	Pulse	202	155
	Non-pulse	N/A	173
Grey seal and harbour seal	Pulse	218	185
	Non-pulse	N/A	201

Table 9.5: Noise exposure thresholds applied to the assessment of TTS onset in marine mammals

Species	Sound type	TTS	
		SPL_{peak} (db re 1 µPa)	SEL_{cum} (db re 1 µPa²s)
Harbour porpoise	Pulse	196	140
	Non-pulse	N/A	153
Grey seal and harbour seal	Pulse	212	170
	Non-pulse	N/A	181

9.3.60. In National Oceanic and Atmospheric Administration (2018) (Ref. 9.14) the weighted SEL_{cum} metric accounts for accumulated exposure, i.e. over the duration of the activity within a 24-hour period. It should be noted that, for all sources, National Oceanic and Atmospheric Administration recommends a baseline accumulation period of 24 hours, although it acknowledges that the activities may last less than 24 hours or may exceed this accumulation period. If the noise generating activities occur over a shorter period within

the 24-hour window (e.g. piling, most of the dredging activities) then a receptor is at risk within the predicted auditory effect zone during the duration of activity. For activities that may last more than 24 hours (e.g. dredging at the BLF location, drilling), the accumulation period accounts only for 24 hours of continuous activity.

9.3.61. The criteria used to undertake the modelling of the impacts of underwater noise on fish species are Popper *et al.* (2014) (Ref. 8.107). These criteria provide quantitative thresholds for TTS, recoverable injury, and death in fish in response to several impulse sound sources, including pile driving. The thresholds are formulated using the peak sound pressure level (dB peak) and SEL_{cum}. These threshold criteria are shown in **Table 9.6** and **Table 9.7**. Fish are categorised according to the following three functional hearing groups (in decreasing order of vulnerability to noise exposure):

- swim bladder or other air cavities aid hearing;
- swim bladder does not aid hearing; and
- no swim bladder.

Table 9.6: Noise exposure thresholds applied to the assessment of mortality and potential mortal injury in fish species

Species	Mortality And Potential Mortal Injury	
	SPL_{peak} (db re 1 µPa)	SEL_{cum} (db re 1 µPa^{2}s)
Fish with no swim bladder	More than 213	More than 219
Fish with swim bladder that is not involved in hearing	More than 207	More than 210
Fish with swim bladder involved in hearing	More than 207	More than 207

Table 9.7: Noise exposure thresholds applied to the assessment of recoverable injury and TTS in fish species

Species	Recoverable Injury		TTS
	SPL_{peak} (db re 1 µPa)	SEL_{cum} (db re 1 µPa^{2}s)	SEL_{cum} (db re 1 µPa^{2}s)
Fish with no swim bladder	More than 213	More than 216	More than 186
Fish with swim bladder that is not involved in hearing	More than 207	More than 203	More than 186

Species	Recoverable Injury		TTS
	SPL_{peak} (db re 1 µPa)	SEL_{cum} (db re 1 μPa^2s)	SEL_{cum} (db re 1 μPa^2s)
Fish with swim bladder involved in hearing	More than 207	More than 203	More than 186

9.3.62. The key prey species for harbour porpoise, grey seal and harbour seal are predominately species that have a swim bladder that does not aid hearing, and some with a swim bladder that does aid in hearing. A smaller number of marine mammal prey species have no swim bladder.

9.3.63. The movement of the receptor can be included in the model used to assess the cumulative sound exposure and, in particular, a fleeing behaviour is often considered in such models; namely the receptor is assumed to move away from the noise source, thus in general reducing its sound exposure. However, it should be noted that the assumptions underlying such fleeing models, particularly probability of fleeing, swim speed and flight path have a critical influence on the size and extent of the predicted effect zones. These assumptions related to the animal behavioural responses are likely to be site-specific (Ref. 9.15) and need to be better understood in order to avoid underestimating the risk (Ref. 9.16). Assuming that an animal remains stationary produces conservative predictions of the auditory effect zone extents. These can be interpreted as zones where the animal would be at risk of TTS or PTS onset, if it was to remain within the area for 24 hours (or the actual duration of activity if less than 24 hours).

9.3.64. Given the uncertainties related to the possible fleeing behaviour of the marine mammal receptors and the sensitivity of modelling predictions to the fleeing parameters, in this case the cumulative sound exposure levels were modelled for both stationary receptors and using a set of generic fleeing assumptions. For harbour porpoise this was a swimming speed of 1.4m/s and minimum depth constraint of 3m and, for grey and harbour seal, a swimming speed of 1.8m/s (Ref. 8.106).

Modelling input parameters

9.3.65. In order to install the BLF jetty, fender and dolphin piles, impact piling is proposed. The indicative piling specifications for these works are set out in **Table 2.2**. These specifications, along with the maximum pile diameter of 1m for the jetty piles and 1.52m for the dolphins, were used to inform underwater noise modelling.

9.3.66. It was assumed that piling would not occur concurrently, i.e. piles would be installed one at a time, but the modelling was based on the worst-case location; using the location of dolphin pile to be installed in the deepest water

(-3.38m ODN). Therefore, the cumulative assessments assume that all piles are at a water depth of 4.77m (deepest pile + 1.39m). This represents a highly precautionary approach that envelopes all piling scenarios.

9.3.67. The intake and outfall tunnels also require piles. However, these piles would be installed using drill methods, rather than by impact piling. The two FRR tunnels would also be drilled into the seabed.

9.3.68. For the wet drilling works, three distinct scenarios were modelled, including drilling at the furthest offshore positions for the northern intake, the outfall and the southern intake shafts. In all three cases, 24 hours of continuous drilling per day from one drill rig was assumed.

9.3.69. At Sizewell C, dredging at the location of the BLF is anticipated to be by plough dredger with cutter suction dredging anticipated at the locations of the infrastructure installations (FRRs, CDO, and cooling water infrastructure (Ref. 7.1)). The assessment assumed source terms from a large Trailing Suction Hopper Dredger for all dredging activities.

9.3.70. Due to the site bathymetry and the various durations required for each dredging activity, seven different dredging scenarios were assessed, based on the assumption that, within a 24-hour period, dredging activities would take place at a single distinct location. However, as a precaution, the in-combination effects of concurrent dredging at the BLF and at the south intake was modelled, as this was assumed to represent the worst-case scenario.

9.3.71. In all cases, continuous noise generation during the dredging activities was assumed. In the case of the BLF location, the noise was assumed the be continuous for 24 hours (the full length of the assessment period).

Noise source levels

9.3.72. The estimated source noise levels used for the underwater noise modelling are shown below (Ref. 8.106):

- Impact piling for the BLF jetty – 197.4 and 200.9dB re 1 μPa^2s for hammer energies of 90kJ and 200kJ respectively.
- Wet drilling for the intake and outfalls – 160dB re 1 µPa at 1m.
- Dredging for the BLF navigational channel and grounding area – 187.5dB re 1 µPa.

Potential for PTS during construction

9.3.73. The predicted underwater noise effect ranges for PTS onset in marine mammals, and for mortality and potential mortal injury to their prey species,

are presented in the following sections for each potential noise source. The predicted effects ranges for TTS are considered in the following section. The effect ranges are based on the worst-case scenario assessed within the underwater noise modelling (Ref. 8.106).

Potential for PTS from impact piling

9.3.74. Impact piling for the installation of BLF jetty piles resulted in the greatest auditory effect zones for instantaneous and cumulative exposures, for both fish and marine mammals.

9.3.75. The maximum instantaneous effect range during piling was estimated to be 41m for harbour porpoise with a hammer energy of 200kJ, and 27m for a 90kJ hammer energy (**Table 9.8**). The predicted effect ranges and areas were considerably less for seals for impact piling, with an effect range of 16m for piling under the larger hammer energy of 200kJ.

Table 9.8: Maximum predicted effect ranges and areas for PTS in marine mammals for impact piling

Species	Threshold And Criteria (Ref. 9.14)	90kJ Hammer Energy Range Of Effect (Area Of Effect)	200kJ Hammer Energy Range Of Effect (Area Of Effect)
Harbour porpoise	PTS 202 SPL_{peak}	27m (0.0023km^2)*	41m (0.0053km^2)*
	PTS 155 SEL_{cum}	Stationary cumulative = 1,297m (1.9km^2)	Stationary cumulative = 2,081m (5.6km^2)
		Fleeing cumulative = no effect	Fleeing cumulative = no effect
Grey seal and harbour seal	PTS 218 SPL_{peak}	6m (0.0001km^2)*	9m (0.00025km^2)*
	PTS 185 SEL_{cum}	Stationary cumulative = 206m (0.1km^2)	Stationary cumulative = 303m (0.2km^2)
		Fleeing cumulative = no effect	Fleeing cumulative = no effect

** area of effect based on the area of a circle*

9.3.76. The results of the stationary cumulative modelling (for five piles over a 24 hour period) show that the sound propagation is influenced by the Sizewell Dunwich Bank, and the cumulative effect areas extend furthest in the north and south directions, at 2.1km from the BLF for harbour porpoise with a hammer energy of 200kJ, or 1.3km for the 90kJ hammer energy (**Table 9.8**).

9.3.77. The cumulative PTS areas using the stationary modelling were smaller for grey and harbour seals than for those predicted for harbour porpoise. PTS was predicted to extend 303m with a 200kJ hammer energy, and for the most

likely 90kJ hammer energy, the maximum effect ranges were found to be 206m.

9.3.78. The cumulative PTS fleeing modelling indicated no potential effect on harbour porpoise, grey seal or harbour seal (**Table 9.8**).

Potential for PTS from drilling

9.3.79. The predicted underwater noise levels from the drilling activities associated with the construction of the intake and outfall headworks, and the FRR and CDO, were too low for PTS to occur in marine mammals for an instantaneous effect (note that under the National Marine Fisheries Service (2018) (Ref. 9.14) criteria, there are no set thresholds for PTS and TTS onset from SPL_{peak}, however, they recommend using the PTS and TTS SPL_{peak} criteria for impulsive sound sources if required).

9.3.80. For cumulative effects, the range at which PTS may occur in harbour porpoise due to the drilling works is predicted to be 50m, based on the stationary modelling. For grey and harbour seal, PTS due to cumulative exposure is predicted to be less than 25m, based on the stationary modelling (**Table 9.9**).

9.3.81. The cumulative PTS fleeing modelling indicate no potential effect of drilling on harbour porpoise, grey seal or harbour seal (**Table 9.9**).

Table 9.9: Maximum predicted effect ranges and areas for PTS in marine mammals for drilling and dredging activities

Species	Threshold And Criteria (National Marine Fisheries Service, 2018)	Drilling Of The Cooling Water Outfall Shaft	Dredging Works For The BLF Only	Dredging Works At The BLF And At The South Intake Concurrently
Harbour porpoise	PTS 202 SPL_{peak}	No effect	No effect	No effect
	PTS 173 SEL_{cum}	Stationary cumulative = 50 m (0.01km^2)	Stationary cumulative = 1,657 m (3.94 km^2)	Stationary cumulative = 6.2km^2
		Fleeing cumulative = no effect	Fleeing cumulative = no effect	Fleeing cumulative = no effect
Grey seal and harbour seal	PTS 218 SPL_{peak}	No effect	No effect	No effect
	PTS 201 SEL_{cum}	Stationary cumulative = less than 25m (0.002km^2)*	Stationary cumulative = 111m (0.05km^2)	Stationary cumulative = 0.05km^2

Species	Threshold And Criteria (National Marine Fisheries Service, 2018)	Drilling Of The Cooling Water Outfall Shaft	Dredging Works For The BLF Only	Dredging Works At The BLF And At The South Intake Concurrently
		Fleeing cumulative = no effect	Fleeing cumulative = no effect	Fleeing cumulative = no effect

** area of effect based on the area of a circle*

Potential for PTS from dredging

9.3.82. Noise levels from dredging were too low to generate instantaneous auditory effect zones for marine mammals.

9.3.83. For cumulative effects from the dredging activities, the worst-case scenario of a single dredging activity for harbour porpoise was for the dredging associated with the BLF, with a PTS range of 1.657km (or an area of 3.94km^2) for continuous exposure over a 24-hour period, based on the stationary modelling. The concurrent dredging scenario of dredging at the BLF and at the south intake headworks resulted in a predicted PTS area of 6.20km^2, based on the stationary modelling (**Table 9.9**).

9.3.84. For both grey and harbour seal, the worst-case single dredging scenario was again for the dredging works for the BLF, with a resultant PTS effect range of 0.11km (or an area of 0.05km^2) for 24 hours of exposure, based on the stationary modelling. The concurrent dredging scenario of dredging at the BLF and at the south intake location, resulted in a PTS onset area of 0.05km^2, based on the stationary modelling (**Table 9.9**).

9.3.85. The cumulative PTS fleeing modelling indicates no potential effect of dredging on harbour porpoise, grey seal or harbour seal (**Table 9.9**).

Potential for PTS from UXO clearance

9.3.86. The hypothetical UXO detonations resulted in the greatest auditory effect zones for instantaneous assessments (**Table 9.10**). The explosive charge mass of 500lb had the largest impact ranges with instantaneous PTS ranges of up to 9.7km for harbour porpoise and up to 1.9km for grey and harbour seal. For the explosive charge mass of 250lb the precited PTS ranges were 7.7km for harbour porpoise and 1.5km for grey and harbour seal.

Table 9.10: Maximum predicted effect ranges and areas for PTS in marine mammals for UXO clearance

Species	Threshold And Criteria (National Marine Fisheries Service, 2018)	250lb Charge Mass Range Of Effect (Area Of Effect)	500lb Charge Mass Range Of Effect (Area Of Effect)
Harbour porpoise	PTS 202 SPL_{peak}	7.7km (186.27km^2)*	9.7km (295.59km^2)*
Grey seal and harbour seal	PTS 218 SPL_{peak}	1.5km (7.1km^2)*	1.9km (11.34km^2)*

9.3.87. It should be noted that the requirement for any UXO clearance is currently unknown and, therefore, this hypothetical assessment has been included for illustrative purposes. In addition, the modelling assumes a freely suspended charge, unlike a UXO which would be resting on the seabed and does not take into account the bathymetry variations in the seabed or that the UXO could be buried, degraded or subject to other significant attenuation. It should also be noted that long range (beyond 2km) propagation measurements in shallow water are currently lacking and, therefore, caution should be used over long range predication of the peak pressure values.

Potential for TTS during construction

Potential for TTS from impact piling

9.3.88. Impact piling for the installation of BLF jetty piles resulted in the greatest auditory effect zones for instantaneous and cumulative exposures.

9.3.89. The maximum instantaneous TTS effect range during piling was estimated to be 67m for harbour porpoise with a hammer energy of 200kJ, and 45m for a 90kJ hammer energy (**Table 9.11**). The predicted TTS effect ranges and areas were considerably less for seals for impact piling, with an effect range of 16m for piling under the larger hammer energy of 200kJ.

Table 9.11: Maximum predicted effect ranges and areas for TTS in marine mammals for impact piling

Species	Threshold And Criteria (National Marine Fisheries Service, 2018)	90kJ Hammer Energy Range Of Effect (Area Of Effect)	200kJ Hammer Energy Range Of Effect (Area Of Effect)
Harbour porpoise	TTS 196 SPL_{peak}	45m (0.0064 km^2)*	67m (0.014 km^2)*

Species	Threshold And Criteria (National Marine Fisheries Service, 2018)	90kJ Hammer Energy Range Of Effect (Area Of Effect)	200kJ Hammer Energy Range Of Effect (Area Of Effect)
	TTS 140 SEL_{cum}	Stationary cumulative = 6.62 km (49.94 km^2)	Stationary cumulative = 12.45 km (102.23 km^2)
		Fleeing cumulative = 2.76 km^2 (7.68 km^2)	Fleeing cumulative = 4.8 km^2 (21.79 km^2)
Grey seal and harbour seal	TTS 212 SPL_{peak}	10m (0.0003 km^2)*	16m (0.0008 km^2)*
	TTS 170 SEL_{cum}	Stationary cumulative = 1.88 km (4.30 km^2)	Stationary cumulative = 3.1 km (10.64 km^2)
		Fleeing cumulative = no effect	Fleeing cumulative = no effect

** area of effect based on the area of a circle*

9.3.90. The results of the cumulative TTS effect modelling (of five piles being installed over a 24 hour period) show that the sound propagation is influenced by the Sizewell Dunwich Bank, and the cumulative effect areas extend furthest in the north and south directions, at 12.45km from the BLF for harbour porpoise with a hammer energy of 200kJ, or 6.62km for the 90kJ hammer energy, based on the stationary modelling (**Table 9.11**).

9.3.91. The cumulative TTS areas of effect were smaller for seals than for those predicted for harbour porpoise. Cumulative TTS was predicted to extend 3.1km with a 200kJ hammer energy and, for the most likely 90kJ hammer energy, the maximum effect ranges were found to be 1.9km, based on the stationary modelling (**Table 9.11**).

9.3.92. The cumulative TTS fleeing modelling indicated maximum predicted ranges of 4.8km for the 200kJ hammer energy and 2.8km for the 90kJ hammer energy for harbour porpoise (**Table 9.11**).

9.3.93. The cumulative TTS fleeing modelling indicate no potential effect grey seal or harbour seal.

Potential for TTS from drilling

9.3.94. The underwater noise levels from the drilling activities associated with the construction of the intake and outfall headworks, and the FRR and CDO, were too low for TTS to occur in marine mammals from an instantaneous effect.

9.3.95. For cumulative effects based on the stationary model, the range at which TTS may occur due to drilling activities in harbour porpoise is 1.31km. For grey and harbour seal, TTS due to cumulative exposure is less than 0.025km, based on the stationary model (**Table 9.12**).

9.3.96. The cumulative TTS fleeing modelling indicated no potential effect of drilling on harbour porpoise, grey seal or harbour seal.

Table 9.12: Maximum predicted effect ranges and areas for PTS in marine mammals for drilling and dredging activities

Species	Threshold And Criteria (Ref. 9.14)	Drilling Of The Cooling Water Outfall Shaft	Dredging Works For The BLF Only	Dredging Works At The BLF And At The South Intake Concurrently
Harbour porpoise	TTS 196 SPL_{peak}	No effect	No effect	No effect
	TTS 153 SEL_{cum}	Stationary cumulative =1.307km (3.99km^2 for the outfall shaft, but a larger area of 4.31km^2 for south intake shaft)	Stationary cumulative = 11.576km (113.31km^2)	Stationary cumulative = 143.59km^2
		Fleeing cumulative = no effect	Fleeing cumulative = 1.38km (2.41km^2)	Fleeing cumulative = 10.4km^2
Grey seal and harbour seal	TTS 212 SPL_{peak}	N/A	N/A	N/A
	TTS 181 SEL_{cum}	Stationary cumulative = less than 0.025km (0.002km^2)*	Stationary cumulative = 2.975km (9.69km^2)	Stationary cumulative = 14.11km^2
		Fleeing cumulative = no effect	Fleeing cumulative = no effect	Fleeing cumulative = no effect

** area of effect based on the area of a circle*

Potential for TTS from dredging

9.3.97. The underwater noise levels from the dredging works to be undertaken for the construction of the BLF, were also too low for TTS to occur in marine mammals from an instantaneous effect.

9.3.98. For cumulative effects from the dredging activities, the worst-case scenario of a single dredging activity for harbour porpoise was for the dredging associated with the BLF, with a TTS range of 11.58km (or an area of

113.3km^2) for continuous exposure over a 24-hour period. The concurrent dredging scenario of dredging at the BLF and at the south intake headworks resulted in a TTS area of 143.6km^2 (**Table 9.12**).

9.3.99. For both grey and harbour seal, the worst-case single dredging scenario was again for the dredging works for the BLF, with a resultant TTS effect range of 2.98km (or an area of 9.69km^2) for 24-hours of exposure. The concurrent dredging scenario of dredging at the BLF and at the south intake location, resulted in a TTS onset area of 14.1km^2 (**Table 9.12**).

9.3.100. The cumulative TTS fleeing modelling indicate no potential effect associated with dredging on harbour porpoise, grey seal or harbour seal.

Potential for behavioural effects due to underwater noise during construction works

9.3.101. Marine mammals may exhibit varying intensities of behavioural response at different noise levels. These include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment. The response can vary due to exposure level, the hearing sensitivity of the individual, context, previous exposure history or habituation, motivation and ambient noise levels (e.g. Ref. 9.17).

9.3.102. Harbour porpoise have relatively high daily energy demands and need to consume between 4% and 9.5% of their body weight in food per day (Ref. 6.137). If a harbour porpoise does not capture enough prey to meet its daily energy requirements, it can rely on stored energy (primarily blubber) for an estimated three to five days, depending on body condition (Ref. 6.137). Should harbour porpoise be excluded from an area of key prey resource it will likely seek an alternative food resource and this could have an effect on the individual's fitness. For example, they may have to travel further or take less than optimum prey species.

9.3.103. The effects on an individual harbour porpoise fitness levels are partly caused by the exclusion of animals from high-quality foraging areas and partly by the net energy losses associated with fleeing from disturbances (Ref. 9.19). Therefore, impacts in lower quality habitat are likely to have a lower potential impact on an animal's fitness.

9.3.104. Grey seal and harbour seal both exhibit alternate periods of foraging and resting at haul out sites (during which limited, or no feeding occurs). Prolonged fasting also occurs in these species during annual breeding and moult, when there are marked seasonal changes in body condition (Ref. 9.19; Ref. 9.20). Although adult seals may be relatively robust to short term

changes in prey availability, young and small individuals have a more sensitive energy balance; this is exhibited through effects of mass dependant survival (Ref. 9.21). Although disturbance to grey seal or harbour seal may lead to a severe or sustained avoidance of an area, these species can be considered less sensitive to such an impact than harbour porpoise.

9.3.105. Tagged harbour seals in the Wash indicated that seals were not excluded from the vicinity of the Lincs windfarm during the overall construction phase, but that there was clear evidence of avoidance during pile driving, with significantly reduced levels of seal activity at ranges up to 25km from piling sites (Ref. 9.22). However, within two hours of piling cessation, the harbour seal distribution returned to normal pre-piling levels (Ref. 9.22).

9.3.106. For harbour porpoise, grey seal and harbour seal, a fleeing (behavioural) response is assumed to occur at the same noise levels as TTS. As outlined in Southall *et al.* (2007) (Ref. 9.17) the onset of behavioural disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (i.e. TTS-onset). Although, as Southall *et al.* (2007) (Ref. 9.17) recognise that this is not a behavioural effect per se, exposures to lower noise levels from a single pulse are not expected to cause disturbance. However, any compromise, even temporarily, to hearing functions could have the potential to affect behaviour.

9.3.107. The Statutory Nature Conservation Body (Ref. 9.23) currently recommend that a potential disturbance range of 26km around an individual impact piling location is used to assess the area that harbour porpoise may be disturbed in the Southern North Sea SAC. As data has suggested that seals show clear avoidance of piling, up to a distance of 25km (as stated above), the approach of using the 26km disturbance range will also be used to assess disturbance responses on seals for impact piling at the BLF.

9.3.108. Using the 26km disturbance range gives an area of effect of 2,124km^2. However, the location of the Sizewell C main development site in relation to both the boundary of the Southern North Sea SAC and the coastline mean that this area will be significantly less. For harbour porpoise, the area of effect taking into account both the coastline and the site boundary (and using the worst-case spatial piling location) is 967km^2. For grey and harbour seal, the area of effect taking into account the coastline (and the worst-case spatial location for piling) is 1,101km^2.

Potential for underwater effects on prey species during construction

Potential auditory injury effects

9.3.109. The potential underwater noise source through the construction phase with the largest range of effect is the impact piling of the BLF jetty, fenders and

dolphins. The fish species with the largest predicted effect ranges are those that have a swim bladder that is involved in hearing. As stated above, many marine mammal prey species are within this category.

9.3.110. For impact piling, the largest effect ranges and areas were found to be both for fish species that have a swim bladder that is involved in and those with a swim bladder not involved in hearing. For these species groups, effect ranges were found to be 27m for both mortality or potential mortal injury and for recoverable injury, for the worst case hammer energy of 200kJ. For fish species with no swim bladder, the range of effect of mortality or potential for mortal injury and for recoverable injury was 15m for the worst case hammer energy of 200kJ (**Table 9.13**).

9.3.111. The cumulative stationary modelling indicated maximum ranges of 158m for recoverable injury in fish with a swim bladder and less than 25m for mortality or recoverable injury in fish without a swim bladder for the 200kJ hammer energy.

9.3.112. The potential for TTS under the cumulative piling modelling was found to be up to 821m for fish species with a swim bladder, for the worst case hammer energy of 200kJ (**Table 9.13**).

Table 9.13: Maximum predicted effect ranges and areas for mortality, recoverable injury and TTS in fish species from impact piling (results shown for the worst case hammer energy of 200kJ only)

Species Group	Threshold And Criteria (Ref. 8.107)	Instantaneous Effect	Cumulative Effect
Fish species with swim bladder involved in hearing	Mortality and potential mortal injury	27m (0.0023km^2)*	111m (0.02km^2)
	Recoverable injury	27m (0.0023km^2)*	158m (0.04km^2)
	TTS	N/A	821m (0.88km^2)
Fish species with swim bladder not involved in hearing	Mortality and potential mortal injury	27m (0.0023km^2)*	70 m (0.01km^2)*
Fish species with no swim bladder	Mortality and potential mortal injury	15m (0.005km^2)*	Less than 25m (0.002km^2)*
	Recoverable injury	15m (0.005km^2)*	Less than 25m (0.002km^2)*

** area of effect based on the area of a circle*

9.3.113. Noise levels from drilling activities of the outfall and intake headworks, and from the FRR and CDO, are predicted to be too low to generate instantaneous auditory effects for fish, under the SPL_{peak} criteria. For all

species groups, cumulative exposure from drilling activities could have the potential for mortality and potential for mortal injury, recoverable injury, and TTS at less than 25m (an area of 0.0025km^2) from the source (Ref. 8.106).

9.3.114. Noise levels arising from dredging activities were also too low to generate instantaneous auditory effect zones for all fish species. However, the largest cumulative effect zones for all fish species were predicted for the dredging works at the BLF, with TTS ranges of up to 1.84km (an area of 4.35km^2), and the concurrent dredging scenario of activities at the BLF and the outfall resulted in the largest overall effect ranges; with the cumulative TTS effect area for all fish species being 9.39km^2.

9.3.115. For mortality and potential mortal injury, fish species with a swim bladder involved in hearing were predicted to experience an area of effect of 0.02km^2 for concurrent dredging at the both the BLF and outfall location. For fish species with a swim bladder not involved in hearing this is 0.01km^2 and for fish species with no swim bladder this is less than 0.0025km^2 (**Table 9.14**) (Ref. 8.106).

Table 9.14: Maximum predicted effect ranges and areas for mortality, recoverable injury and TTS in fish species from dredging activities

Species Group	Criteria	Dredging At The BLF Alone	Dredging At The BLF And Outfall Location Concurrently
Fish species with a swim bladder involved in hearing	Mortality and potential for mortal injury	70m (0.02km^2)	0.02km^2
	Recoverable injury	158m (0.06km^2)	0.07km^2
	TTS	1.843km (4.35km^2)	9.39km^2
Fish species with a swim bladder not involved in hearing	Mortality and potential for mortal injury	50m (0.01km^2)	0.01km^2
Fish species with no swim bladder	Mortality and potential for mortal injury	Less than 25m (0.002km^2)*	Less than 0.0025km^2
	Recoverable injury	Less than 25m (0.002km^2)*	Less than 0.0025km^2

** area of effect based on the area of a circle*

9.3.116. The explosive charge mass of 500lb had the largest effect ranges for the fish species, with the maximum instantaneous mortality and potential mortal injury estimated to 622m. For the smaller charge mass of 250lb, the predicted mortality and potential injury range was 493m. The potential auditory effect ranges for fish are substantially smaller than for marine mammals.

Potential behavioural effects on marine mammal prey species

9.3.117. Behavioural responses or displacement due to underwater noise has the potential to temporarily effect migratory fish species or influence prey availability for designated marine mammals.

9.3.118. Threshold criteria are not available for the behavioural effects on fish species. However, unweighted sound level contours were generated. An assessment was then made on the potential for behavioural responses with reference to peer-reviewed literature. For example, Hawkins and Popper (2014) (Ref. 9.24) reported startle responses of schools of wild sprat (one of the key species at the Sizewell C main development site) at a single-pulse sound exposure level of 135dB re 1 μPa^2s and 142dB re 1 μPa^2s for mackerel shoals.

9.3.119. These single-pulse sound exposure levels were applied to estimate potential behavioural response ranges. The behavioural response ranges calculated were based on observations of responses to instantaneous noise sources in two species (sprat and mackerel). As such, the assessments are subject to a lower degree of confidence than the injury and auditory damage assessments that were based on established criteria.

9.3.120. Behavioural response ranges due to the impact piling of the BLF jetty, fenders and dolphins in fish species were calculated for two groups of fish species (as described above); hearing specialists and less sensitive species. For hearing specialists, the behavioural response effect range is estimated to be up to 2.86km (an area of 9.68km^2); while for less sensitive species the range is up to 1.6km (an area of 2.69km^2) for the worst case hammer energy of 200kJ (Ref. 8.106).

9.3.121. For the drilling works for the intake and outfall headworks, and the FRR and CDO, behavioural responses were predicted to occur within 25m of the source for both hearing specialists and less sensitive fish species (an area of 0.002km^2 based on the area of a circle from the source location) (Ref. 8.106).

For the dredging works, the largest behavioural response ranges were found for the concurrent dredging activities at the BLF and outfall location, with an area of effect of up to 21.31km^2 for hearing specialist species and 3.71km^2 for the less sensitive fish species (Ref. 8.106).

v. Physical interaction between species and project infrastructure

Potential for increased vessel collision risk during construction and decommissioning

9.3.122. The BLF, once constructed, would be used to import rock armour, AILs and marine freight during the construction phase. There would be an estimated 180 deliveries of AILs and rock armour through the period 31st March to 31st October. It could also be used in the decommissioning phase.

9.3.123. Harbour porpoises are small and highly mobile and given their responses to vessel noise (e.g. Ref. 9.25; Ref. 9.26; Ref. 9.27), are expected to avoid vessel collisions. Heinänen and Skov (2015) (Ref. 6.129) indicated a negative relationship between the number of ships and the distribution of harbour porpoises in the North Sea, suggesting potential avoidance behaviour. However, harbour porpoises have been observed with signs of physical trauma (blunt trauma or propeller cuts) indicating vessel strike (Ref. 9.28).

9.3.124. Of the 273 reported harbour porpoise stranding's in 2015 (latest UK Cetacean Stranding's Investigation Programme report currently available), 53 were investigated at post mortem (27 were conducted in England, 13 in Scotland and 13 in Wales). A cause of death was established in 51 examined individuals (approximately 96% of examined cases). Of these, four (8%) had died from physical trauma of an unknown cause, which could have been vessel strikes (Ref. 9.29). Approximately 4% of all harbour porpoise post mortem examinations from the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS area) are thought to have evidence of interaction with vessels (Ref. 9.30).

Potential for increased vessel collision risk during operation

9.3.125. Through the operational phase of the project, occasional deliveries of AILs may use the BLF; approximately every 5 to 10 years. Given the anticipated lifetime of the Sizewell C Project (of 60 years), this would equate to between 6 and 12 deliveries at the BLF through the operational phase.

Potential for impingement, entrainment and entrapment of prey species during operation

9.3.126. During the operation of the power station, abstracted water would be transported through the intake tunnels to the forebays, where rotating drum screens would impinge any larger biota present, including fish and crustaceans. The drum screens would be fitted with a 10mm mesh and any impinged biota would be washed off and returned to the marine environment via FRRs (one for each intake tunnel and reactor). Low velocity side entry

intake heads will be fitted, which have been designed to substantially reduce impingement of fish species.

9.3.127. The FRRs would be located in water depths of 5.5 to 6m below ODN and the use of two FRRs would reduce the time any biota transit along the 475m tunnels. Biota would be discharged from the tunnels at a speed of 0.3m/s into the Greater Sizewell Bay. The fish retention time is expected to be 33 minutes at HAT and 50 minutes at lowest astronomical tide (LAT).

9.3.128. A study of the potential for marine mammal prey species to be impinged through the operation of the Sizewell C Project was undertaken (Ref. 8.5). The study found that of the species present within the Greater Sizewell Bay area, pelagic species such as sprat, herring, and whiting are the most likely to be impinged (with herring being the highest in weight), whilst other species such as seabass, sand goby, sole and dab could also be impinged. The impingement assessment results show that Sizewell C fitted with low velocity side entry intake heads and a FRR system would have negligible effects on the sustainability of the fish populations and, therefore, no effect on the prey of the relevant designated site features.

9.3.129. Assessment of entrainment effects (Ref. 8.4) found that the eggs or larvae of sprat, herring, anchovy and seabass are expected to be entrained, however, the predicted effects on population levels were expected to be negligible.

9.3.130. Therefore, the potential for entrainment of prey species during the operation of Sizewell C has not been assessed further in this chapter, as there are no anticipated effects on marine mammal species; but impingement effects are considered on a precautionary basis.

c) In-combination effects

9.3.131. In-combination effects with other plans and projects could arise due to:

- water quality effects;
- direct habitat loss and direct / indirect habitat fragmentation (Southern North Sea SAC);
- underwater noise effects; and
- increased collision risk with vessels.

9.3.132. **Table 9.16** outlines each plan and project that has been identified as having the potential for in-combination effects with the Sizewell C Project, showing the potential effects of relevance from each.

9.4 Assessment of effects: Humber Estuary SAC

a) Water quality effects – marine environment

i. Construction and decommissioning

Potential for water quality effects due to construction and decommissioning phase discharges on foraging grey seal

Pinnipeds are not known to produce sonar for prey detection purposes; however, it is likely that other senses are used instead of, or in combination with, vision. Studies have shown that vision is not essential to seal survival, or their ability to forage (Ref. 9.31). It has been concluded that the limited information available indicates that increased turbidity, as a result of dredging, is unlikely to have a substantial direct impact on marine mammals (Ref. 9.31).

Table 9.15: In-combination plan or project screened in to the assessment (relevant effects screened in indicated by ✓)

In-Combination Plan Or Project Screened In	Potential Effect			
	Water Quality Effects	Direct Habitat Loss / Indirect Habitat Fragmentation (Southern North Sea SAC Only)	Underwater Noise Effects	Increased Collision Risk With Vessels
East Anglia ONE Offshore Wind Farm	✓	✓	✓	✓
East Anglia ONE North Offshore Wind Farm	✓	✓	✓	✓
East Anglia THREE Offshore Wind Farm	✓	✓	✓	✓
East Anglia TWO Offshore Wind Farm	✓	✓	✓	✓
Eurolink	✓	✓	✓	✓
Extension of Inner Gabbard East Disposal Site	-	-	✓	✓
Galloper Offshore Wind Farm Extension project	✓	✓	✓	✓
Galloper Offshore Wind Farm Operation and Maintenance	-	✓	✓	✓
Great Yarmouth Third River Crossing	✓	-	-	-
Greater Gabbard Offshore Wind Farm Extension project	✓	✓	✓	✓

In-Combination Plan Or Project Screened In	Potential Effect			
	Water Quality Effects	Direct Habitat Loss / Indirect Habitat Fragmentation (Southern North Sea SAC Only)	Underwater Noise Effects	Increased Collision Risk With Vessels
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	✓	-	✓	✓
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	✓	-	✓	✓
Hamilton Dock, Lowestoft – Pontoon reconfiguration	✓	-	-	-
Harwich Haven approach channel deepening	-	-	✓	✓
Lowestoft Flood Risk Management Project	-	✓	-	-
Lowestoft Lake Lothing Third Crossing	✓	-	✓	-
Nautilus	✓	✓	✓	✓
Norfolk Boreas Offshore Wind Farm	-	✓	✓	✓
Norfolk Vanguard Offshore Wind Farm	✓	✓	✓	✓

In-Combination Plan Or Project Screened In	Potential Effect			
	Water Quality Effects	Direct Habitat Loss / Indirect Habitat Fragmentation (Southern North Sea SAC Only)	Underwater Noise Effects	Increased Collision Risk With Vessels
Proposed aggregate extraction sites in the study area (Outer OTE [528/2], Thames D [524] and New 495 [525])	✓	✓	✓	✓
Proposed new disposal sites in the study area (i.e. between Lowestoft and Ipswich)	✓	✓	-	✓
SZB Nuclear Power Station Decommissioning	✓	✓	✓	-
Thanet Extension Offshore Wind Farm	✓	-	✓	✓

9.4.1. The remobilisation and bioavailability of contaminants is site-specific, complex, and affected by a multitude of factors. Literature on the release of contaminants as a result of dredging suggests that, as long as highly contaminated sediments are managed appropriately, concentrations should not high enough to have detrimental effects on the environment (Ref. 9.32; Ref. 9.31).

9.4.2. Marine mammals are susceptible to bioaccumulation because they feed at high trophic levels and have a large proportion of lipid-rich blubber which accumulates contaminants readily (Ref. 9.33). High contaminant levels have been linked to immune system depression, disease, reproductive effects, developmental effects and endocrine disruption (Ref. 9.34; Ref. 9.33).

9.4.3. Marine mammals accumulate high levels of contaminants irrespective of whether dredging occurs. Therefore, linking remobilisation of contaminants from dredging and other activities to potential effects in marine mammals is challenging. Levels of toxins in blubber before, during, and after dredging are unknown, marine mammals are mobile and exposed to contaminants throughout their entire range, and any effects are only likely to be discovered long after dredging or other activities cease (Ref. 9.31).

9.4.4. Due to the limited dispersion area, rapid dispersion and material being quickly deposited, along with the relatively low contaminant levels in sediments, any potential effects on marine mammals as a result of increased suspended sediments and contaminant re-mobilisation are unlikely.

9.4.5. To put this into context, the change in water quality that would have the largest area of effect on foraging grey seal during operation would be from the total residual oxidant plume for both Sizewell B and C in-combination, affecting an area of 7.26km^2. As a precautionary approach, the number of grey seal that potentially could be present (and percentage of the reference population) within this area of effect has been estimated. The total number of foraging grey seal that could be present in the affected area is 0.3 individuals; this represents up to 0.003% of the reference population (or up to 0.005% of the estimated Humber Estuary SAC population). Therefore, no adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C chemical discharge in relation to the conservation objectives for grey seal.

Potential for water quality effects due to construction and decommissioning phase discharges on foraging grey seal prey species

9.4.6. Juvenile and adult fish are mobile and will be able to avoid localised areas disturbed by increased suspended sediments and sediment re-deposition. If displaced, they would be able to move to adjacent, undisturbed areas within their normal habitat range. However, excessive suspended sediment can

have a range of effects on fish, from mortality to gill trauma and a reduction in reproductive success.

9.4.7. As a function of their migratory behaviour, diadromous species of fish encounter and tolerate a range of environmental conditions as they pass through fresh, brackish and seawater during their life cycle. Such environmental conditions would include very turbid waters and a range of temperature, salinity and dissolved oxygen levels. Mortality is seldom recorded in migratory species as a result of increased SSC, although a range of sublethal effects can be seen, such as clogging of gills, increased deformities, fin erosion and lesions and 'coughing' behaviour (Ref. 9.35). Turbid water can also reduce feeding rates in salmonids which are visual feeders (Ref. 9.36).

9.4.8. A review of critical thresholds by Berry *et al.* (2003) (Ref. 9.37) reported threshold effect ranges of 4-330,000mg/l for various fish species, but the severity of effect was directly related to associated stressors. Exposure time is a key parameter determining the physiological effects and the resultant barrier to migration (Ref. 9.38).

9.4.9. As a precautionary approach, the number of foraging grey seal that could be present (and percentage of the reference population) in the area from which prey species could be impacted, as a result of any changes to water quality, has been estimated based on the maximum area of effect of 7.26km^2. As the maximum predicted impact area for any increased suspended sediments and contaminant re-mobilisation is the same for foraging grey seal as it is for their prey, there would be no additional impacts on foraging grey seal as a result of the effects of any changes to water quality on prey species within the construction or decommissioning phases. Consequently, no indirect adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C chemical discharge in relation to the conservation objectives for grey seal.

ii. Operation

Potential for water quality effects due to chemical discharges on foraging grey seal

9.4.10. There is very little information currently available on any potential effects of total residual oxidant on marine mammals. However, the International Maritime Organisation (IMO) (2008) (Ref. 9.39) report on the Ballast Water Management Systems concluded that the bioaccumulation potential is very low; biomagnification and persistence in the food web is not considered to be a potential risk based on the results from aquatic toxicity testing, low PEC values, mammalian toxicity evaluation and bioaccumulation and biodegradation data.

9.4.11. There is evidence that hydrazine is harmful to aquatic organisms at low concentrations (Ref. 9.40; Ref. 9.41) and, although its persistence is low to moderate, this is dependent upon various water quality parameters (Ref. 9.40). The predicted area of exceedance of the PNEC standards is 1.6km^2.

9.4.12. The maximum area of effect for bromoform is 3.58km^2 at the sea surface, for the plume from Sizewell B and Sizewell C in-combination.

9.4.13. The maximum area of effect for the total residual oxidant plume for the operation of both Sizewell B and Sizewell C at the surface is 7.26km^2. Therefore, as a worst-case scenario, the number of foraging grey seal that could be affected by changes in water quality due to the total residual oxidant discharge is up to 0.3 individuals; which represents 0.003% of the reference population (or 0.005% of the Humber Estuary SAC site population).

9.4.14. The chemical plume is not expected to have any significant effect on foraging grey seals and this, alongside the very small percentage of the reference population that could be exposed to the area of predicted effect in marine water quality, indicates there is no potential for an effect on foraging grey seals to arise over the operational lifetime of the Sizewell C Project. Taking this into account, no direct adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C chemical discharge in relation to the conservation objectives for grey seal.

Potential for water quality effects due to chemical discharges on foraging grey seal prey species

9.4.15. The potential effect of the changes to water quality on prey species for foraging grey seal would not extend beyond the maximum predicted effect areas described for grey seals themselves. Consequently, the approach taken to assessing the effect on the foraging grey seals is worst case and there would be no additional impact as a result of the effects on prey species.

9.4.16. Consequently, no indirect adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C chemical discharge in relation to the conservation objectives for grey seal.

Potential for water quality effects due to thermal discharge on foraging grey seal

9.4.17. Marine mammals have the ability to regulate their body temperature during periods of high activity, or when the ambient temperature is warm (Ref. 9.42). They do this by controlling the blood flow through their flukes, pectoral and dorsal fins to move blood from their body; this allows the blood to cool as it flows through their fins (Ref. 9.43).

9.4.18. While the change in temperature associated with the Sizewell C thermal plume would be noticeable to marine mammal species, these species are well adapted and accustomed to the change in water temperature as they dive. Due to the evolved ability of marine mammals to naturally regulate their body temperature, it is concluded that the change in ambient temperature due to the thermal plume would have no direct impact on marine mammal species no effect on foraging grey seal in the area.

9.4.19. However, on a very precautionary basis, the number of foraging grey seal that could be present in the maximum predicted surface area for a 2ºC maximum allowed concentration rise in temperature (an area of 224.6km^2) has been estimated as 8.5 individuals, which represents up to 0.1% of the reference population (or 0.13% of the Humber Estuary SAC site population). Therefore, no direct adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C thermal discharge in relation to the conservation objectives for grey seal.

Potential for water quality effects due to thermal discharge on foraging grey seal prey species

9.4.20. Key prey species for grey seal that have been studied for thermal tolerances include sandeel, cod, saithe, haddock, whiting, plaice and dover sole as seen in section 9.4 a i of this report.

9.4.21. Due to the various unknowns in the thermal tolerance of some fish species, it is assumed that most would avoid the highest temperature around the immediate area of the cooling water outfall. Therefore, as a worst case, it could be assumed that all grey seal prey species would also be displaced from the area within the 2°C maximum allowed concentration contour. It should be noted, however, that no fatalities of prey species are expected due to the temperature predicted, and that prey would be available to individuals outside of the 2°C maximum allowed concentration contour.

9.4.22. As a precautionary approach, the number of foraging grey seal that could be present (as percentage of the reference population) in the area of the thermal plume from which prey species could be displaced has been estimated. As the maximum predicted impact area for any changes in water temperature would be the same for foraging grey seal and their prey, there would be no additional effects on grey seal as a result of the effects of any changes in water temperature on prey species. Therefore, no indirect adverse effects on the integrity of the Humber Estuary SAC are predicted due to the Sizewell C main development site thermal discharge in relation to the conservation objectives for grey seal.

b) Underwater noise effects on species populations

i. Construction and decommissioning

Impact piling effects on grey seal

Permanent auditory injury from impact piling

9.4.23. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for PTS in grey seal, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for unweighted SPL_{peak} and PTS from weighted sound exposure levels (SEL_{cum}) are outlined in **Table 9.8**. These areas of effect have been used to determine the maximum number of foraging grey seal that may be at risk of PTS onset.

9.4.24. The number of foraging grey seal that could be at risk of PTS onset as a result of impact piling associated with Sizewell C, prior to any mitigation, is outlined in **Table 9.16**. The estimated maximum number of grey seal that could potentially be at risk of PTS (SPL_{peak}) as a result of a single strike of the worst case hammer energy of 200kJ is 0.00001 individuals (0.0000001% of the South-East England Management Unit reference population; 0.0000001% of the Humber Estuary SAC population). The maximum number of grey seal that could be at risk of PTS from cumulative exposure, based on the stationary model, is up to 0.008 individuals (up to 0.00009% of the South-East England Management Unit reference population; 0.0001% of the Humber Estuary SAC population). However, based on the more realistic fleeing model for cumulative PTS, there would be no effect.

Table 9.16: Maximum predicted effect areas for PTS for grey seal from impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
Impact piling with 90kJ hammer	PTS 218 SPL_{peak}	0.0001km^2	0.000004 grey seal (0.00000004% of the South-East England Management Unit reference population; 0.0000001% of the Humber Estuary count).
	PTS 185 SEL_{cum} Stationary model	0.1km^2	0.004 grey seal (0.00004% of the South-East England Management Unit reference population; 0.00006% of the Humber Estuary count).
	PTS 185 SEL_{cum} Fleeing model	No effect	0

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
Impact piling with 200kJ hammer	PTS 218 SPL_{peak}	0.00025km^2	0.00001 grey seal (0.0000001% of the South-East England Management Unit reference population; 0.0000001% of the Humber Estuary count).
	PTS 185 SEL_{cum} Stationary model	0.2km^2	0.008 grey seal (0.00009% of the South-East England Management Unit reference population; 0.0001% of the Humber Estuary count).
	PTS 185 SEL_{cum} Fleeing model	No effect	0

9.4.25. Mitigation would be implemented for the impact piling works at the Sizewell C Project, following the "*Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise*" (Ref. 9.44). The guidelines state that a 500m mitigation zone should established in which a marine mammal observer would complete a pre-piling search in order to detect the presence of marine mammals, prior to piling commencing (Ref. 9.44). As the instantaneous effect ranges (SPL_{peak}) for impact piling on grey seal are within the 500m mitigation zone, any potential for a PTS onset in grey seal would be further reduced. A Marine Mammal Mitigation Plan would be developed following these JNCC guidelines.

9.4.26. The Marine Mammal Mitigation Plan for impact piling at the Sizewell C Project would reduce the risk of PTS to grey seal. Therefore, no direct adverse effects on the integrity of the Humber Estuary SAC are predicted from any permanent auditory injury from impact piling at the Sizewell C main development site in relation to the conservation objectives for foraging grey seal.

9.4.27. Impact piling is not expected to be required during decommissioning.

Temporary auditory injury and fleeing response from impact piling

9.4.28. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for TTS and fleeing response in grey seal, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for SPL_{peak} and TTS from weighted sound exposure levels (SEL_{cum}) are outlined in **Table 9.11**. These areas of effect have been used to determine the maximum number of foraging grey seal that may be at risk of TTS onset and eliciting a fleeing response. It should be noted that the onset of TTS is also

considered to show where individuals could exhibit a fleeing response, and therefore this is considered to be a behavioural as well as an auditory effect.

9.4.29. The number of foraging grey seal that could be at risk of TTS onset or a fleeing response as a result of impact piling at the Sizewell C Project, prior to any mitigation, is outlined in **Table 9.17**. The estimated maximum number of grey seal that potentially could be at risk of TTS or fleeing response (SPL_{peak}) as a result of a single strike of the worst case hammer energy of 200kJ is 0.00003 individuals (0.0000003% of the South-East England Management Unit reference population; 0.0000005% of the Humber Estuary SAC population). The maximum number of grey seal that could be at risk of TTS from cumulative exposure, based on the stationary model, is up to 0.4 individuals (up to 0.005% of the South-East England Management Unit reference population; 0.006% of the Humber Estuary SAC population). However, based on the more realistic fleeing model for cumulative TTS, there would be no effect.

Table 9.17: Maximum predicted effect areas for TTS and fleeing response for foraging grey seal from impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
Impact piling with 90kJ hammer	TTS 212 SPL_{peak}	0.0003km^2	0.00001 grey seal (0.0000001% of the South-East England Management Unit reference population; 0.0000002% of the Humber Estuary count).
	TTS 170 SEL_{cum} Stationary model	4.3km^2	0.16 grey seal (0.002% of the South-East England Management Unit reference population; 0.003% of the Humber Estuary count).
	TTS 170 SEL_{cum} Fleeing model	No effect	0
Impact piling with 200kJ hammer	TTS 212 SPL_{peak}	0.0008km^2	0.00003 grey seal (0.0000003% of the South-East England Management Unit reference population; 0.0000005% of the Humber Estuary count).
	TTS 170 SEL_{cum} Stationary model	10.6km^2	0.4 grey seal (0.005% of the South-East England Management Unit reference population; 0.006% of the Humber Estuary count).

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
	TTS 170 SEL_{cum} Fleeing model	No effect	0

9.4.30. Taking into account the temporary disturbance and intermittent duration of underwater noise from piling (with only 12 piles to be installed underwater), along with the relatively low and infrequent number of foraging grey seal in and around the Sizewell C main development site, there is unlikely to be any significant disturbance or barrier effects for foraging individuals. Therefore, under these circumstances, no direct adverse effects on the integrity of the Humber Estuary SAC are predicted from any temporary auditory injury from impact piling at the Sizewell C main development site in relation to the conservation objectives for foraging grey seal.

Disturbance from impact piling

9.4.31. The assessment of TTS on grey seal, as outlined above, is considered to also show the number of individuals that could show a fleeing response due to the impact piling at Sizewell C.

9.4.32. Data from tagged harbour seals in The Wash indicate that seals were not excluded from the vicinity of Dudgeon Offshore Windfarm during the overall construction phase, but that there was clear evidence of avoidance during pile driving, with significantly reduced levels of seal activity at ranges up to 25km from piling sites (Ref. 9.22; Ref. 6.112). Therefore, a 26km disturbance range has been used to assess the number of grey seal that could be disturbed as a result of impact piling due to the Sizewell C Project (**Table 9.18**).

Table 9.18: Maximum predicted effect areas for disturbance of foraging grey seal from impact piling

Effect	Maximum Area Of Effect	Assessment For Grey Seal
Disturbance from impact piling	1,100.66km^2	41.8 grey seal (0.48% of the South-East England Management Unit reference population; 0.64% of the Humber Estuary count).

9.4.33. The duration of potential disturbance for impact piling at the BLF would be between three and 12 days (based on up to five piles being installed in a 24-hour period). In addition, it is highly unlikely that all foraging grey seal effected by the construction of the Sizewell C main development site would be from

the Humber Estuary SAC. There would be no direct effect or overlap with the site itself.

9.4.34. Taking into account the temporary disturbance and intermittent duration of underwater noise from piling, along with the relatively low and infrequent number of grey seal in and around the Sizewell C main development site, there is unlikely to be any significant disturbance or barrier effects for foraging grey seal. Therefore, under these circumstances, no direct adverse effect on the integrity of the Humber Estuary SAC is predicted as a result of disturbance during impact piling for the construction of the Sizewell C main development site in relation to the conservation objectives for grey seal.

Drilling and dredging activity effects on grey seal

Permanent auditory injury from drilling and dredging activities

9.4.35. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for PTS in grey seal, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for SEL_{cum}, are outlined in **Table 9.9**. These areas of effect have been used to determine the maximum number of foraging grey seal that may be at risk of PTS onset due to the planned drilling and dredging works for Sizewell C.

9.4.36. The number of foraging grey seal that could be at risk of PTS onset as a result of drilling is outlined in **Table 9.19**. The estimated maximum number of grey seal that could potentially be at risk of PTS (SEL_{cum}) as a result of drilling, based on the stationary model, is 0.00008 individuals (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary SAC population).

Table 9.19: Maximum predicted effect areas for PTS for grey seal from drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
Drilling activities	PTS 201 SEL_{cum}	0.002km^2	0.00008 grey seal (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary count).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	PTS 201 SEL_{cum}	0.05km^2	0.002 grey seal (0.00002% of the South-East England Management Unit reference population; 0.00003% of the Humber Estuary count).

9.4.37. The maximum number of grey seal that could be at risk of PTS from cumulative exposure of the dredging works, based on the stationary model, is up to 0.002 individuals (up to 0.00002% of the South-East England Management Unit reference population; 0.00003% of the Humber Estuary SAC population) (**Table 9.19**).

9.4.38. Noise levels arising from drilling and dredging activities were too low to generate instantaneous auditory effect in grey seal. The fleeing model for cumulative PTS resulted in no PTS effect areas for grey seal from drilling or dredging activities.

9.4.39. The results of the underwater noise modelling show that grey seal would have to remain within close proximity of the drilling (less than 25m) and the dredging activities (less than 111m) for a period of 24 hours to be at risk of PTS onset (**Table 9.9**). Given this, and the low number of foraging grey seal within the vicinity of the Sizewell C Project, the potential risk of permanent auditory injury is considered to be unlikely. Therefore, a direct adverse effect on the integrity of the Humber Estuary SAC is not predicted from any permanent auditory injury during construction or decommissioning phase drilling and dredging associated with the Sizewell C main development site in relation to the conservation objectives for foraging grey seal.

Temporary auditory injury from drilling and dredging activities

9.4.40. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for TTS and fleeing response in grey seal, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for SEL_{cum}, are outlined in **Table 9.12**. These areas of effect have been used to determine the maximum number of foraging grey seal that may be at risk of TTS onset and eliciting a fleeing response. It should be noted that the onset of TTS is also considered to show where individuals could exhibit a fleeing response and, therefore, this is considered to be a behavioural as well as an auditory effect.

9.4.41. The maximum number of foraging grey seal that could be at risk of TTS onset or a fleeing response as a result of drilling for the Sizewell C Project is outlined in **Table 9.20**. The estimated maximum number of grey seal that could be at risk of TTS from cumulative exposure as a result of drilling activities, based on the stationary model, is up to 0.00008 individuals (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary SAC population).

Table 9.20: Maximum predicted effect areas for TTS and fleeing response for foraging grey seal from drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Grey Seal
Drilling activities	TTS 181 SEL_{cum} Stationary model	0.002km^2	0.00008 grey seal (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary count).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	TTS 181 SEL_{cum} Stationary model	14.11km^2	0.5 grey seal (0.006% of the South-East England Management Unit reference population; 0.008% of the Humber Estuary count).

9.4.42. The estimated maximum number of grey seal that could be at risk of TTS or fleeing response from cumulative exposure from dredging activities, based on the stationary model, is up to 0.5 individuals (up to 0.006% of the South-East England Management Unit reference population; 0.008% of the Humber Estuary SAC population; **Table 9.20**).

9.4.43. Noise levels arising from drilling and dredging activities were too low to generate instantaneous auditory effect in grey seal. The fleeing model for cumulative TTS resulted in no TTS effect areas for grey seal from drilling or dredging activities.

9.4.44. Taking into account the temporary disturbance and intermittent duration of underwater noise from both dredging and drilling activities, along with the relatively low and infrequent number of foraging grey seal in and around the Sizewell C main development site, there is unlikely to be any significant disturbance or barrier effects for foraging individuals. Therefore, under these circumstances, a direct adverse effect on the integrity of the Humber Estuary SAC is not predicted from any temporary auditory injury during construction and decommissioning phase drilling and dredging for Sizewell C in relation to the conservation objectives for foraging grey seal.

Underwater noise effects for UXO clearance on grey seal

9.4.45. The hypothetical UXO detonations for an explosive charge mass of 500lb had an impact area for instantaneous PTS of up to 11km^2, which could affect 0.4 grey seal (up to 0.005% of the South-East England Management Unit reference population; 0.007% of the Humber Estuary SAC population).

9.4.46. As previously outlined, the requirement for any UXO clearance is currently unknown and therefore this hypothetical assessment has been included for illustrative purposes and the modelling is based on a worst-case scenario.

9.4.47. Mitigation would be implemented for any UXO clearance following the latest guidance and requirements, and the Marine Mammal Mitigation Plan for any UXO clearance would reduce the risk of PTS to grey seal.

9.4.48. Therefore, under these circumstances, no direct adverse effects on the integrity of the Humber Estuary SAC are predicted from any permanent auditory injury from any UXO clearance associated with the Sizewell C Project in relation to the conservation objectives for grey seal.

Underwater noise effects on prey species

9.4.49. Construction activities that generate underwater noise that could impact on grey seal could also have effects on grey seal prey species, indirectly impacting on foraging grey seal in the area.

9.4.50. As a worst-case, the potential effect of changes to prey availability to foraging grey seal as a result of underwater noise has been based on the largest of those areas of effect that have been predicted for fish species. The underwater noise modelling shows that the largest area of effect to prey species is for a behavioural response in hearing specialist species, as a result of the impact piling at the BLF jetty, fenders and dolphins. The maximum area of potential effect is 9.68km^2.

9.4.51. The number of foraging grey seal that, therefore, could be affected by a change in prey species availability is 0.4 individuals. This represents 0.0004% of the South-East England Management Unit or, as a worst-case scenario, 0.0006% of the Humber Estuary SAC count. However, it is highly unlikely that all grey seal in the vicinity of the Sizewell C main development site would be from the Humber Estuary SAC. In addition, there would be no direct effect or overlap with the Humber Estuary SAC area.

9.4.52. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat would typically represent a small percentage of the potential habitat in the surrounding area. Consequently, no indirect adverse effect on the integrity of the Humber Estuary SAC is predicted from disturbance effects on prey species during the construction or decommissioning of the Sizewell C main development site in relation to the conservation objectives for foraging grey seal.

c) Physical interaction between species and project infrastructure

i. Construction and decommissioning

Increased collision risk between grey seal and vessels

9.4.53. As a worst-case, the number of foraging grey seal that could be at increased collision risk with vessels during construction (180 deliveries between 31st March and 31st October) has been assessed based on 5% of the number of animals that could be present in the study area (an area of 6.5km^2) as based on the information provided in section 9.3b)v)of this report.

9.4.54. As outlined in **Table 9.21**, 0.01 grey seal (or 0.0001% of the South-East England Management Unit reference population; 0.0002% of the Humber Estuary SAC population) could be at increased risk of collision with vessels within the Sizewell C main development site. This is very precautionary, as it is highly unlikely that foraging grey seal present in the main development site would be at increased collision risk with vessels, especially taking into account the relatively small increase vessel movements compared to existing vessel movements in the area.

Table 9.21: Number of grey seal at potential increased vessel collision risk

Effect	Maximum Area Of Effect	Assessment Of Grey Seal
Increased collision risk (5% of grey seal at increased risk)	6.5km^2	0.01 grey seal (0.0001% of the South-East England Management Unit reference population; 0.0002% of the Humber Estuary count)

9.4.55. In addition, based on the assumption that grey seal would be disturbed from the area as a result of underwater noise from construction and decommissioning activities and vessels, there should be no potential for increased collision risk within the main development site.

9.4.56. Therefore, under these circumstances, no direct adverse effect on the integrity of the Humber Estuary SAC is predicted from any increased vessel collision risk during construction or decommissioning of the Sizewell C Project in relation to the conservation objectives for foraging grey seal.

ii. Operation

Increased collision risk between grey seal and vessels

9.4.57. For this assessment, it has been assumed (as a very worst-case based on 6 to 12 deliveries through the operational phase) that the potential effects

would be the same as for construction effects (**Table 9.21**). Therefore, under these circumstances, no direct adverse effect on the integrity of the Humber Estuary SAC is predicted from any increased vessel collision risk during operation of the Sizewell C Project in relation to the conservation objectives for foraging grey seal.

Impingement of prey species

9.4.58. There is the potential for grey seal prey species to be impinged through the operation of Sizewell C. As discussed in section 6.4 of this report, the principal prey species of the grey seal are sandeel, cod, saithe, haddock, whiting, plaice and dover sole. The only species expected to be impinged are cod, whiting, plaice and Dover sole. The impingement assessment (Ref. 8.5) reports that, with the mitigation of the low velocity side entry intake heads and the FRR, there would be a negligible effect on all grey seal prey species populations as a result of impingement.

9.4.59. However, as a worst-case scenario, an assessment has been made of the number of grey seal that could be displaced by the loss of prey availability through impingement. This assessment is based on the precautionary assumption that all grey seal prey species would be lost within close proximity of the intake tunnels. An area of effect has been defined as the study area for the Sizewell C Project, which is the Greater Sizewell Bay; a total area of 4,120ha (or 41.2km^2). This is considered to be precautionary, as not all prey species within that area would be lost and the effect would be temporary, as grey seal would be able to move to a nearby area where prey species are available. Hence, all grey seal prey species are expected to be at risk of a negligible effect only, with less than 1% of the available prey populations being affected.

9.4.60. As outlined in **Table 9.22**, up to 1.6 grey seal (or 0.018% of the South-East England Management Unit reference population; 0.025% of the Humber Estuary SAC population) could be displaced from foraging with the Greater Sizewell Bay due to the loss of prey availability. This is very precautionary, as it is more likely that the effect would be restricted to the area directly around the intake tunnels.

Table 9.22: Number of grey seal potentially displaced as a result of loss of prey availability

Effect	Maximum Area Of Effect	Assessment Of Grey Seal
Loss of prey availability	41.2km^2 (Greater Sizewell Bay)	1.6 grey seal (0.018% of the South-East England Management Unit reference population; 0.025% of the Humber Estuary count)

9.4.61. Therefore, under these circumstances, no direct adverse effect on the integrity of the Humber Estuary SAC is predicted from the loss of prey availability during operation of Sizewell C, in relation to the conservation objectives for foraging grey seal.

d) In-combination effects

Water quality effects

9.4.62. From the analysis included in **Table 9.23**, based on currently available information, it has been determined that none of the plans and projects included in the in-combination assessment for changes to water quality have the potential to have any in-combination effects on foraging grey seal, or their prey species, from the Humber Estuary SAC during the construction, operation or decommissioning of the Sizewell C main development site. Therefore, there is no potential for an adverse effect on the integrity of the Humber Estuary SAC to arise in relation to its conservation objectives for grey seal as a result of in-combination water quality effects.

Noise effects

9.4.63. The commitment to the Marine Mammal Mitigation Plan for UXO clearance and piling would reduce the risk for any potential PTS. No other activities were identified that could lead to PTS effects. As such, the Sizewell C Project would not contribute to any in-combination effects for PTS and, therefore, the in-combination assessment for underwater noise only considers potential disturbance effects.

9.4.64. Piling of the BLF could take place in 2021, 2022 or 2023. Therefore, the Sizewell C piling could take place at the same time as offshore wind farm construction during this period, i.e. East Anglia THREE and the Thanet Extension, as well as the Harwich Haven approach channel deepening project, and disposal at the extended Inner Gabbard East site. The number of grey seal that could be disturbed by piling for Sizewell C, East Anglia THREE and the Thanet Extension offshore wind farms (based on seal at sea density; Ref. 4.5) is 123.5 grey seal (1.4% of the South-East England Management Unit; or 1.9% of the Humber Estuary count). All other projects and plans would not have a significant disturbance on foraging grey seal (**Table 9.24**).

9.4.65. The maximum piling duration for the Sizewell C Project is expected to be 12 days, if it is assumed that only one pile would be installed per day. Therefore, its contribution to in-combination effects for underwater noise would be limited. Taking the short duration of piling for the Sizewell C Project into account, an adverse effect on the integrity of the Humber Estuary SAC is not

predicted to arise in relation to its conservation objectives for grey seal as a result of in-combination disturbance effects from underwater noise.

Vessel movements

9.4.66. The estimated number of grey seal that could be at increased collision risk during the construction and operation phase of the Sizewell C Project in-combination with the increased collision risk associated with East Anglia ONE North, East Anglia THREE, East Anglia TWO, Norfolk Boreas, Norfolk Vanguard and the Thanet Extension offshore wind farms, the Harwich Haven approach channel deepening project and the extension of the Inner Gabbard East disposal site is 0.4 grey seal (0.005% of the South-East England Management Unit; or 0.006% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population (**Table 9.25**) and an adverse effect on the integrity of the Humber Estuary SAC in relation to its conservation objectives for grey seal as a result of in-combination collision risk effects is not predicted.

Table 9.23: In-combination assessment of plans and projects with the potential to affect foraging grey seal from the Humber Estuary SAC through changes to water quality

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km to offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and decommissioning phases of the project. No water quality effects were assessed as no potential impacts were identified for any marine mammal species during operation and decommissioning (Ref. 9.45).	No potential for in-combination effect.	No.
East Anglia ONE North Offshore Wind Farm.	11km to cable corridor. 48km to windfarm site	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan.	No potential for in-combination effect.	No.
East Anglia THREE Offshore Wind Farm.	11km to cable corridor. 78km to windfarm site.	No water quality effects were identified for marine mammals and were therefore not assessed, and all effects to prey species were assessed as being negligible or minor adverse (Ref. 9.46).	Given the distance to the project from the main development site and the very low significance of effect, it is considered that there is no potential for in-combination effect.	No.
East Anglia TWO Offshore Wind Farm.	11km to cable corridor. 31km to windfarm site.	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan.	No potential for in-combination effect.	No.
Eurolink.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Galloper Offshore Wind Farm Extension project.	38km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km to cable corridor. 27km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance.	64km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.48).	No potential for in-combination effect.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance.	58km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.49).	No potential for in-combination effect.	No.
Hamilton Dock, Lowestoft – Pontoon reconfiguration.	30km.	This project will have no effect on marine mammals or water quality (Ref. 9.50).	No potential for in-combination effect.	No.
Lowestoft Lake Lothing Third Crossing.	31km.	There is the potential for water pollution from the project to affect the Southern North SAC given its distance (1.3km), however, mitigation measures that will be implemented during the construction, operation and decommissioning of the project will have no effect on the integrity on the site (Ref. 8.127).	No potential for in-combination effect.	No.

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Nautilus.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Vanguard Offshore Wind Farm.	59km to cable corridor. 83km to windfarm site.	During construction and decommissioning, the risk of accidental release of will be mitigated through contingency planning for the control of pollution. Modelling indicates that the majority of the sediment released during seabed preparation would be coarse and would fall within minutes/ tens of minutes) to the seabed as a highly turbid dynamic plume immediately upon its discharge. Taking into account the low sensitivity of marine mammals to changes in water quality and the low magnitude temporary impact, the impact significance for any changes to water quality is negligible (Ref. 8.134).	Given the distance to the Sizewell C Project, and the small areas of effect for both projects, there is no potential for in-combination effect.	No.
Proposed aggregate extraction sites in the study area.	47km.	No assessment of effects has been completed to date, however, the Scoping Report for the Thames D area suggests that there may be the potential for water quality effects on marine mammals within the Southern North Sea SAC which will be assessed further (Ref. 9.52).	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area.	50km.	No information available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm.	82km.	Through the construction, operation and decommissioning phases of the project, it has been determined that there is no potential for adverse effect due to the implementation of the Project	No potential for in-combination effect.	No

In-Combination Project	Distance to Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
		Environmental Management Plan to control any accidental pollution releases (Ref. 9.55). No other water quality effects have been assessed for this project.		

Table 9.24: In-combination assessment of plans and projects with the potential to have underwater noise disturbance effects on foraging grey seal from the Humber Estuary SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km from offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
East Anglia ONE North Offshore Wind Farm.	11km from cable corridor. 48km from windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
East Anglia THREE Offshore Wind Farm.	11km from cable corridor. 78km from windfarm site.	Piling for the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance (based on 26km effective disturbance radius) is 2,124km^2. Based on the grey seal density for the East Anglia THREE site (0.014/km^2), the maximum number of grey seal that could potentially be disturbed is 30.	The maximum number of grey seal that could be disturbed during piling of the Sizewell C Project is 42. In-combination with the East Anglia THREE project up to 72 grey seal (0.8% of South-East Management Unit; or 1.1% of Humber Estuary count) could be temporary disturbed for 12 days piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging grey seal.	No
East Anglia TWO Offshore Wind Farm.	11km from cable corridor. 31km from windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Extension of Inner Gabbard East Disposal site		There is the potential for disposal activities to cause disturbance to grey seal through underwater noise. Disturbance effects could impact upon grey seal up to 1km from the disposal site, potentially affecting 3 grey seal (or 0.03% of the South-East England Management Unit) (Harwich Haven Authority, 2019b).	The maximum number of grey seal that could be disturbed during piling of the Sizewell C Project is 42. In-combination with the extension of Inner Gabbard East Disposal site, up to 45 grey seal (0.5% of South-East Management Unit; or 0.7% of Humber Estuary count) could be temporary disturbed for 12 days during piling at	

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
			the Sizewell C Project. Therefore, there would be no significant disturbance of foraging grey seal.	
Galloper Offshore Wind Farm Extension project	38km windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km from cable corridor. 27km from windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
			potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	
Harwich Haven approach channel deepening	41km.	There is the potential for dredging activities to cause disturbance to grey seal through underwater noise. Disturbance effects could impact upon grey seal up to 1km from the dredging activities, potentially affecting 6 grey seal (or 0.07% of the South-East England Management Unit) (Ref. 8.124).	The maximum number of grey seal that could be disturbed during piling of the Sizewell C Project is 42. In-combination with the Harwich Haven approach channel deepening project up to 48 grey seal (0.5% of South-East Management Unit; or 0.7% of Humber Estuary count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging grey seal.	No
Lowestoft Flood Risk Management Project.	30km.	The scheme application has not yet been submitted. However, a Preliminary Environmental Impact Report is available. All potential effects to marine mammals were scoped out of further assessment (Ref. 9.56).	No potential for in-combination effect.	No.
Lowestoft Lake Lothing Third Crossing	31km.	The HRA concluded that, underwater noise generated by construction activities has the potential to disturb marine mammals. However, such works would be of temporary duration during construction only. Because of the large size of the European site	No potential for any significant disturbance in-combination effect, due to the small scale and piling durations of the Sizewell C Project	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
		which at its closest point to the site is 1.3km distant from the works, noise and vibration is not considered likely to disturb this species and would not give rise to their displacement from the site. Regardless, construction methods would follow the Statutory Nature Conservation Agency protocol for minimising the risk of harm to individual marine mammals occurring as a result of piling noise (Ref. 8.127).	and Lowestoft Lake Lothing Third Crossing.	
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km from cable corridor. 103km from windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Norfolk Vanguard Offshore Wind Farm.	59km from cable corridor. 83km from windfarm site.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area	50km.	No information available.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Piling for the Thanet Extension project is currently planned to take place between 2020 and 2023, therefore there is the potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance, based on 26km effective disturbance radius is 2,124km^2. The maximum number of grey seal that could potentially be disturbed is up to 42.5 (based on density estimate of 0.02/km^2).	The maximum number of grey seal that could be disturbed during piling of the Sizewell C Project is 42. In-combination with the Thanet Extension project up to 84.5 grey seal (0.99% of South-East Management Unit; or 1.3% of Humber Estuary count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging grey seal.	No

Table 9.25: In-combination assessment of plans and projects with the potential to have increased collision risk vessels with foraging grey seal from the Humber Estuary SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
East Anglia ONE Offshore Wind Farm.	11km from cable corridor. 54km from	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
	offshore wind farm site.		Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	
East Anglia ONE North Offshore Wind Farm.	11km from cable corridor. 48km from windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of grey seal that could be at increased collision risk during the construction of East Anglia ONE North is 0.01 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of grey seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia ONE North project is 0.02 grey seal (0.0002% of South-East England Management Unit; or 0.0003% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	No.
East Anglia THREE Offshore Wind Farm.	11km from cable corridor. 78km from windfarm site.	Construction of the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for increased vessels during the construction of the Sizewell C Project. The estimated number of grey seal that could be at increased collision risk during the construction of East Anglia THREE is 0.0015 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of grey seal that could be at increased collision risk during the construction phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia THREE project is 0.0115 grey seal (0.0001% of South-East England Management Unit; or 0.0002% of the Humber Estuary count). Therefore, there would be no	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
			significant effects on the grey seal population.	
East Anglia TWO Offshore Wind Farm.	11km from cable corridor. 31km from windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of grey seal that could be at increased collision risk during the construction of East Anglia TWO is 0.05 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of grey seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia TWO project is 0.06 grey seal (0.0007% of South-East England Management Unit; or 0.0009% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	No.
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Extension of Inner Gabbard East Disposal Site		There is the potential for disposal activities to increase the risk of collision of grey seal with vessels. It was assessed that up to 0.05 grey seal (based on 90% avoidance) could be at increased risk (or 0.0006% of the South-East England Management Unit) (Ref. 8.125).	The estimated number of grey seal that could be at increased collision risk during construction of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with the extension of Inner Gabbard East Disposal Site is 0.06 grey seal (0.007% of South-East England Management Unit; or 0.0009% of the Humber Estuary count). Therefore,	

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
			there would be no significant effects on the grey seal population.	
Galloper Offshore Wind Farm Extension project	38km windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km from cable corridor. 27km from windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
			during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	
Harwich Haven approach channel deepening	41km.	There is the potential for dredging activities to increase the risk of collision of grey seal with dredging vessels. It was assessed that up to 0.15 grey seal (based on 90% avoidance) could be at increased risk (or 0.002% of the South-East England Management Unit) (Ref. 8.124).	The estimated number of grey seal that could be at increased collision risk during construction of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with the Harwich Haven approach channel deepening project is 0.16 grey seal (0.002% of South-East England Management Unit; or 0.002% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	No
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km from cable corridor. 103km from windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of grey seal that could be at increased collision risk during the construction of Norfolk Boreas is 0.02 (based on	The estimated number of grey seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Norfolk Boreas project is 0.03 grey seal (0.0003% of South-East England Management Unit; or	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
		area of wind farm site, seal at sea density and 5% increased collision risk).	0.0005% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	
Norfolk Vanguard Offshore Wind Farm.	59km from cable corridor. 83km from windfarm site.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of grey seal that could be at increased collision risk during the construction of Norfolk Vanguard is 0.03 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of grey seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Norfolk Vanguard project is 0.04 grey seal (0.0005% of South-East England Management Unit; or 0.0006% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	No.
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area	50km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Construction the Thanet Extension project is currently planned to take place between 2020 and 2023. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of grey seal that could be at increased collision risk during the construction of the Thanet Extension is 0.07	The estimated number of grey seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Thanet Extension project is	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
		(based on area of wind farm site, seal at sea density and 5% increased collision risk).	0.08 grey seal (0.0009% of South-East England Management Unit; or 0.001% of the Humber Estuary count). Therefore, there would be no significant effects on the grey seal population.	

Impingement of prey

9.4.67. No other projects screened in have the potential to cause the impingement or entrapment of grey seal prey species and, therefore, this effect has not been considered within this in-combination assessment.

e) Summary of effects (alone and in-combination)

9.4.68. **Table 9.26** summarises the potential effects of the Sizewell C Project on the Humber Estuary SAC alone and in-combination with other plans and projects.

Table 9.26: Summary of the potential effects of the Sizewell C Project on the Humber Estuary SAC alone and in-combination with other plans and projects

Potential Effect	Assessment Of Grey Seal	Potential For Adverse Effect On The Integrity Of The Site
Construction And Decommissioning Of The Sizewell C Project Alone		
Water quality effects – marine environment		
Potential for water quality effects due to construction related discharges on foraging grey seal and/or grey seal prey species.	0.3 grey seal (0.003% of the South-East England reference population; or 0.005% of the Humber Estuary SAC count).	No
Underwater noise effects on species populations – grey seal		
Permanent auditory injury (PTS) from a single strike of impact piling (200kJ) on grey seal.	0.00001 grey seal (0.0000001% of the South-East England Management Unit reference population; 0.0000001% of the Humber Estuary SAC count).	No A Marine Mammal Mitigation Plan for piling would be implemented
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of impact piling (200kJ) on grey seal.	0.008 grey seal (0.00009% of the South-East England Management Unit reference population; 0.0001% of the Humber Estuary SAC count).	No A Marine Mammal Mitigation Plan for piling would be implemented
Temporary auditory injury (TTS) from a single strike of impact piling (200kJ) on grey seal.	0.00003 grey seal (0.0000003% of the South-East England Management Unit reference population; 0.0000005% of the Humber Estuary SAC count).	No

Potential Effect	Assessment Of Grey Seal	Potential For Adverse Effect On The Integrity Of The Site
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of impact piling (200kJ) on grey seal.	0.4 grey seal (0.005% of the South-East England Management Unit reference population; 0.006% of the Humber Estuary SAC count).	No
Disturbance of grey seal from impact piling.	41.8 grey seal (0.48% of the South-East England Management Unit reference population; 0.64% of the Humber Estuary SAC count).	No
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of drilling on grey seal.	0.00008 grey seal (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary SAC count).	No
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of dredging on grey seal.	0.002 grey seal (0.00002% of the South-East England Management Unit reference population; 0.00003% of the Humber Estuary SAC count).	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of drilling on grey seal.	0.00008 grey seal (0.000001% of the South-East England Management Unit reference population; 0.000001% of the Humber Estuary SAC count).	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of dredging on grey seal.	0.5 grey seal (0.006% of the South-East England Management Unit reference population; 0.008% of the Humber Estuary SAC count).	No
Permanent auditory injury (PTS) for effects on grey seal from UXO clearance.	0.4 grey seal (0.005% of the South-East England Management Unit reference population; 0.007% of the Humber Estuary SAC count).	No A Marine Mammal Mitigation Plan for UXO clearance would be implemented

Potential Effect	Assessment Of Grey Seal	Potential For Adverse Effect On The Integrity Of The Site
Disturbance effects on grey seal prey species		
Behavioural response of grey seal prey species to impact piling.	0.4 grey seal (0.0004% of the South-East England Management Unit reference population; 0.0006% of the Humber Estuary SAC count).	No
Physical interaction between species and project infrastructure		
Increased collision risk of grey seal and vessels.	0.01 grey seal (0.0001% of the South-East England Management Unit reference population; 0.0002% of the Humber Estuary SAC count).	No
Operation Of The Sizewell C Project Alone		
Water quality effects – marine environment		
Potential for water quality effects due to operational chemical discharges on foraging grey seal and/or grey seal prey species.	0.3 grey seal (0.003% of the South-East England reference population; or 0.005% of the Humber Estuary SAC count).	No
Potential for water quality effects due to operational thermal discharge on foraging grey seal and/or grey seal prey species.	8.5 grey seal (0.10% of the South-East England reference population; or 0.13% of the Humber Estuary SAC count).	No
Physical interaction between species and project infrastructure		
Increased collision risk of grey seal and vessels.	0.01 grey seal (0.0001% of the South-East England Management Unit reference population; 0.0002% of the Humber Estuary SAC count).	No
Impingement of prey species	1.6 grey seal (0.018% of the South-East England Management Unit reference population; 0.025% of the Humber Estuary count).	No
In-Combination Effects		
Water quality effects	None of the projects included in the in-combination assessment for any changes to water quality would have the	No

Potential Effect	Assessment Of Grey Seal	Potential For Adverse Effect On The Integrity Of The Site
	potential to have any in-combination effects on foraging harbour seal, or their prey species.	
Disturbance from underwater noise	123.5 grey seal (1.4% of the South-East England reference population; or 1.9% of the Humber Estuary SAC count).	No
Increased collision risk with vessels.	0.4 grey seal (0.005% of the South-East England reference population; or 0.006% of the Humber Estuary SAC count).	No

f) Conclusions

9.4.69. In relation to the conservation objective for grey seal, there is no potential for adverse effects on the integrity of the Humber Estuary SAC to arise due to the Sizewell C Project either alone or in-combination with other plans or projects.

9.5 Assessment of effects: Southern North Sea SAC

a) Water quality effects – marine environment

i. Construction and decommissioning

Potential for water quality effects due to construction and decommissioning phase discharges on harbour porpoise

9.5.1. Marine mammals often naturally inhabit turbid environments, and many use sonar to sense the environment around them; there is little evidence that turbidity affects cetaceans directly (Ref. 9.31). As above, the limited information available indicates that increased turbidity, as a result of dredging, is unlikely to have a substantial direct impact on marine mammals (Ref. 9.31). A pool-based study was carried out on a captive harbour porpoise that was blindfolded, where the individual was still able to forage using echolocation to navigate. However, it did reduce its swim speed when blindfolded (Ref. 9.57).

9.5.2. As discussed in section 9.4 a of this report, marine mammals are susceptible to bioaccumulation because they feed at high trophic levels and have a large

proportion of lipid-rich blubber which accumulates contaminants readily (Ref. 9.33). However, due to the predicted limited dispersion area, rapid dispersion and rapid deposit of material, along with relatively low contaminant levels in sediments, any potential effects on marine mammals as a result of increased suspended sediments and contaminant re-mobilisation are unlikely.

9.5.3. To put this into context, the assessment considered the worst-case area of effect for changes to water quality as result of operational activities due to the total residual oxidant plume for both Sizewell B and C affecting an area of 7.26km^2. The total number of harbour porpoise that could be affected by the increases in SSC is 4.4 individuals (or 0.001% of the North Sea Management Unit reference population).

9.5.4. In the context of the Southern North Sea SAC, the maximum area of any potential effect (7.26km^2) is approximately 0.06% of the SAC winter area (which has an area of 12,697km^2). If it is assumed as a worst-case that changes to water quality could occur throughout the duration of the winter season (a total of 182 days), the maximum seasonal average would be 0.06%. Displacement of harbour porpoise, therefore, would not exceed either the 20% threshold of effect at any one time or exceed the 10% seasonal component of the SAC on average over the season.

9.5.5. Consequently, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to Sizewell C Project construction and decommissioning phase discharges in relation to the conservation objectives for harbour porpoise.

Potential for water quality effects due to construction and decommissioning phase discharges on harbour porpoise prey species

9.5.6. There is potential for effects on harbour porpoise prey species through physiological compensation where pelagic fish remain in an exposed area, or avoid temporary SSC increases, with consequential increased energy expenditure and reduced fitness. However, the mobility of pelagic prey species for harbour porpoise provides access to habitat within and outside the Southern North Sea SAC for the period of dredging. As such, declines in abundance and distribution of prey stocks and populations are unlikely. Further details are provided in section 9.4 a of this report.

9.5.7. On a precautionary basis, the number of harbour porpoise that could be present in the areas from which prey species could be affected as a result of any changes to water quality has been estimated based on the maximum area of effect of 7.26km^2. However, as the maximum predicted impact area for any increased suspended sediments and contaminant re-mobilisation is the same for harbour porpoise and their prey, there would be no additional impacts on harbour porpoise as a result of the effects of any changes to water

quality on prey species. Consequently, no indirect adverse effect on the integrity of the Southern North Sea SAC is predicted due to the Sizewell C Project construction and decommissioning phase discharges in relation to the conservation objectives for harbour porpoise prey species.

ii. Operation

Potential for water quality effects due to chemical discharges on harbour porpoise

9.5.8. For hydrazine the predicted area of exceedance of the PNEC standards is 1.6km^2. The areas of exceedance of the total residual oxidant and bromoform EQS standard are modelled as 7.26km^2 and 3.6km^2 respectively. Skin infections have been observed in captive mammals due to the chlorination destroying beneficial microflora and inactivation of antimicrobial substances secreted by the skin (Ref. 9.58). However, there is no indication that chemical discharge from the Sizewell B power station (of total residual oxidants, bromoform, ammonia) has had any effect on harbour porpoises in the area (Ref. 9.59).

9.5.9. On a precautionary basis, the number of harbour porpoise that could be present within the maximum area of effect (of 7.26km^2 for total residual oxidant effect area) has been estimated to be 4.4 individuals, or 0.001% of the North Sea Management Unit reference population. The maximum area of effect equates to 0.06% of the Southern North Sea SAC winter area and, as a worst-case, the maximum seasonal average would be 0.06%. As above, displacement of harbour porpoise, therefore, would not exceed either the 20% threshold of effect at any one time or the 10% seasonal component of the SAC on average over the season.

9.5.10. Consequently, based on this precautionary assessment, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to the Sizewell C operational chemical discharge in relation to the conservation objectives for harbour porpoise.

Potential for water quality effects due to chemical discharges on harbour porpoise prey species

9.5.11. The potential effect of the changes to water quality on prey species for harbour porpoise would not extend beyond the maximum predicted effect areas described for harbour porpoise. Consequently, no indirect adverse effect on the integrity of the Southern North Sea SAC is predicted due to the Sizewell C chemical discharge in relation to the conservation objectives for harbour porpoise.

Potential for water quality effects due to thermal discharge on harbour porpoise

9.5.12. On a very precautionary basis, the number of harbour porpoise that could be present within the maximum area of effect (an area of 224.6km^2 for the 2°C area at the sea surface) has been estimated to be 136.3 individuals, or 0.04% of the North Sea Management Unit reference population. The maximum area of effect equates to 1.8% of the Southern North Sea SAC winter area. Similarly, as a worst case, it is assumed that changes to water quality could occur throughout the duration of the winter season, which would result in a seasonal average of 1.8% of the Southern North Sea SAC winter area. Displacement of harbour porpoise, therefore, would not exceed either the 20% threshold of effect at any one time nor the 10% seasonal component of the SAC on average over the season.

9.5.13. Based on this precautionary assessment, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to the Sizewell C operational thermal discharge in relation to the conservation objectives for harbour porpoise.

Potential for water quality effects due to thermal discharge on harbour porpoise prey species

9.5.14. The thermal tolerance of the key prey species for harbour porpoise has been reviewed, including sprat, herring, whiting, and dover sole as seen in section 9.3b)i of this report. As a worst-case approach, it can be assumed that all harbour porpoise prey species would be displaced from the area within the 2°C contour; but no fatalities of prey species are expected and prey would be available to marine mammals outside of the 2°C contour.

9.5.15. On a precautionary basis, the number of harbour porpoise that could be present in the area of the thermal plume from which prey species could be displaced has been estimated. However, as the maximum predicted impact area for any changes in water temperature would be the same for marine mammal and their prey, there would be no additional effects on harbour porpoise as a result of the effects of any changes in water temperature on prey species. Consequently, no indirect adverse effect on the integrity of the Southern North Sea SAC is predicted due to the Sizewell C operational thermal discharge in relation to the conservation objective for harbour porpoise prey species.

b) Underwater noise effects on species populations

i. Construction and decommissioning

9.5.16. The assessments of effects for the Southern North Sea SAC includes consideration of the spatial and temporal thresholds for disturbance and displacement effects, as well as an assessment for the North Sea Management Unit reference population. As the Sizewell C main development site is wholly within the winter area of the Southern North Sea SAC (an area of 12,697km^2 and a seasonal duration of 182 days), the assessment considers the effect on the SAC winter area of the SAC only.

Impact piling effects on harbour porpoise

Permanent auditory injury (PTS) from impact piling

9.5.17. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for PTS in harbour porpoise, based on the National Oceanic and Atmospheric Administration (Ref. 9.41) criteria for SPL_{peak} and PTS from weighted sound exposure levels (SEL_{cum}) are outlined in **Table 9.8**.

9.5.18. The number of harbour porpoise that could be at risk of PTS onset as a result of impact piling, prior to any mitigation, is outlined in **Table 9.27**. The estimated maximum number that could be at risk of PTS (SPL_{peak}) as a result of a single strike of the worst-case hammer energy of 200kJ is 0.003 individuals (0.000001% of the North Sea Management Unit reference population). The maximum number of individuals that could be at risk of PTS from cumulative exposure, based on the stationary model, is up to 3.4 individuals (up to 0.001% of the North Sea Management Unit reference population). However, based on the more realistic fleeing model for cumulative PTS, there would be no effect.

Table 9.27: Maximum predicted effect areas for PTS for harbour porpoise from impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Porpoise
Impact piling with 90kJ hammer	PTS 202 SPL_{peak}	0.0023km^2	0.001 harbour porpoise (0.0000004% of the North Sea Management Unit reference population)
	PTS 155 SEL_{cum} Stationary model	1.9km^2	1.2 harbour porpoise (0.0003% of the North Sea Management Unit reference population)

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Porpoise
	PTS 155 SEL_{cum} Fleeing model	No effect	0
Impact piling with 200kJ hammer	PTS 202 SPL_{peak}	0.005km^2	0.003 harbour porpoise (0.000001% of the North Sea Management Unit reference population)
	PTS 155 SEL_{cum} Stationary model	5.6km^2	3.4 harbour porpoise (0.001% of the North Sea Management Unit reference population)
	PTS 155 SEL_{cum} Fleeing model	No effect	0

9.5.19. As outlined in section 9.4 b of this report, mitigation would be implemented for the impact piling works at the Sizewell C Project (as per JNCC guidance; Ref. 9.44). As the instantaneous effect ranges (SPLpeak) for impact piling on harbour porpoise are within the 500m mitigation zone, any potential for a PTS onset in harbour porpoise would be reduced. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to any permanent auditory injury from impact piling associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Temporary auditory injury (TTS) and fleeing response from impact piling

9.5.20. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for TTS and fleeing response in harbour porpoise, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for SPL_{peak} and TTS from weighted sound exposure levels (SEL_{cum}), are outlined in **Table 9.11**.

9.5.21. The number of harbour porpoise that could be at risk of TTS onset or a fleeing response as a result of impact piling for the Sizewell C Project, prior to any mitigation, is outlined in **Table 9.28**. The estimated maximum number of harbour porpoise that could be at risk of TTS or fleeing response (SPL_{peak}) as a result of a single strike of 200kJ is 0.008 individuals (0.000002% of the North Sea Management Unit reference population). The maximum number of harbour porpoise that could be at risk of TTS from cumulative exposure, based on the stationary model, is up to 62 individuals (up to 0.02% of the North Sea Management Unit reference population).

Table 9.28: Maximum predicted effect areas for TTS and fleeing response for harbour porpoise from impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Porpoise
Impact piling with 90kJ hammer	TTS 196 SPL_{peak}	0.006km^2	0.004 harbour porpoise (0.000001% of the North Sea Management Unit reference population).
	TTS 140 SEL_{cum} Stationary model	49.94km^2	30 harbour porpoise (0.009% of the North Sea Management Unit reference population).
	TTS 140 SEL_{cum} Fleeing model	7.86km^2	5 harbour porpoise (0.001% of the North Sea Management Unit reference population).
Impact piling with 200kJ hammer	TTS 196 SPL_{peak}	0.014km^2	0.008 harbour porpoise (0.000002% of the North Sea Management Unit reference population).
	TTS 140 SEL_{cum} Stationary model	102.23km^2	62 harbour porpoise (0.02% of the North Sea Management Unit reference population).
	TTS 140 SEL_{cum} Fleeing model	21.79km^2	13 harbour porpoise (0.004% of the North Sea Management Unit reference population).

9.5.22. Based on the more realistic fleeing model for cumulative TTS, for the worst-case hammer energy of 200kJ, the maximum number of harbour porpoise that could be at risk of TTS is 13 individuals (0.004% of the North Sea Management Unit reference population).

9.5.23. Taking into account the temporary disturbance and intermittent duration of underwater noise from piling (with only 12 piles to be installed underwater), there is unlikely to be any significant disturbance or barrier effects for harbour porpoise.

9.5.24. The maximum area of effect from TTS (and fleeing response) for harbour porpoise as a result of impact piling is 102.23km^2 (from the cumulative piling of five piles over a 24-hour period with hammer energy of 200kJ, based on the stationary model). This equates to 0.8% of the winter area of the Southern North Sea SAC (12,697km^2) and, therefore, is below the spatial disturbance threshold of 20% of the seasonal component of the Southern North Sea SAC.

9.5.25. The maximum piling duration for the Sizewell C Project is expected to be 12 days, if it is assumed that only one pile would be installed per day. As a worst-case, it is assumed that the total duration of piling would take place during the winter season. Taking into account the maximum spatial area with the potential for TTS onset and fleeing response in harbour porpoise (an area of 0.8%), and the maximum proportion of the winter season in which piling could occur (a maximum of 12 days of the 182-day season), the overall temporal disturbance would be 0.05% of the winter season. This is below the temporal disturbance threshold of 10% of the seasonal component.

9.5.26. Therefore, under these circumstances, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to any temporary auditory injury from impact piling associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Disturbance due to impact piling

9.5.27. The current Statutory Nature Conservation Body's recommendation is that an effective disturbance radius of 26km (approximate area of 2,123.7km^2) around pile locations is used to assess the area that harbour porpoise could be disturbed in the Southern North Sea SAC. As set out above, this approach has been used in this assessment, taking into account the potential maximum area of possible disturbance of harbour porpoise in the Southern North Sea SAC winter area.

9.5.28. The number of harbour porpoise that could be at risk of disturbance as a result of impact piling due to the Sizewell C Project, prior to any mitigation, is outlined in **Table 9.29**. The estimated maximum number of harbour porpoise that could be at risk of disturbance is 587 individuals (0.17% of the North Sea Management Unit reference population).

Table 9.29: Maximum predicted effect ranges (and areas) for disturbance to harbour porpoise due to impact piling

Effect	Maximum Area Of Effect	Assessment For Harbour Porpoise
Disturbance from impact piling	967.0km^2	587 harbour porpoise (0.17% of the North Sea Management Unit reference population).

9.5.29. Taking into account the temporary nature of the disturbance and intermittent duration of underwater noise from piling, there is unlikely to be any significant disturbance or barrier effects for harbour porpoise.

9.5.30. The maximum area of effect from disturbance for harbour porpoise as a result of impact piling is 967km^2; this equates to 7.6% of the winter area of the

Southern North Sea SAC (12,697km^2) and is below the spatial disturbance threshold of 20% of the seasonal component.

9.5.31. The maximum piling duration for the Sizewell C Project is expected to be 12 days. Taking into account the maximum spatial area with the potential for disturbance to harbour porpoise and the maximum proportion of the winter season that may have piling undertaken in it, the overall temporal disturbance will be 0.5% of the winter season. This is below the temporal disturbance threshold of 10% of the seasonal component.

9.5.32. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to disturbance from impact piling associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Drilling and dredging activity effects on harbour porpoise

Permanent auditory injury (PTS) from drilling and dredging activities

9.5.33. The number of harbour porpoise that could be at risk of PTS onset as a result of drilling for the Sizewell C Project is outlined in **Table 9.30**. The estimated maximum number of harbour porpoise that could be at risk of PTS (SEL_{cum}) as a result of drilling, based on the stationary model, is 0.006 individuals (0.000002% of the North Sea Management Unit reference population).

Table 9.30: Maximum predicted effect areas for permanent auditory injury (PTS) for harbour porpoise from drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Porpoise
Drilling activities	PTS 173 SEL_{cum}	0.01km^2	0.006 harbour porpoise (0.000002% of the North Sea Management Unit reference population).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	PTS 173 SEL_{cum}	6.2km^2	3.8 harbour porpoise (0.001% of the North Sea Management Unit reference population).

9.5.34. The maximum number of harbour porpoise that could be at risk of PTS from cumulative exposure of the dredging works, based on the stationary model, is up to 3.8 individuals (up to 0.001% of the North Sea Management Unit reference population) (**Table 9.30**).

9.5.35. Noise levels arising from drilling and dredging activities were too low to generate instantaneous auditory effect in harbour porpoise. The fleeing model for cumulative PTS resulted in no PTS effect areas for harbour porpoise from drilling or dredging activities.

9.5.36. The results of the underwater noise modelling show that harbour porpoise would have to remain within close proximity of the drilling (less than 50m) for a period of 24-hours to be at risk of PTS onset (**Table 9.9**). For dredging works, a harbour porpoise would have to be within 1.66km of the activity for a period of 24-hours. Given this, the low number of individuals that may be at risk and the small percentage of the North Sea Management Unit reference population that would be affected, the risk of permanent auditory injury is considered to be unlikely. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to permanent auditory injury from construction or decommissioning phase drilling or dredging associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Temporary auditory injury (TTS) from drilling and dredging activities

9.5.37. The maximum number of harbour porpoise that could be at risk of TTS onset or a fleeing response as a result of drilling for the Sizewell C Project is outlined in **Table 9.31**. The estimated maximum number of harbour porpoise that could be at risk of TTS from cumulative exposure as a result of drilling activities, based on the stationary model, is 2.6 individuals (0.0008% of the North Sea Management Unit reference population).

Table 9.31: Maximum predicted effect areas for TTS and fleeing response for harbour porpoise from drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Porpoise
Drilling activities	TTS 153 SEL_{cum} Stationary model	4.31km^2	2.6 harbour porpoise (0.0008% of the North Sea Management Unit reference population).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	TTS 153 SEL_{cum} Stationary model	143.6km^2	87 harbour porpoise (0.03% of the North Sea Management Unit reference population).
	TTS 153 SEL_{cum} Fleeing model	10km^2	6 harbour porpoise (0.002% of the North Sea Management Unit reference population).

9.5.38. The estimated maximum number of harbour porpoise that could be at risk of TTS or fleeing response from cumulative exposure from dredging activities,

based on the stationary model, is 87 individuals (up to 0.03% of the North Sea Management Unit reference population) (**Table 9.31**). However, based on the more realistic fleeing model, the estimated maximum number of harbour porpoise that could be at risk of TTS or fleeing response from cumulative exposure from dredging activities is 6 individuals (up to 0.002% of the North Sea Management Unit reference population) (**Table 9.31**).

9.5.39. Taking into account the temporary disturbance and intermittent duration of underwater noise from both dredging and drilling activities, there is unlikely to be any significant disturbance or barrier effects for harbour porpoise.

9.5.40. The maximum area of effect from TTS (and fleeing response) for harbour porpoise as a result of dredging and drilling activities is 143.6km^2 (from concurrent dredging at the BLF and southern intake). This equates to 1.1% of the winter area of the Southern North Sea SAC (12,697km^2) and, therefore, is below the spatial disturbance threshold of 20% of the seasonal component of the Southern North Sea SAC.

9.5.41. Offshore construction activities, including the drilling and dredging activities, could occur at any time through the construction period and, as a worst-case, it has been assumed that drilling and dredging could occur throughout the winter period (182 days). Taking into account the maximum spatial area with the potential for TTS onset and fleeing response in harbour porpoise (an area of 1.1%), and that drilling and dredging activities could occur over the entire period, the overall temporal disturbance would be 1.1% of the winter season. This is below the temporal disturbance threshold of 10% of the seasonal component.

9.5.42. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to any temporary auditory injury from construction or decommissioning drilling or dredging associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Underwater noise effects for UXO clearance on harbour porpoise

9.5.43. The hypothetical UXO detonations for an explosive charge mass of 500lb had an impact area for instantaneous PTS of up to 296km^2, which could affect 179 harbour porpoise (up to 0.05% of the North Sea Management Unit). As previously outlined, however, the requirement for any UXO clearance is currently unknown and this hypothetical assessment has been included for illustrative purposes.

9.5.44. Mitigation would be implemented for any UXO clearance for the Sizewell C Project, following the latest guidance and requirements, and reduce the risk of PTS to harbour porpoise.

9.5.45. Therefore, under these circumstances, no direct adverse effects on the integrity of the Southern North Sea SAC are predicted from any permanent auditory injury from any UXO clearance for the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Underwater noise effects on prey species

9.5.46. Construction activities that generate underwater noise that could impact on harbour porpoise, could also have effects on their prey species, indirectly impacting harbour porpoise within the Southern North Sea SAC.

9.5.47. As a worst-case, prediction of the potential effect of changes to prey availability to harbour porpoise as a result of underwater noise has been based on the largest of those areas of effect that have been predicted for fish species. That is, a behavioural response in hearing specialist species as a result of the impact piling for the BLF jetty, fenders and dolphins. The maximum area of effect is 9.68km^2.

9.5.48. The number of harbour porpoise that could be affected by a change in prey species availability is up to 6 individuals, or 0.002% of the North Sea Management Unit reference population. However, any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity.

9.5.49. The maximum area of effect for harbour porpoise prey species equates to 0.08% of the winter area of the Southern North Sea SAC and, therefore, is below the spatial disturbance threshold of 20% of the seasonal component.

9.5.50. The maximum piling duration for the Sizewell C Project is expected to be 12 days and, as a worst-case scenario, it is assumed that the total duration of piling would take place during the winter season. Taking into account the maximum spatial area with the potential for disturbance to harbour porpoise, and the maximum proportion of the winter season that may have piling undertaken within it, the overall temporal disturbance would be 0.01% of the winter season. This is below the temporal disturbance threshold of 10% of the seasonal component.

9.5.51. Therefore, no indirect adverse effects on the integrity of the Southern North Sea SAC are predicted due to disturbance effects associated with the Sizewell C Project in relation to the conservation objective for harbour porpoise prey species.

c) Direct habitat loss and direct / indirect habitat fragmentation

i. Construction and decommissioning

9.5.52. The number of harbour porpoise that could be at risk of displacement as a result of a habitat change due to the dredging for the BLF, is up to 0.006 individuals (or 0.000002% of the North Sea Management Unit reference population). Taking into account the temporary nature of the displacement, and that harbour porpoise already would be disturbed from the area as a result of underwater noise from construction activities and vessels, there is unlikely to be any significant displacement or barrier effects for harbour porpoise.

9.5.53. The maximum area of the displacement effect for harbour porpoise as a result of temporary changes to habitat equates to 0.00007% of the winter area of the Southern North Sea SAC (12,697km^2) and, therefore, would be below the spatial disturbance threshold of 20% and temporal displacement threshold of 10% of the seasonal component. Under these circumstances, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to habitat loss associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

9.5.54. No dredging is envisaged in the decommissioning phase.

ii. Operation

9.5.55. During the operational period of the Sizewell C Project (of 60 years), the presence of the offshore infrastructure has the potential to cause the long-term displacement of harbour porpoise, through the long-term loss of habitat. This would affect a total area of 0.02km^2.

9.5.56. The number of harbour porpoise that could be at risk of displacement as a result of long-term habitat change due to the introduction of hard structures is up to 0.01 individuals (or 0.000004% of the North Sea Management Unit reference population). Taking into account the very small area of habitat that harbour porpoise may be displaced from, there is unlikely to be any significant displacement or barrier effects for harbour porpoise.

9.5.57. The maximum area of the displacement effect for harbour porpoise as a result of the introduction of hard substrate through the operational period equates to 0.0002% of the winter area of the Southern North Sea SAC and, therefore, is below the spatial disturbance threshold of 20% and the temporal displacement threshold of 10% of the seasonal component. Consequently, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to habitat loss associated with the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

d) Physical interaction between species and project infrastructure

i. Construction and decommissioning

Increased collision risk of harbour porpoise and vessels

9.5.58. On a precautionary basis, the number of harbour porpoise that could be at increased collision risk with vessels during construction has been assessed based on 5% of the number of animals that could be present in the study area of 6.5km^2, based on the information provided in section 9.3b)v of this report.

9.5.59. As outlined in **Table 9.32**, 4 harbour porpoise (or 0.001% of the North Sea Management Unit reference population) could be at increased risk of collision with vessels within the Sizewell C main development site. However, this is highly precautionary, as it is highly unlikely that harbour porpoise present in the main development site would be at increased collision risk with vessels, especially taking into account the relatively small increase vessel movements compared to existing vessel movements in the area.

Table 9.32: Number of harbour porpoise at potential increased vessel collision risk

Effect	Area Of Effect	Assessment Of Harbour Porpoise
Increased collision risk (5% of harbour porpoise at increased risk)	6.5km^2	4 harbour porpoise (0.001% of the North Sea Management Unit reference population).

9.5.60. In addition, based on the assumption that harbour porpoise would be disturbed from the area as a result of underwater noise from construction activities and vessels, there should be no potential for increased collision risk.

9.5.61. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to vessel collision during the construction or decommissioning of the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

ii. Operation

Increased collision risk of harbour porpoise and vessels

9.5.62. For this assessment and on a precautionary basis, it is assumed that the potential effects in the operational phase would be the same as for construction phase (**Table 9.32**). Therefore, under these circumstances, no direct adverse effects on the integrity of the Southern North Sea SAC is

predicted due to vessel collision during operation of the Sizewell C Project in relation to the conservation objectives for harbour porpoise.

Impingement of prey species

9.5.63. There is the potential for harbour porpoise prey species to be impinged through the operation of the Sizewell C Project. As discussed in section 6.4b of this report, the principal prey species of the harbour porpoise are sandeel, sprat, whiting, dover sole, and gadoid and clupeid species, such as cod and herring. The only species expected to be impinged are sprat, whiting, dover sole, cod and herring. The impingement assessment (Ref. 8.5) reports that, with the mitigation provided by the low velocity side entry intake heads and the FRR system, there would be a negligible effect on all harbour porpoise prey species' populations as a result of impingement.

9.5.64. However, as a worst-case, an assessment has been made of the number of harbour porpoise that could be displaced by the loss of prey availability through impingement. This assessment is based on the precautionary assumption that all harbour porpoise prey species would be lost within close proximity of the intake tunnels. The area of effect has been defined as the study area for the Sizewell C Project, which is the Greater Sizewell Bay; a total area of 4,120ha (or 41.2km^2). This is precautionary, as not all prey species within that area would be lost and the effect would be temporary, as harbour porpoise would be able to move to a nearby area where prey species are available. Harbour porpoise prey species are expected to be at risk of a negligible effect only, with less than 1% of the available prey populations being affected.

9.5.65. As outlined in **Table 9.33**, up to 25 harbour porpoise (or 0.007% of the North Sea Management Unit reference population) could be displaced from foraging with the Greater Sizewell Bay due to loss of prey availability. However, in reality, the effect would be restricted to directly around the intake tunnels.

Table 9.33: Number of harbour porpoise potentially displaced through loss of prey availability

Effect	Maximum area of effect	Assessment of harbour porpoise
Loss of prey availability	41.2km^2 (Greater Sizewell Bay)	25 harbour porpoise (0.007% of the North Sea Management Unit reference population)

9.5.66. The maximum area of effect from the potential displacement of harbour porpoise as a result of loss of prey availability equates to 0.3% of the winter

area of the Southern North Sea SAC and, therefore, is below the spatial disturbance threshold of 20% of the seasonal component.

9.5.67. The potential area for displacement due to loss of prey availability through the operational phase has the potential to occur for the entirety of the winter season. Taking into account the maximum spatial area from which harbour porpoise could be displaced (an area of 0.3%), the overall temporal disturbance would be 0.3% of the winter season. This is below the temporal displacement threshold of 10% of the seasonal component.

9.5.68. Therefore, no direct adverse effect on the integrity of the Southern North Sea SAC is predicted due to the potential loss of prey availability resulting from the operation of the Sizewell C Project, in relation to the conservation objectives for harbour porpoise.

e) In-combination effects

Water quality

9.5.69. The operational phase of the Sizewell C Project could lead to water quality effects over a maximum area of 7.26km^2 (or 0.06% of the Southern North Sea SAC winter area). In-combination with the East Anglia ONE North project (341km^2) and East Anglia TWO project (436km^2), this equates to a total maximum area of 784.3km^2 of potential water quality effects (**Table 9.34**); which is up to 6.2% of the Southern North Sea SAC winter area. Therefore, any displacement of harbour porpoise or their prey as a result of in-combination water quality effects would not exceed 20% of the SAC winter area at any time or exceed a seasonal average of 10% of the SAC winter area during the summer period. The maximum number of harbour porpoise that could be displaced is up to 476 (0.12% of the North Sea Management Unit). Therefore, there would be no potential for a significant displacement effect on harbour porpoise within the SAC.

9.5.70. Neither of the two projects included in this in-combination assessment for changes to water quality have the potential to have significant in-combination effects on harbour porpoise, or their prey species, from the Southern North Sea SAC, during the construction and operation of the Sizewell C Project based on currently available information (**Table 9.34**). Therefore, there is no an adverse effect on the integrity of the Southern North Sea SAC to arise in relation to its conservation objectives for harbour porpoise as a result of in-combination water quality effects.

Habitat loss

9.5.71. The area of potential habitat loss to harbour porpoise and their prey in the Southern North Sea SAC as a result of the Sizewell C Project in-combination

with offshore wind farms and other projects is estimated to be up to 54.89km^2 (**Table 9.35**), which represents 0.4% of the Southern North Sea SAC winter area. Therefore, any displacement of harbour porpoise or their prey as a result of any in-combination habitat loss would not exceed 20% of the SAC winter area at any time or exceed a seasonal average of 10% of the SAC winter area during the summer period. The maximum number of harbour porpoise that could be displaced is up to 33.3 (0.01% of the North Sea Management Unit). Therefore, a significant displacement effect on harbour porpoise within the SAC would not occur.

Table 9.34: In-combination assessment of plans and projects with the potential to affect harbour porpoise from the Southern North Sea SAC through changes to water quality

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km to offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and decommissioning phases of the project. No water quality effects were assessed as no potential impacts were identified for any marine mammal species during operation and decommissioning (Ref. 9.45).	No potential for in-combination effect.	No.
East Anglia ONE North Offshore Wind Farm.	11km to cable corridor. 48km windfarm site	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan. However, as a worst-case scenario, the potential for water quality to deter harbour porpoise from the Southern North Sea SAC has been assessed, concluding that an area of 341km^2 could be affected by changes to water quality (Ref. 8.129).	The operational phase of the Sizewell C Project will lead to water quality effects over a maximum area of 7.26km^2 (or 0.06% of the Southern North Sea SAC winter area). In-combination with the East Anglia ONE North project, this equates to a total area of 348.3km^2 (or 2.7% of the SAC winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
East Anglia THREE Offshore Wind Farm.	11km to cable corridor. 78km to windfarm site.	No water quality effects were identified for marine mammals and were therefore not assessed, and all effects to prey species were assessed as being negligible or minor adverse (Ref. 9.46).	Given the distance to the project from the main development site and the very low significance of effect, it is	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
			considered that there is no potential for in-combination effect.	
East Anglia TWO Offshore Wind Farm.	11km to cable corridor. 31km windfarm site.	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan. However, as a worst-case scenario, the potential for water quality to deter harbour porpoise from the Southern North Sea SAC has been assessed, concluding that an area of 436km^2 could be affected by changes to water quality (Ref. 8.121).	The operational phase of the Sizewell C Project will lead to water quality effects over a maximum area of 7.26km^2 (or 0.06% of the Southern North Sea SAC winter area). In-combination with the East Anglia TWO project, this equates to a total area of 443.3km^2 (or 3.5% of the SAC winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
Eurolink.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Galloper Offshore Wind Farm Extension project.	38km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km to cable corridor. 27km to windfarm site.	No information available.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Great Yarmouth Third River Crossing.	75km.	Standard pollution control measures will be implemented throughout the project, and a surface water drainage strategy would be in place through the construction phase to ensure that no contaminated run-off is allowed to enter the water. Therefore, there would be no potential for adverse effect on the Southern North Sea SAC.	No potential for in-combination effect.	No
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance.	64km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.48).	No potential for in-combination effect.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance.	58km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.49).	No potential for in-combination effect.	No.
Hamilton Dock, Lowestoft – Pontoon reconfiguration.	30km.	This project will have no effect on marine mammals or water quality (Ref. 9.50).	No potential for in-combination effect.	No.
Lowestoft Lake Lothing Third Crossing.	31km.	There is the potential for water pollution from the project to affect the Southern North SAC given its distance (1.3km), however, mitigation measures that will be implemented during the construction, operation and decommissioning of the project will have no effect on the integrity on the site (Ref. 8.127).	No potential for in-combination effect.	No.
Nautilus.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse In-Combination Effect?
Norfolk Vanguard Offshore Wind Farm.	59km to cable corridor. 83km to windfarm site.	During construction and decommissioning, the risk of accidental release of will be mitigated through contingency planning for the control of pollution. Modelling indicates that the majority of the sediment released during seabed preparation would be coarse and would fall within minutes/ tens of minutes) to the seabed as a highly turbid dynamic plume immediately upon its discharge. Taking into account the low sensitivity of marine mammals to changes in water quality and the low magnitude temporary impact, the impact significance for any changes to water quality is negligible (Ref. 8.134).	Given the distance to the Sizewell C project, and the small areas of effect for both projects, there is no potential for in-combination effect.	No.
Proposed aggregate extraction sites in the study area.	47km.	No assessment of effects has been completed to date, however, the Scoping Report for the Thames D area suggests that there may be the potential for water quality effects on marine mammals within the Southern North Sea SAC which will be assessed further (Ref. 9.52).	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area.	50km.	No information available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm.	82km.	Through the construction, operation and decommissioning phases of the project, it has been determined that there is no potential for adverse effect due to the implementation of the Project Environmental Management Plan to control any accidental pollution releases (Ref. 9.55). No other water quality effects have been assessed for this project.	No potential for in-combination effect.	No

Table 9.35: In-combination assessment of plans and projects with the potential to have direct habitat loss on the Southern North Sea SAC and its designated features

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km to offshore wind farm site.	This project is within the Southern North Sea SAC and so there is the potential for habitat loss to occur, however, this loss was not assessed in this project (Ref. 9.45). The BEIS Review of Consents for the Southern North Sea SAC states that the estimated extent of habitat that could be impacted by the project infrastructure is 7.372km^2 (Ref. 8.133).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the East Anglia ONE project, this equates to a total area of long-term habitat loss of 7.392km^2 (or 0.06% of the winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
East Anglia ONE North Offshore Wind Farm.	11km to cable corridor. 48km to windfarm site.	The introduction of hard project infrastructure within the Southern North Sea SAC will mean the long-term loss of habitat to prey species. In total, the area affected will be 1.9km^2 for all turbines, substations and other infrastructure, cables and scour and cable protection (Ref. 8.129).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the East Anglia ONE North project, this equates to a total area of long-term habitat loss of 1.92km^2 (or 0.015% of the winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
East Anglia THREE Offshore Wind Farm.	11km to cable corridor.	The BEIS Review of Consents for the Southern North Sea SAC states that the estimated extent of habitat that could be impacted by the project	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
	78km to windfarm site.	infrastructure is 0.325km^2 within the wind farm site and 16.174km^2 from the associated cables (Ref. 8.133).	North Sea winter area). In-combination with the East Anglia THREE project, this equates to a total area of long-term habitat loss of 16.194km^2 (or 0.13% of the winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	
East Anglia TWO Offshore Wind Farm.	11km to cable corridor. 31km to windfarm site.	The introduction of hard project infrastructure within the Southern North Sea SAC will mean the long-term loss of habitat to prey species. In total, the area affected will be 2.025km^2 for all turbines, substations and other infrastructure, cables and scour and cable protection (Ref. 8.131).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the East Anglia TWO project, this equates to a total area of long-term habitat loss of 2.045km^2 (or 0.016% of the winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
Eurolink.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Galloper Offshore Wind Farm Operation and Maintenance.	0km to cable corridor. 31km to windfarm site.	The BEIS Review of Consents for the Southern North Sea SAC states that the estimated extent of habitat that could be impacted by the project infrastructure is 0.097km^2 within the wind farm site and 0.9035km^2 from the associated cables (Ref. 8.133).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the Galloper project, this equates to a total area of long-term habitat loss of	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			0.9235km^2 (or 0.007% of the winter area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	
Galloper Offshore Wind Farm Extension project	38km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km to cable corridor. 27km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Lowestoft Flood Risk Management Project.	30km.	Planning application not yet submitted, and no information publicly available.	In-combination assessment not possible.	No.
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km to cable corridor. 103km to windfarm site.	The introduction of hard project infrastructure within the Southern North Sea SAC will mean the long-term loss of habitat to prey species. In total, the area affected will be 11.75km^2 for all turbines, substations and other infrastructure, cables and scour and cable protection, with the majority of the area of effect being within the summer area, while a small area is within the winter area of the Southern North Sea SAC (Ref. 8.129).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the Norfolk Boreas project, this equates to a total area of long-term habitat loss of 11.77km^2 (within the Southern North Sea SAC (or 0.003% of the total SAC area). Overall, there would be no potential for a significant displacement	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			effect on harbour porpoise within the site, and therefore no in-combination effect.	
Norfolk Vanguard Offshore Wind Farm.	59km to cable corridor. 83km to windfarm site.	The introduction of hard project infrastructure within the Southern North Sea SAC will mean the long-term loss of habitat to prey species. In total, the area affected will be 11.75km^2 for all turbines, substations and other infrastructure, cables and scour and cable protection with the majority of the area of effect being within the summer area, while a small area is within the winter area of the Southern North Sea SAC (Ref. 9.60).	The operational phase of the Sizewell C Project will lead to a long-term loss of 0.02km^2 (or 0.0002% of the Southern North Sea winter area). In-combination with the Norfolk Vanguard project, this equates to a total area of long-term habitat loss of 11.77km^2 within the Southern North Sea SAC (or 0.003% of the total SAC area). Overall, there would be no potential for a significant displacement effect on harbour porpoise within the site, and therefore no in-combination effect.	No.
Proposed aggregate extraction sites in the study area.	47km.	No assessment of effects has been completed to date, however, the Scoping Report for the Thames D area suggests that there may be the potential for habitat effects within the Southern North Sea SAC which will be assessed further (Ref. 9.52).	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area.	50km.	No information publicly available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information publicly available.	In-combination assessment not possible.	No.

Table 9.36 In-combination assessment of plans and projects with the potential to have underwater noise disturbance effects on harbour porpoise or their prey from the Southern North Sea SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km to offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
East Anglia ONE North Offshore Wind Farm.	11km to cable corridor. 48km to windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
East Anglia THREE Offshore Wind Farm.	11km to cable corridor. 78km to windfarm site.	Piling for the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance, based on 26km effective disturbance radius, and maximum overlap with the SAC winter area is up to 1,803km^2 and minimum overlap is 294.1km^2.	The maximum area of potential disturbance of harbour porpoise in the Southern North Sea SAC during piling for the as piling for the Sizewell C Project is up to 967km^2 (based on 26km range). In-combination with the East Anglia THREE project, this equates to a total area of 2,770km^2 (or up to 21.8% of the SAC winter area), which exceeds the 20% threshold for disturbance at any time. However, taking into account the average overlap of the East Anglia THREE project	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			(1,048.6km^2) and maximum area for the Sizewell C Project, the area of potential disturbance would be 2,016km^2 (15.6% of the SAC winter area). Therefore, the seasonal average, based on the 12 days of piling at Sizewell C Project during the winter period, would be 1.03%, which is significantly lower than the 10% seasonal average threshold. Therefore, there would be no significant displacement of harbour porpoise.	
East Anglia TWO Offshore Wind Farm.	11km to cable corridor. 31km to windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Extension of Inner Gabbard East Disposal Site		There is the potential for disposal activities to cause disturbance to harbour porpoise through underwater noise. Disturbance effects could impact upon harbour porpoise up to 1km from the disposal activities, potentially affecting an area of 52.4km^2 within the Southern North Sea SAC, or 32 harbour porpoise (or 0.009% of the North Sea Management Unit) (Ref. 8.125).	The maximum area of potential disturbance of harbour porpoise in the Southern North Sea SAC during piling for the as piling for the Sizewell C Project is up to 967km^2 (based on 26km range). In-combination with extension of Inner Gabbard East Disposal Site, this equates to a total area of 1,019.4km^2 (or up to 8.0% of the SAC winter area), below the 20% threshold for disturbance on any given day. The seasonal average, based on the 12 days	

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			of piling at Sizewell C Project during the winter period, would be 0.5%, which is significantly lower than the 10% seasonal average threshold. Therefore, there would be no significant displacement of harbour porpoise.	
Galloper Offshore Wind Farm Operation and Maintenance	0km to cable corridor. 31km to windfarm site.	The Galloper Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
Galloper Offshore Wind Farm Extension project	38km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km to cable corridor. 27km to windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
Harwich Haven approach channel deepening	41km.	There is the potential for dredging activities to cause disturbance to harbour porpoise through underwater noise. Disturbance effects could impact upon harbour porpoise up to 1km from the dredging, vessels and disposal activities, potentially affecting an area of 37.6km^2 within the Southern North Sea SAC, or 23 harbour porpoise (or 0.007% of the North Sea Management Unit) (Ref. 8.124).	The maximum area of potential disturbance of harbour porpoise in the Southern North Sea SAC during piling for the as piling for the Sizewell C Project is up to 967km^2 (based on 26km range). In-combination with the Harwich Haven approach channel deepening project, this equates to a total area of 1,004.6km^2 (or up to 7.9% of the SAC winter area), below the 20% threshold for disturbance on any given day. The seasonal average, based on the 12 days of piling at Sizewell C Project during the winter period, would be 0.5%, which is significantly lower than the 10% seasonal average threshold. Therefore, there would be	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			no significant displacement of harbour porpoise.	
Lowestoft Lake Lothing Third Crossing	31km.	The HRA concluded that, underwater noise generated by construction activities has the potential to disturb harbour porpoise. However, such works would be of temporary duration during construction only. Because of the large size of the European site which at its closest point to the site is 1.3km distant from the works, noise and vibration is not considered likely to disturb this species and would not give rise to their displacement from the site. Regardless, construction methods would follow the Statutory Nature Conservation Agency protocol for minimising the risk of harm to individual marine mammals occurring as a result of piling noise (Ref. 8.127).	No potential for any significant disturbance in-combination effect, due to the small scale and piling durations of the Sizewell C Project and Lowestoft Lake Lothing Third Crossing.	No.
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km to cable corridor. 103km to windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Norfolk Vanguard Offshore Wind Farm.	59km to cable corridor.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. Therefore, there is no	No potential for any in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
	83km to windfarm site.	potential for piling to take place at the same time as piling for the Sizewell C Project.		
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area	50km.	No information available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Piling for the Thanet Extension project is currently planned to take place between 2020 and 2023, therefore there is the potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance, based on 26km effective disturbance radius, and maximum overlap with the SAC winter area is up to 1,308km^2 and minimum overlap is 119km^2.	The maximum area of potential disturbance of harbour porpoise in the Southern North Sea SAC during piling for the as piling for the Sizewell C Project is up to 967km^2 (based on 26km range). In-combination with the Thanet Extension project, this equates to a total area of 2,275km^2 (or up to 17.9% of the SAC winter area), which does not exceed the 20% threshold for disturbance at any time. Taking into account the average overlap of the Thanet Extension project (713.5km^2) and maximum area for the Sizewell C Project, the area of potential disturbance would be 1,6805km^2 (13.2% of the SAC winter area). Therefore, the seasonal average, based on the 12 days of piling at Sizewell C Project during the winter period, would be 0.87%, which is significantly	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse In-Combination Effect?
			lower than the 10% seasonal average threshold. Therefore, there would be no significant displacement of harbour porpoise.	

Table 9.37 In-combination assessment of plans and projects with the potential to have increased collision risk vessels with harbour porpoise from the Southern North Sea SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
East Anglia ONE Offshore Wind Farm.	11km from cable corridor. 54km from offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
East Anglia ONE North Offshore Wind Farm.	11km from cable corridor. 48km from windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the construction of East Anglia ONE	The estimated number of harbour porpoise that could be at increased collision risk during the operation phase of the Sizewell C project is 4. Therefore, the potential in-combination collision risk with East Anglia ONE North project is 10 harbour porpoise (0.003% of North Sea MU). Therefore, there would be no	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
		North is 6 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	significant effects on the harbour porpoise population.	
East Anglia THREE Offshore Wind Farm.	11km from cable corridor. 78km from windfarm site.	Construction of the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for increased vessels during the construction of the Sizewell C Project. The estimated number of harbour porpoise that could be at increased collision risk during the construction of East Anglia THREE is 9 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	The estimated number of harbour porpoise that could be at increased collision risk during the construction phase of the Sizewell C project is 4. Therefore, the potential in-combination collision risk with East Anglia THREE project is 13 harbour porpoise (0.004% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No
East Anglia TWO Offshore Wind Farm.	11km from cable corridor. 31km from windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the construction of East Anglia TWO is 7 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	The estimated number of harbour porpoise that could be at increased collision risk during the operation phase of the Sizewell C project is 4. Therefore, the potential in-combination collision risk with East Anglia TWO project is 11 harbour porpoise (0.003% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No.
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (National Grid Ventures, 2018). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
Extension of Inner Gabbard East Disposal Site		There is the potential for increased vessels during the disposal activities associated with this project, and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the extension of Inner Gabbard East Disposal Site is 0.6 (based on 10% increased collision risk) (or 0.0002% of the North Sea Management Unit) (Ref. 8.125).	The estimated number of harbour porpoise that could be at increased collision risk at Sizewell C Project is 4. Therefore, the potential in-combination collision risk with the extension of Inner Gabbard East Disposal Site is 4.6 harbour porpoise (0.0001% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	
Galloper Offshore Wind Farm Operation and Maintenance	0km cable corridor. 31km windfarm site.	The Galloper Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Galloper Offshore Wind Farm Extension project	38km windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km from cable corridor. 27km from windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
Operations and Maintenance		maintenance activities during the construction and operation of the Sizewell C Project.	to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Harwich Haven approach channel deepening	41km.	There is the potential for increased vessels during the dredging and disposal activities associated with this project, and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the Harwich Haven approach channel deepening project is 0.4 (based on 10% increased collision risk) (Ref. 8.124).	The estimated number of harbour porpoise that could be at increased collision risk at Sizewell C Project is 4. Therefore, the potential in-combination collision risk with Harwich Haven approach channel deepening project is 4.4 harbour porpoise (0.001% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No
Lowestoft Flood Risk Management Project.	30km.	The scheme application has not yet been submitted. However, a Preliminary Environmental Impact Report is available. All potential effects to marine	No potential for in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
		mammals were scoped out of further assessment (Ref. 9.56).		
Lowestoft Lake Lothing Third Crossing	31km.	The HRA did not identify any increased collision risk to marine mammals (Ref. 8.127).	No potential for in-combination effect.	No.
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km from cable corridor. 103km from windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the construction of Norfolk Boreas is 32 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	The estimated number of harbour porpoise that could be at increased collision risk during the operation phase of the Sizewell C Project is 4. Therefore, the potential in-combination collision risk with Norfolk Boreas project is 36 harbour porpoise (0.01% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No.
Norfolk Vanguard Offshore Wind Farm.	59km from cable corridor. 83km from windfarm site.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the construction of Norfolk Vanguard is 26 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	The estimated number of harbour porpoise that could be at increased collision risk during the operation phase of the Sizewell C Project is 4. Therefore, the potential in-combination collision risk with Norfolk Vanguard project is 30 harbour porpoise (0.009% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effect In-Combination?
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area	50km.	No information available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Construction the Thanet Extension project is currently planned to take place between 2020 and 2023. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour porpoise that could be at increased collision risk during the construction of the Thanet Extension is 2 (based on area of wind farm site, SCANS-III density and 5% increased collision risk).	The estimated number of harbour porpoise that could be at increased collision risk during the operation phase of the Sizewell C Project is 4. Therefore, the potential in-combination collision risk with Thanet Extension project is 6 harbour porpoise (0.002% of North Sea Management Unit). Therefore, there would be no significant effects on the harbour porpoise population.	No

9.5.72. None of the projects included in this in-combination assessment for habitat loss have the potential to have significant in-combination effects on harbour porpoise, or their prey species, from the Southern North Sea SAC, during the construction and operation of the Sizewell C Project based on currently available information (**Table 9.35**). Therefore, there is no adverse effect on the integrity of the Southern North Sea SAC to arise in relation to its conservation objectives for harbour porpoise as a result of in-combination habitat loss effects.

Noise effects

9.5.73. The commitment to the Marine Mammal Mitigation Plan for UXO clearance and piling would reduce the risk of any PTS. No other activities were identified that could lead to PTS effects. As such, the proposed Sizewell C main development site would not contribute to any in-combination effects for PTS and, therefore, the in-combination assessment for underwater noise (below) only considers potential disturbance effects.

9.5.74. Piling for the BLF could take place in 2021, 2022 or 2023 and, therefore, at the same time as offshore wind farms being constructed during this period; which includes East Anglia THREE and the Thanet Extension, the Harwich Haven approach channel dredging project (expected to be undertaken from 2021 to 2022). and the extension of Inner Gabbard East Disposal Site.

9.5.75. The number of harbour porpoise that could be disturbed during piling for the Sizewell C Project and the in-combination projects as listed above is (based on the maximum area of overlap with the winter SAC area and SCANS-III density estimate; Ref. 6.127) 2,530. Therefore, up to 0.74% of the North Sea Management Unit could be temporary disturbed as a result of the potential in-combination underwater noise during the 12 days of piling for the Sizewell C Project.

9.5.76. The maximum area of potential disturbance for harbour porpoise in the Southern North Sea SAC winter area during piling for the Sizewell C Project (up to 967km^2), in-combination with the East Anglia THREE project (1,803km^2 for maximum overlap with of winter SAC area), the Thanet Extension project (1,308km^2 for maximum overlap with of winter SAC area), extension of the Inner Gabbard East disposal site (52.4km^2), and the Harwich Haven approach channel deepening project (37.6km^2), could equate to a total area of 4,168km^2. This represents up to 32.8% of the winter SAC area, which exceeds the 20% threshold at any one time. However, taking into account the average overlap of the East Anglia THREE project with the SAC area (1,048.6km^2), the average overlap of the Thanet Extension project with the SAC (713.5km^2), the maximum overlap of the Harwich Haven approach channel deepening project (37.6km^2), the extension of the Inner Gabbard

East disposal site (52.4km^2), and the maximum disturbance area for the Sizewell C Project (967km^2), the area of potential disturbance within the SAC would be 2,819km^2 (22.2% of the SAC winter area). Therefore, the seasonal average, based on the 12 days of piling for Sizewell C during the winter period, would be 1.46%, which is significantly lower than the 10% seasonal average threshold. Consequently, significant displacement of harbour porpoise is not predicted.

9.5.77. No other projects and plans would cause disturbance to harbour porpoise during the piling for the Sizewell C Project (**Table 9.36**).

9.5.78. Given that the maximum piling duration for the Sizewell C Project is expected to be 12 days, its contribution to any underwater noise in-combination effect would be limited. Taking into account this short duration, there is no potential for an adverse effect on the integrity of the Southern North Sea SAC to arise in relation to its conservation objectives for harbour porpoise due to in-combination effects related to disturbance from underwater noise.

Vessel movements

9.5.79. The estimated number of harbour porpoise that could be at increased collision risk during the construction and operation phases of the Sizewell C Project, in-combination with the increased collision risk at the East Anglia ONE North, East Anglia THREE, East Anglia TWO, Norfolk Boreas, Norfolk Vanguard and the Thanet Extension offshore wind farms, the extension of the Inner Gabbard East disposal site, and the Harwich Haven approach channel deepening project is 87 harbour porpoise (0.025% of North Sea Management Unit). Therefore, there is no potential for an adverse effect to arise on the integrity of the Southern North Sea SAC in relation to its conservation objectives for harbour porpoise as a result of in-combination effects due to increased collision risk with vessels (**Table 9.37**).

Impingement of prey

9.5.80. No other plans and projects screened in to this assessment have the potential to cause the impingement of harbour porpoise prey species and, therefore, this effect has not been considered further within this assessment.

f) Summary of effects (alone and in-combination)

9.5.81. **Table 9.38** summarises the potential effects of the Sizewell C Project on the Southern North Sea SAC alone and in-combination with other plans and projects.

Table 9.38: Summary of the potential effects of the Sizewell C Project on the Southern North Sea SAC alone and in-combination with other plans and projects

Potential Effect	Assessment Of Harbour Porpoise	Spatial And Temporal Assessment In Relation To The Winter Area	Potential For Adverse Effect On The Integrity Of The Site
Construction And Decommissioning Of The Sizewell C Project Alone			
Water quality effects – marine environment			
Potential for water quality effects due to construction related discharges on harbour porpoise and/or harbour porpoise prey species.	Up to 4.4 harbour porpoise (0.001% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.06%) at any one time and would not exceed 10% (up to 0.06%) of the duration of the winter season.	No
Direct habitat loss and direct / indirect habitat fragmentation			
Potential for temporary habitat change during construction.	0.006 harbour porpoise (0.000002% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.00007%) at any one time and would not exceed 10% (up to 0.00007%) of the duration of the winter season.	No
Underwater noise effects on species populations – harbour porpoise			
Permanent auditory injury (PTS) from a single strike of impact piling (200kJ) on harbour porpoise.	0.003 harbour porpoise (0.000001% of the Management Unit).	N/A	No A Marine Mammal Mitigation Plan for piling would be implemented
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of impact piling (200kJ) on harbour porpoise.	3.4 harbour porpoise (0.001% of the North Sea Management Unit).	N/A	No A Marine Mammal Mitigation Plan for piling would be implemented
Temporary auditory injury (TTS) from a single strike of impact piling (200kJ)	0.008 harbour porpoise (0.000002% of the North Sea	N/A	No

Potential Effect	Assessment Of Harbour Porpoise	Spatial And Temporal Assessment In Relation To The Winter Area	Potential For Adverse Effect On The Integrity Of The Site
on harbour porpoise.	Management Unit).		
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of impact piling (200 kJ) on harbour porpoise.	62 harbour porpoise (0.02% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.8%) at any one time and would not exceed 10% (up to 0.05%) of the duration of the winter season.	No
Disturbance of harbour porpoise from impact piling.	587 harbour porpoise (0.17% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 7.6%) at any one time and would not exceed 10% (up to 0.5%) of the duration of the winter season.	No
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of drilling on harbour porpoise.	0.006 harbour porpoise (0.000002% of the North Sea Management Unit).	N/A	No
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of dredging on harbour porpoise.	3.8 harbour porpoise (0.001% of the North Sea Management Unit).	N/A	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of drilling on harbour porpoise.	2.6 harbour porpoise (0.0008% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.03%) at any one time and would not exceed 10% (up to 0.03%) of the duration of the winter season.	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary	87 harbour porpoise (0.03% of the North Sea	Temporary displacement would not exceed 20% of the SAC winter area (up to 1.1%)	No

Potential Effect	Assessment Of Harbour Porpoise	Spatial And Temporal Assessment In Relation To The Winter Area	Potential For Adverse Effect On The Integrity Of The Site
model) of dredging on harbour porpoise.	Management Unit).	at any one time and would not exceed 10% (up to 1.1%) of the duration of the winter season.	
Permanent auditory injury (PTS) for effects on harbour porpoise from UXO clearance.	Up to 179 harbour porpoise (up to 0.05% of the North Sea Management Unit).	N/A	No A Marine Mammal Mitigation Plan for UXO clearance would be implemented
Disturbance effects on harbour porpoise prey species			
Behavioural response of harbour porpoise prey species to impact piling (200kJ).	6 harbour porpoise (0.002% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.08%) at any one time and would not exceed 10% (up to 0.01%) of the duration of the winter season.	No
Physical interaction between species and project infrastructure			
Increased collision risk of harbour porpoise and vessels.	4 harbour porpoise (0.001% of the North Sea Management Unit).	N/A	No
Operation of the Sizewell C Project alone			
Water quality effects – marine environment			
Potential for water quality effects due to operational chemical discharges on harbour porpoise and/or harbour porpoise prey species.	4.4 harbour porpoise (0.001% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.06%) at any one time and would not exceed 10% (up to 0.06%) of the duration of the winter season.	No
Potential for water quality effects due to operational thermal discharge on	136.3 harbour porpoise (0.04% of the North Sea	Temporary displacement would not exceed 20% of the SAC winter area (up to 1.8%)	No

Potential Effect	Assessment Of Harbour Porpoise	Spatial And Temporal Assessment In Relation To The Winter Area	Potential For Adverse Effect On The Integrity Of The Site
harbour porpoise and/or harbour porpoise prey species.	Management Unit).	at any one time and would not exceed 10% (up to 1.8%) of the duration of the winter season.	
Direct habitat loss and direct / indirect habitat fragmentation			
Potential for long-term habitat loss due to the introduction of hard structures.	0.01 harbour porpoise (0.000004% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.0002%) at any one time and would not exceed 10% (up to 0.0002%) of the duration of the winter season.	No
Physical interaction between species and project infrastructure			
Increased collision risk of harbour porpoise and vessels.	4 harbour porpoise (0.001% of the North Sea Management Unit).	N/A	No
Impingement of prey species	25 harbour porpoise (0.007% of the North Sea Management Unit reference population).	Temporary displacement would not exceed 20% of the SAC winter area (up to 0.3%) at any one time and would not exceed 10% (up to 0.3%) of the duration of the winter season.	No
In-combination effects			
Water quality effects	476 harbour porpoise (0.12% of the North Sea Management Unit).	Temporary displacement would not exceed 20% of the SAC winter area (up to 6.2%) at any one time and would not exceed 10% (up to 6.2%) of the duration of the winter season.	No
Habitat loss	33.3 harbour porpoise	Displacement would not exceed 20% of the SAC winter area (up to 0.4%)	No

Potential Effect	Assessment Of Harbour Porpoise	Spatial And Temporal Assessment In Relation To The Winter Area	Potential For Adverse Effect On The Integrity Of The Site
	(0.01% of the North Sea Management Unit).	at any one time and would not exceed 10% (up to 0.4%) of the duration of the winter season.	
Disturbance from underwater noise	2,530 harbour porpoise (0.74% of the North Sea Management Unit).	Maximum total area of potential disturbance could be up to 32.8% of the SAC winter area, however, the seasonal average for the winter period would only be 1.46% for the 12 piling days for the Sizewell C Project.	No
Increased collision risk with vessels.	87 harbour porpoise (0.025% of the North Sea Management Unit).	N/A	No

g) Conclusions

9.5.82. There is no potential for any adverse effects on the integrity of the Southern North Sea SAC to arise due to the Sizewell C Project either alone or in-combination with other plans or projects, in relation to the conservation objectives for harbour porpoise.

9.6 Assessment of effects: The Wash and North Norfolk Coast SAC

a) Water quality effects – marine environment

i. Construction and decommissioning

Potential for water quality effects due to construction and decommissioning phase discharges on foraging harbour seal

9.6.1. The change in water quality that would have the largest area of effect on foraging harbour seal during the construction phase would be from the total residual oxidant plume for Sizewell B and C in-combination, predicted to affect an area of 7.26km^2. On a precautionary basis, the number of foraging harbour seal that could be present (and the percentage of the reference population) within this area of effect has been estimated. This is 0.3 individuals; up to 0.006% of the reference population (or up to 0.008% of the

estimated Wash and North Norfolk Coast SAC population). Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted for the Sizewell C Project construction and decommissioning phase discharges in relation to the conservation objective for harbour seal.

Potential for water quality effects due to construction and decommissioning phase discharges on foraging harbour seal prey species

9.6.2. As the maximum predicted impact area for any increased suspended sediments and contaminant re-mobilisation (7.26km^2) is the same for foraging harbour seal as it is for their prey, there would be no additional impacts on individuals as a result of the effects of any changes to water quality on prey species. Consequently, an indirect adverse effect on the integrity of The Wash and North Norfolk Coast SAC is not predicted for the Sizewell C Project construction and decommissioning phase discharges in relation to the conservation objective for harbour seal prey species.

ii. Operation

Potential for water quality effects due to chemical discharges on foraging harbour seal

9.6.3. The maximum area of effect predicted for changes to water quality due to chemical discharges during operation is 7.26km^2 (for the total residual oxidant plume associated with both Sizewell B and Sizewell C at the surface as detailed in section 9.3 b i of this report. Therefore, as a worst-case, the number of foraging harbour seal that could be affected by changes in water quality due to the total residual oxidant discharge is up to 0.3 individuals; which represents 0.006% of the reference population (or 0.008% of The Wash and North Norfolk Coast SAC population).

9.6.4. The total residual oxidant plume is not expected to have any significant effect on foraging harbour seals and this, alongside the very small percentage of the reference population that could be exposed to the area of predicted effect in marine water quality, means that there is no potential for an effect on foraging harbour seals to arise over the operational lifetime of Sizewell C. Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted for Sizewell C operational chemical discharges in relation to the conservation objectives for harbour seal

Potential for water quality effects due to chemical discharges on foraging harbour seal prey species

9.6.5. The potential effect of the changes to water quality on prey species for foraging harbour seal would not extend beyond the maximum predicted effect

areas as described for harbour seals themselves. Consequently, there would be no additional impact as a result of the effects on prey species and indirect adverse effect on the integrity of The Wash and North Norfolk Coast SAC is not predicted for Sizewell C operational chemical discharges in relation to the conservation objective for harbour seal prey species.

Potential for water quality effects due to thermal discharge on foraging harbour seal

9.6.6. As discussed in section 9.3 b i of this report, marine mammals are well adapted to changing water temperatures. Due to this, it can be concluded that the change in ambient temperatures due to the thermal discharge through operation would have no effect on foraging harbour seal in the area.

9.6.7. However, on a very precautionary basis, the number of foraging harbour seal that could be present in the maximum predicted surface area for a 2ºC maximum allowed concentration rise in temperature (an area of 224.6km^2) has been estimated as 8.8, which represents up to 0.18% of the reference population (or 0.24% of The Wash and North Norfolk Coast SAC site population). Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted for Sizewell C operational thermal discharges in relation to the conservation objectives for harbour seal.

Potential for water quality effects due to operational thermal discharge on foraging harbour seal prey species

9.6.8. As a worst case, it can be assumed that all harbour seal prey species would be displaced from the area within the 2°C maximum allowed concentration contour, but no fatalities of prey species are expected, and that all prey would be available to individuals outside of the 2°C maximum allowed concentration contour.

9.6.9. However, as the maximum predicted impact area for any changes in water temperature would be the same for foraging harbour seal and their prey, there would be no additional effects on individuals as a result of the effects of any changes in water temperature on prey species. Consequently, an indirect adverse effect on the integrity of The Wash and North Norfolk Coast SAC is not predicted for the Sizewell C thermal discharge in relation to the conservation objective for harbour seal prey species.

b) Underwater noise effects on species populations

i. Construction and decommissioning

Impact piling effects on harbour seal

Permanent auditory injury (PTS) from impact piling

9.6.10. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for PTS in harbour seal, based on the National Oceanic and Atmospheric Administration (Ref. 9.14) criteria for SPL_{peak} and PTS from weighted sound exposure levels (SEL_{cum}) are outlined in **Table 9.8**.

9.6.11. The number of foraging harbour seal that could be at risk of PTS onset as a result of Sizewell C impact piling, prior to any mitigation, is outlined in **Table 9.39**. The estimated maximum number of harbour seal that could be at risk of PTS (SPL_{peak}) as a result of a single strike of the worst-case hammer energy of 200kJ is 0.00001 individuals (0.0000002% of the South-East England Management Unit reference population; 0.0000003% of The Wash and North Norfolk Coast SAC population). The maximum number of harbour seal that could be at risk of PTS from cumulative exposure, based on the stationary model, is up to 0.008 individuals (up to 0.0002% of the South-East England Management Unit reference population; 0.0002% of The Wash and North Norfolk Coast SAC population). However, based on the more realistic fleeing model for cumulative PTS, there would be no effect.

Table 9.39: Maximum predicted effect ranges areas for any PTS for harbour seal from impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Seal
Impact piling with 90kJ hammer	PTS 218 SPL_{peak}	0.0001km^2	0.000004 harbour seal (0.0000001% of the South-East England Management Unit reference population; 0.0000001% of The Wash count).
	PTS 185 SEL_{cum} Stationary model	0.1km^2	0.004 harbour seal (0.00008% of the South-East England Management Unit reference population; 0.0001% of The Wash count).
	PTS 185 SEL_{cum} Fleeing model	No effect	0
	PTS 218 SPL_{peak}	0.00025km^2	0.00001 harbour seal (0.0000002% of the South-East England Management Unit

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Seal
Impact piling with 200kJ hammer			reference population; 0.0000003% of The Wash count).
	PTS 185 SEL_{cum} Stationary model	0.2km^2	0.008 harbour seal (0.0002% of the South-East England Management Unit reference population; 0.0002% of The Wash count).
	PTS 185 SEL_{cum} Fleeing model	No effect	0

9.6.12. The Marine Mammal Mitigation Plan for impact piling associated with the Sizewell C Project would reduce the risk of PTS to harbour seal. Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from permanent auditory injury due to impact piling in relation to the conservation objective for harbour seal.

Temporary auditory injury (TTS) and fleeing response from impact piling

9.6.13. The underwater noise modelling results for the maximum predicted effect ranges (and areas) for TTS and fleeing response in foraging harbour seal, based on the National Oceanic and Atmospheric Administration (National Marine Fisheries Service, 2018) criteria for unweighted peak sound pressure levels (SPL_{peak}), and TTS from weighted sound exposure levels (SEL_{cum}), are outlined in **Table 9.11**.

9.6.14. The maximum number of foraging harbour seal that could be at risk of TTS onset, or a fleeing response, as a result of impact piling for Sizewell C, prior to any mitigation, is outlined in **Table 9.40**. The estimated maximum number of harbour seal that could be at risk of TTS or fleeing response (SPL_{peak}) as a result of a single strike of the worst-case hammer energy of 200kJ is 0.00003 individuals (0.0000006% of the South-East England Management Unit reference population; 0.0000009% of The Wash and North Norfolk Coast SAC population). The maximum number of harbour seal that could be at risk of TTS from cumulative exposure, based on the stationary model, is up to 0.4 individuals (up to 0.008% of the South-East England Management Unit reference population; 0.01% of The Wash and North Norfolk Coast SAC population). However, based on the more realistic fleeing model for cumulative TTS, there would be no effect.

Table 9.40: Maximum predicted effect areas for TTS and fleeing response for foraging harbour seal for impact piling

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Seal
Impact piling with 90kJ hammer	TTS 212 SPL_{peak}	0.0003km^2	0.00001 harbour seal (0.0000002% of the South-East England Management Unit reference population; 0.0000003% of The Wash count).
	TTS 170 SEL_{cum} Stationary model	4.3km^2	0.2 harbour seal (0.003% of the South-East England Management Unit reference population; 0.005% of The Wash count).
	TTS 170 SEL_{cum} Fleeing model	No effect	0
Impact piling with 200kJ hammer	TTS 212 SPL_{peak}	0.0008km^2	0.00003 harbour seal (0.0000006% of the South-East England Management Unit reference population; 0.0000009% of The Wash count).
	TTS 170 SEL_{cum} Stationary model	10.6km^2	0.4 harbour seal (0.008% of the South-East England Management Unit reference population; 0.01% of The Wash count).
	TTS 170 SEL_{cum} Fleeing model	No effect	0

9.6.15. Taking into account the temporary disturbance and intermittent duration of underwater noise from piling (with only 12 piles to be installed underwater), along with the relatively low and infrequent number of foraging harbour seal in and around the Sizewell C Project, there is unlikely to be any significant disturbance or barrier effects for foraging individuals. Therefore, under these circumstances, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from temporary auditory injury from impact piling for the Sizewell C Project in relation to the conservation objectives for harbour seal.

Disturbance from impact piling

9.6.16. The assessment of TTS on foraging harbour seal, as outlined above, is considered to also show the number of individuals that could exhibit a fleeing response due to the impact piling for Sizewell C.

9.6.17. Data from tagged harbour seals in The Wash indicate that seals were not excluded from the vicinity of Dudgeon Offshore Windfarm during the construction phase in general, but that there was clear evidence of avoidance during pile driving, with significantly reduced levels of seal activity at ranges up to 25km from piling sites (Ref. 9.22; Ref. 6.118, Ref. 6.116). Therefore, a 26km disturbance range (in line with the assessments undertaken for harbour porpoise and as a worst-case) has been used to assess the number of harbour seal that could be disturbed as a result of impact piling for the Sizewell C Project (**Table 9.41**).

Table 9.41: Maximum predicted effect ranges (and areas) for TTS and fleeing response for foraging harbour seal for impact piling

Effect	Maximum Area Of Effect	Assessment For Harbour Seal
Disturbance from impact piling	1,100.66km^2	43 harbour seal (0.87% of the South-East England Management Unit reference population; 1.19% of The Wash count).

9.6.18. For the purpose of this assessment, the duration of potential disturbance for impact piling at the BLF is assumed to be 12 days (based on up one pile a day; albeit up to five piles could be installed in a 24-hour period). In addition, it is highly unlikely that all foraging harbour seal affected by the construction of the Sizewell C Project would be from The Wash and North Norfolk Coast SAC. There would be no direct effect on or overlap with site itself.

9.6.19. Taking into account the temporary disturbance and intermittent duration of underwater noise from piling, along with the relatively low and infrequent number of harbour seal predicted to be in and around the Sizewell C Project, there is unlikely to be any significant disturbance to or barrier effects for foraging harbour seal. Therefore, under these circumstances, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from disturbance during impact piling at the Sizewell C Project in relation to the conservation objectives for harbour seal.

Drilling and dredging activity effects on harbour seal

Permanent auditory injury (PTS) from drilling and dredging activities

9.6.20. The number of foraging harbour seal that could be at risk of PTS onset as a result of drilling for the Sizewell C Project is outlined in **Table 9.42**. The

estimated maximum number of harbour seal that could be at risk of PTS (SEL_{cum}) as a result of drilling, based on the stationary model, is 0.00008 individuals (0.000002% of the South-East England Management Unit reference population; 0.000002% of The Wash and North Norfolk Coast SAC population).

Table 9.42: Maximum predicted effect areas for PTS for harbour seal from drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Seal
Drilling activities	PTS 201 SEL_{cum}	0.002km^2	0.00008 harbour seal (0.000002% of the South-East England Management Unit reference population; 0.000002% of The Wash count).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	PTS 201 SEL_{cum}	0.05km^2	0.002 harbour seal (0.00004% of the South-East England Management Unit reference population; 0.00005% of The Wash count).

9.6.21. The maximum number of harbour seal that could be at risk of PTS from cumulative exposure of the dredging works, based on the stationary model, is up to 0.002 individuals (up to 0.00004% of the South-East England Management Unit reference population; 0.00005% of The Wash and North Norfolk Coast SAC population) (**Table 9.42**).

9.6.22. The noise levels predicted to arise from drilling and dredging activities were too low to generate instantaneous auditory effects in harbour seal. The fleeing model for cumulative PTS similarly predicted no PTS effect areas for harbour seal from drilling or dredging activities.

9.6.23. The results of the underwater noise modelling show that foraging harbour seal would have to remain within close proximity of the drilling (less than 25m) and the dredging activities (less than 111m) for a period of 24 hours to be at risk of PTS onset (**Table 9.9**). Given this, and the low number of foraging harbour seal within the vicinity of the Sizewell C Project, the risk of permanent auditory injury arising is unlikely. Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from permanent auditory injury from construction or decommissioning drilling and dredging in relation to the conservation objectives for harbour seal.

Temporary auditory injury (TTS) from drilling and dredging activities

9.6.24. The number of foraging harbour seal that could be at risk of TTS onset or a fleeing response as a result of drilling for the Sizewell C Project is outlined in **Table 9.43**. The estimated maximum number of harbour seal that could be at risk of TTS from cumulative exposure as a result of drilling activities, based on the stationary model, is up to 0.00008 individuals (0.000002% of the South-East England Management Unit reference population; 0.000002% of The Wash and North Norfolk Coast SAC population).

9.6.25. The estimated maximum number of harbour seal that could be at risk of TTS or fleeing response from cumulative exposure from dredging activities, based on the stationary model, is up to 0.6 individuals (up to 0.01% of the South-East England Management Unit reference population; 0.02% of The Wash and North Norfolk Coast SAC population) (**Table 9.43**).

Table 9.43: Maximum predicted effect areas for TTS and fleeing response for foraging harbour seal for drilling and dredging activities

Effect	Criteria And Threshold	Maximum Area Of Effect	Assessment For Harbour Seal
Drilling activities	TTS 181 SEL_{cum}	0.002km^2	0.00008 harbour seal (0.000002% of the South-East England Management Unit reference population; 0.000002% of The Wash count).
Dredging activities (worst case of concurrent dredging at the BLF and south intake)	TTS 181 SEL_{cum}	14.11km^2	0.6 harbour seal (0.01% of the South-East England Management Unit reference population; 0.02% of The Wash count).

9.6.26. Taking into account the temporary disturbance and intermittent duration of underwater noise from both dredging and drilling activities, along with the relatively low and infrequent number of foraging harbour seal in and around the Sizewell C Project, there is unlikely to be any significant disturbance or barrier effects for foraging individuals. Therefore, under these circumstances, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted due to temporary auditory injury from construction or decommissioning drilling and dredging of the Sizewell C Project in relation to the conservation objectives for harbour seal.

Underwater noise effects for UXO clearance on harbour seal

9.6.27. On a very precautionary basis, the hypothetical UXO detonations for an explosive charge mass of 500lb have an impact area for instantaneous PTS of up to 11km^2, which could affect 0.4 harbour seal (up to 0.009% of the SE England MU reference population; 0.01% of The Wash and North Norfolk Coast SAC population).

9.6.28. Mitigation would be implemented for any UXO clearance, following the latest guidance and requirements. The Marine Mammal Mitigation Plan for any UXO clearance at the Sizewell C Project would reduce the risk of PTS to harbour seal.

9.6.29. Therefore, no direct adverse effects on the integrity of The Wash and North Norfolk Coast SAC are predicted from permanent auditory injury due to any UXO clearance at the Sizewell C Project in relation to the conservation objectives for harbour seal.

Underwater noise effects on prey species

9.6.30. As a worst-case, the potential effect of changes to prey availability for foraging harbour seal as a result of underwater noise effects has been based on the largest of the areas of effect that have been predicted for fish species. The underwater noise modelling shows that the largest area of effect on prey species is for a behavioural response in hearing specialist species as a result of the impact piling at the BLF jetty, fenders and dolphins. The area of effect is predicted to be up to 9.68km^2.

9.6.31. The number of foraging harbour seal that could be affected by a change in prey species availability is 0.4 individuals. This represents 0.008% of the South-East England Management Unit or, 0.001% of The Wash and North Norfolk Coast SAC count. However, it is highly unlikely that all foraging harbour seal in the vicinity of the Sizewell C main development site would be from The Wash and North Norfolk Coast SAC. In addition, there would be no direct effect or overlap with The Wash and North Norfolk Coast SAC area.

9.6.32. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat would typically represent a small percentage of the potential habitat in the surrounding area. Consequently, no indirect adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from disturbance effects from the construction or decommissioning of the Sizewell C Project in relation to the conservation objective for harbour seal prey species.

c) Physical interaction between species and project infrastructure

i. Construction and decommissioning

Increased collision risk of harbour seal and vessels

9.6.33. On a precautionary basis, the number of foraging harbour seal that could be at increased collision risk with vessels during construction has been assessed based on 5% of the number of animals that could be present in the study area (an area of 6.5 km^2) as seen in section 9.3b)v of this report.

9.6.34. As outlined in **Table 9.44**, 0.01 harbour seal (or 0.0002% of the South-East England Management Unit reference population; 0.0003% of The Wash and North Norfolk Coast SAC population) could be at increased risk of collision with vessels within the Sizewell C Project. However, it is highly unlikely that foraging harbour seal present in vicinity of the main development site would be at increased collision risk with vessels, especially taking into account the relatively small increase in vessel movements (180 deliveries between 31st March and 31st October) compared to existing vessel movements in the area.

Table 9.44: Number of harbour seal at potential increased vessel collision risk

Effect	Area Of Effect	Assessment Of Harbour Seal
Increased collision risk (5% of harbour seal at increased risk)	6.5km^2	0.01 harbour seal (0.0002% of the South-East England Management Unit reference population; 0.0003% of The Wash count).

9.6.35. In addition, based on the assumption that harbour seal would be disturbed from the area as a result of underwater noise from construction activities and vessels, there should be no potential for increased collision risk.

9.6.36. Therefore, under these circumstances, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from vessel collision risk during construction or decommissioning of the Sizewell C Project in relation to the conservation objectives for harbour seal.

ii. Operation

Increased collision risk of harbour seal and vessels

9.6.37. Through the operational phase of the Sizewell C Project, occasional deliveries of AILs may use the BLF, approximately every 5 to 10 years. Given the anticipated lifetime of the Sizewell C Project (of 60 years), this will equate to between 6 and 12 deliveries at the BLF through the operational phase.

9.6.38. For this assessment, it is assumed that the potential effects would be the same as for construction effects as outlined above (**Table 9.44**); although the number of deliveries would be significantly reduced (6 to 12 in total). Therefore, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from vessel collision risk during the operation of the Sizewell C Project in relation to the conservation objectives for harbour seal.

Impingement of prey

9.6.39. There is the potential for harbour seal prey species to be impinged through the operation of Sizewell C. As discussed in section 6.4 c of this report, the principal prey species of the harbour seal are sandeel, cod, haddock, whiting, herring and sprat. The only species expected to be impinged are cod, whiting, herring and sprat. The impingement assessment (Ref. 8.5) reports that, with the mitigation of the low velocity side entry intake heads and the FRR, there would be a negligible effect on all harbour seal prey species' populations; with less than 1% of the available prey populations being affected.

9.6.40. However, on a precautionary basis, an assessment has been made of the number of harbour seal that could be displaced by the loss of prey availability through impingement. This assessment is based on the precautionary assumption that all harbour seal prey species would be lost within close proximity of the intake tunnels. The area of effect has been defined as the Greater Sizewell Bay; a total area of 4,120ha (or 41.2km^2). However, not all prey species within that area would be lost and the effect would be temporary, as harbour seal would be able to move to a nearby area where prey species are available.

9.6.41. As outlined in **Table 9.45**, up to 1.6 harbour seal (or 0.03% of the South-East England Management Unit reference population; 0.04% of The Wash and Blakeney Point count) could be displaced from foraging with the Greater Sizewell Bay due to loss of prey availability. This is precautionary, as it is highly unlikely that changes in the prey resource would occur over the entire area and, is more likely, that the effect would be restricted to directly around the intake tunnels.

Table 9.45: Number of harbour seal potentially displaced as a result of loss of prey availability

Effect	Maximum area of effect	Assessment of harbour seal
Loss of prey availability	41.2km^2 (Greater Sizewell Bay)	1.6 harbour seal (0.03% of the South-East England Management Unit reference population; 0.04% of The Wash and Blakeney Point count)

9.6.42. Therefore, under these circumstances, no direct adverse effect on the integrity of The Wash and North Norfolk Coast SAC is predicted from the loss of prey availability during operation of the Sizewell C Project in relation to the conservation objectives for foraging harbour seal.

d) In-combination effects

Water quality effects

9.6.43. None of the projects included in the in-combination assessment for changes to water quality (**Table 9.46**:), based on currently available information, have the potential to have in-combination effects on foraging harbour seal, or their prey species, from The Wash and North Norfolk Coast SAC, during the construction and operation of the Sizewell C Project. Therefore, there is no potential for an adverse effect on the integrity of The Wash and North Norfolk Coast SAC to arise in relation to its conservation objectives for harbour seal as a result of in-combination water quality effects.

Noise effects

9.6.44. Commitment to the Marine Mammal Mitigation Plan for UXO clearance and for piling would reduce the risk of PTS, and no other activities were identified that could lead to PTS effects on harbour seal. As such, the proposed Sizewell C Project would not contribute to any PTS in-combination effects, therefore, the in-combination assessment for underwater noise only considers potential disturbance effects.

9.6.45. Piling of the BLF could take place in either 2021, 2022 or 2023. Therefore, there is the potential for piling to take place at the same time as offshore wind farms being constructed during this period, which include East Anglia THREE and the Thanet Extension, as well as the Harwich Haven approach channel deepening project and the extension of the Inner Gabbard East disposal site. The maximum number of harbour seal that could be temporary disturbed during piling for Sizewell C above projects is up to 186 harbour seal (3.75% of the South-East England Management Unit; or 5.2% of The Wash count). All other projects and plans would not have significant disturbance effects on foraging harbour seal (**Table 9.47**:).

9.6.46. The maximum piling duration for the Sizewell C Project is expected to be 12 days. Therefore, its contribution to in-combinations effects associated with underwater noise would be limited and an adverse effect on the integrity of The Wash and North Norfolk Coast SAC is not predicted in relation to its conservation objectives for foraging harbour seal.

Vessel movements

9.6.47. The estimated number of harbour seal that could be at increased collision risk during the construction and operation of Sizewell C, in-combination with the increased collision risk associated with the East Anglia ONE North, East Anglia THREE, East Anglia TWO, Norfolk Boreas, Norfolk Vanguard and the Thanet Extension offshore wind farms, as well as the Harwich Haven approach channel deepening project, and the extension of the Inner Gabbard East disposal site, is 0.44 harbour seal (0.009% of the South-East England Management Unit; or 0.01% of the Wash Estuary count) (**Table 9.48**:). Consequently, an adverse effect on the integrity of The Wash and North Norfolk Coast SAC is not predicted in relation to its conservation objectives for harbour seal in this context.

Impingement of prey

9.6.48. No other screened in projects have the potential to cause the impingement of harbour seal prey species. Therefore, this effect was not considered further.

Table 9.46: In-combination assessment of plans and projects with the potential to affect foraging harbour seal from The Wash and North Norfolk Coast SAC through changes to water quality

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse Effects In-Combination?
East Anglia ONE Offshore Wind Farm.	11km cable corridor. 54km offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and decommissioning phases of the project. No water quality effects were assessed as no potential impacts were identified for any marine mammal species during operation and decommissioning (Ref. 9.45).	No potential for in-combination effect.	No.
East Anglia ONE North Offshore Wind Farm.	11km cable corridor. 48km windfarm site	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan.	No potential for in-combination effect.	No.
East Anglia THREE Offshore Wind Farm.	11km cable corridor. 78km windfarm site.	No water quality effects were identified for marine mammals and were therefore not assessed, and all effects to prey species were assessed as being negligible or minor adverse (Ref. 9.46).	Given the distance to the project from the main development site and the very low significance of effect, it is considered that there is no potential for in-combination effect.	No.
East Anglia TWO Offshore Wind Farm.	11km cable corridor. 31km windfarm site.	Through the construction, operation and decommissioning phases of the project, there would be no potential for adverse effects from water quality due to the implementation of the Project Environmental Management Plan.	No potential for in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse Effects In-Combination?
Eurolink.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Galloper Offshore Wind Farm Extension project.	38km windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km cable corridor. 27km windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance.	64km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.48).	No potential for in-combination effect.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance.	58km.	The operation and maintenance of this project will cause no effect on the water quality (Ref. 9.49).	No potential for in-combination effect.	No.
Hamilton Dock, Lowestoft – Pontoon reconfiguration.	30km.	This project will have no effect on marine mammals or water quality (Ref. 9.50).	No potential for in-combination effect.	No.
Lowestoft Lake Lothing Third Crossing.	31km.	There is the potential for water pollution from the project to affect the Southern North SAC given its distance (1.3km), however, mitigation measures that will be implemented during the	No potential for in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse Effects In-Combination?
		construction, operation and decommissioning of the project will have no effect on the integrity on the site (Ref. 8.127).		
Nautilus.	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Vanguard Offshore Wind Farm.	59km cable corridor. 83km windfarm site.	During construction and decommissioning, the risk of accidental release of will be mitigated through contingency planning for the control of pollution. Modelling indicates that the majority of the sediment released during seabed preparation would be coarse and would fall within minutes/ tens of minutes) to the seabed as a highly turbid dynamic plume immediately upon its discharge. Taking into account the low sensitivity of marine mammals to changes in water quality and the low magnitude temporary impact, the impact significance for any changes to water quality is negligible (Ref. 8.134).	Given the distance to the SZC project, and the small areas of effect for both projects, there is no potential for in-combination effect.	No.
Proposed aggregate extraction sites in the study area.	47km.	No assessment of effects has been completed to date, however, the Scoping Report for the Thames D area suggests that there may be the potential for water quality effects on marine mammals within the Southern North Sea SAC which will be assessed further (Ref. 9.52).	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area.	50km.	No information available.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	Potential For In-Combination Effect With Sizewell C?	Potential For Adverse Effects In-Combination?
Thanet Extension Offshore Wind Farm.	82km.	Through the construction, operation and decommissioning phases of the project, it has been determined that there is no potential for adverse effect due to the implementation of the Project Environmental Management Plan to control any accidental pollution releases (Ref. 9.55). No other water quality effects have been assessed for this project.	No potential for in-combination effect.	No

Table 9.47: In-combination assessment of plans and projects with the potential to have underwater noise disturbance effects on foraging harbour seal from The Wash and North Norfolk Coast SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
East Anglia ONE Offshore Wind Farm.	11km to cable corridor. 54km from offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
East Anglia ONE North Offshore Wind Farm.	11km from cable corridor. 48km from windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
East Anglia THREE Offshore Wind Farm.	11km from cable corridor. 78km from windfarm site.	Piling for the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance (based on 26km effective disturbance radius) is 2,124km^2. Based on the harbour seal density for the East Anglia THREE site (0.003/km^2), the maximum number of harbour seal that could potentially be disturbed is 6.4.	The maximum number of harbour seal that could be disturbed during piling of the Sizewell C Project is 43. In-combination with the East Anglia THREE project up to 49.4 harbour seal (1% of South-East Management Unit; or 1.4% of The Wash count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging harbour seal.	No
East Anglia TWO Offshore Wind Farm.	11km from cable corridor. 31km from windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Extension of Inner Gabbard East Disposal Site		There is the potential for disposal activities to cause disturbance to harbour seal through underwater noise. Disturbance effects could impact upon harbour seal up to 1km from the disposal site, potentially affecting 3 harbour seal (or 0.05% of the South-East England Management Unit) (Ref. 8.125).	The maximum number of harbour seal that could be disturbed during piling of the Sizewell C Project is 43. In-combination with the extension of Inner Gabbard East Disposal site, up to 46 harbour seal (0.9% of management unit; or 1.3% of The Wash count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging harbour seal.	

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
Galloper Offshore Wind Farm Operation and Maintenance	0km to cable corridor. 31km to windfarm site.	The Galloper Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
Galloper Offshore Wind Farm Extension project	38km windfarm site.	No information available.	In-combination assessment not possible.	No.
Greater Gabbard Extension Offshore Wind Farm.	0km from cable corridor. 27km from windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and piling of the Sizewell C Project.	Underwater noise during any operational and maintenance activities would be limited to a small area around the activity and would be temporary, for a short duration. The potential for any significant disturbance is unlikely and therefore taking into account the very short duration of impact piling for the Sizewell C Project (12 days) there is no potential for any significant disturbance in-combination effects.	No.
Harwich Haven approach channel deepening	41km.	There is the potential for dredging activities to cause disturbance to harbour seal through underwater noise. Disturbance effects could impact upon harbour seal up to 1km from the dredging activities, potentially affecting 6 harbour seal (or 0.1% of the South-East England Management Unit) (Ref. 8.124).	The maximum number of harbour seal that could be disturbed during piling of the Sizewell C Project is 43. In-combination with the Harwich Haven approach channel deepening project up to 49 harbour seal (0.99% of South-East Management Unit; or 1.4% of The Wash count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging harbour seal.	No
Lowestoft Lake Lothing Third Crossing	31km.	The HRA concluded that, underwater noise generated by construction activities has the potential to disturb marine mammals. However, such works would be of temporary duration during construction only. Because of the large size of the European site which at its closest point to the site is 1.3km distant from the works, noise and vibration is not considered likely to disturb this species and would not give rise to their	No potential for any significant disturbance in-combination effect, due to the small scale and piling durations of the Sizewell C Project and Lowestoft Lake Lothing Third Crossing.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
		displacement from the site. Regardless, construction methods would follow the Statutory Nature Conservation Agency protocol for minimising the risk of harm to individual marine mammals occurring as a result of piling noise (Ref. 8.127).		
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km from cable corridor. 103km from windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Norfolk Vanguard Offshore Wind Farm.	59km from cable corridor. 83 km from windfarm site.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. Therefore, there is no potential for piling to take place at the same time as piling for the Sizewell C Project.	No potential for any in-combination effect.	No.
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Sizewell B nuclear power station decommissioning.	0km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Piling for the Thanet Extension project is currently planned to take place between 2020 and 2023, therefore there is the	The maximum number of harbour seal that could be disturbed during piling of the Sizewell C Project is 43. In-combination with the Thanet Extension project up to 170.4	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
		potential for piling to occur at the same time as piling for the Sizewell C Project. The maximum potential area for disturbance, based on 26km effective disturbance radius, is 2,124km^2. The maximum number of harbour seal that could potentially be disturbed is up to 127.4 (based on density estimate of 0.06/km^2; Ref. 4.5).	harbour seal (3.4% of South-East Management Unit; or 4.7% of The Wash count) could be temporary disturbed for 12 days during piling at the Sizewell C Project. Therefore, there would be no significant disturbance of foraging harbour seal.	

Table 9.48: In-combination assessment of plans and projects with the potential to have increased collision risk vessels with foraging harbour seal from The Wash and North Norfolk Coast SAC

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
East Anglia ONE Offshore Wind Farm.	11km from cable corridor. 54km from offshore wind farm site.	The East Anglia ONE project is currently under construction and is anticipated to be completed by the end of 2020. Therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
East Anglia ONE North Offshore Wind Farm.	11km from cable corridor. 48km from windfarm site.	The East Anglia ONE North project is currently due to be constructed in 2026-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour seal that could be at increased	The estimated number of harbour seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
		collision risk during the construction of East Anglia ONE North is 0.004 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	ONE North project is 0.014 harbour seal (0.0003% of South-East England Management Unit; or 0.0004% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	
East Anglia THREE Offshore Wind Farm.	11km from cable corridor. 78km from windfarm site.	Construction of the East Anglia THREE project is currently planned to take place between 2020 and 2022, therefore there is the potential for increased vessels during the construction of the Sizewell C Project. The estimated number of harbour seal that could be at increased collision risk during the construction of East Anglia THREE is 0.015 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of harbour seal that could be at increased collision risk during the construction phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia THREE project is 0.025 harbour seal (0.0005% of South-East England Management Unit; or 0.0007% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	No
East Anglia TWO Offshore Wind Farm.	11km from cable corridor. 31km from windfarm site.	The East Anglia TWO project is currently due to be constructed in 2025-2027. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour seal that could be at increased collision risk during the construction of East Anglia TWO is 0.004 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of harbour seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with East Anglia TWO project is 0.014 harbour seal (0.0003% of South-East England Management Unit; or 0.0004% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
Eurolink	1.6km (nearest possible landfall).	Project planned to be fully operational by 2030 (Ref. 9.47). Planning submission not yet completed and no information currently available on the project.	In-combination assessment not possible.	No.
Extension of Inner Gabbard East Disposal Site		There is the potential for disposal activities to increase the risk of collision of harbour seal with vessels. It was assessed that up to 0.05 harbour seal (based on 90% avoidance) could be at increased risk (or 0.001% of the South-East England Management Unit) (Ref. 8.125).	The estimated number of harbour seal that could be at increased collision risk during the construction phase of the Sizewell C Project is 0.01. Therefore, the potential in-combination collision risk with the extension of Inner Gabbard East Disposal Site is 0.06 harbour seal (0.001% of South-East England Management Unit; or 0.002% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	
Galloper Offshore Wind Farm Operation and Maintenance	0km cable corridor. 31km windfarm site.	The Galloper Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Galloper Offshore Wind Farm Extension project	38km windfarm site.	No information available.	In-combination assessment not possible.	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
Greater Gabbard Extension Offshore Wind Farm.	0km from cable corridor. 27km from windfarm site.	No information available.	In-combination assessment not possible.	No.
Gunfleet Sands 1 & 2 Offshore Wind Farm Operations and Maintenance	64km.	The Gunfleet Sands 1 & 2 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Gunfleet Sands 3 Offshore Wind Farm Operations and Maintenance	58km.	The Gunfleet Sands 3 Offshore Wind Farm is currently operational, therefore, the only anticipated in-combination effects will be from the operation and maintenance activities during the construction and operation of the Sizewell C Project.	Any increase in vessel movements during the operation and maintenance of offshore windfarms would be relatively small in relation to current ship movements in the area. Therefore, there is unlikely to be a significant increase in collision risk during the operation and maintenance of offshore windfarms and as a result this has not been included in the assessment.	No.
Harwich Haven approach channel deepening	41km.	There is the potential for dredging activities to increase the risk of collision of harbour seal with dredging vessels. It was assessed that up to 0.15 harbour seal (based on 90% avoidance) could be at increased risk (or 0.003% of the South-East England Management Unit) (Ref. 8.124).	The estimated number of harbour seal that could be at increased collision risk during the construction phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with the Harwich	No

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
			Haven approach channel deepening project is 0.16 harbour seal (0.003% of South-East England Management Unit; or 0.004% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	
Nautilus	1.6km (nearest possible landfall).	Project planned to be fully operational by 2028 (Ref. 9.47). Planning submission planned for late 2022 and no information currently available on the project.	In-combination assessment not possible.	No.
Norfolk Boreas Offshore Wind Farm.	59km from cable corridor. 103km from windfarm site.	The Norfolk Boreas project is currently due to be constructed in 2025-2029. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour seal that could be at increased collision risk during the construction of Norfolk Boreas is 0.002 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of harbour seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Norfolk Boreas project is 0.012 harbour seal (0.0002% of South-East England Management Unit; or 0.0003% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	No.
Norfolk Vanguard Offshore Wind Farm.	59km from cable corridor. 83km from windfarm site.	The Norfolk Vanguard project is currently due to be constructed in 2024-2028. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour seal that could be at increased collision risk during the construction of Norfolk Vanguard is 0.003 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of harbour seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Norfolk Vanguard project is 0.013 harbour seal (0.0003% of South-East England Management Unit; or 0.0004% of the Wash count). Therefore, there would be no	No.

In-Combination Project	Distance To Sizewell C (km)	Assessment Of Effects On Marine Mammal Species	In-Combination Effect With Sizewell C	Potential For Adverse Effects In-Combination?
			significant effects on the harbour seal population.	
Proposed aggregate extraction sites in the study area	47km.	No assessment of effects has been completed to date.	In-combination assessment not possible.	No.
Proposed new disposal sites in the study area	50km.	No information available.	In-combination assessment not possible.	No.
Thanet Extension Offshore Wind Farm	82km.	Construction the Thanet Extension project is currently planned to take place between 2020 and 2023. There is the potential for increased vessels during offshore wind farm construction and therefore increased collision risk. The estimated number of harbour seal that could be at increased collision risk during the construction of the Thanet Extension is 0.2 (based on area of wind farm site, seal at sea density and 5% increased collision risk).	The estimated number of harbour seal that could be at increased collision risk during the operation phase of the Sizewell C project is 0.01. Therefore, the potential in-combination collision risk with Thanet Extension project is 0.21 harbour seal (0.004% of South-East England Management Unit; or 0.006% of the Wash count). Therefore, there would be no significant effects on the harbour seal population.	No

e) Summary of effects (alone and in-combination)

9.6.49. **Table 9.49** summarises the potential effects of the Sizewell C Project on The Wash and North Norfolk Coast SAC alone and in-combination with other plans and projects.

Table 9.49: Summary of the potential effects of the Sizewell C Project on The Wash and North Norfolk Coast SAC alone and in-combination with other plans and projects

Potential Effect	Assessment Of Harbour Seal	Potential For Adverse Effect On The Integrity Of The Site
Construction And Decommissioning Of The Sizewell C Project Alone		
Water quality effects – marine environment		
Potential for water quality effects due to construction related discharges on foraging harbour seal and/or harbour seal prey species.	0.3 harbour seal (0.006% of the South-East England reference population; or 0.008% of The Wash and North Norfolk Coast SAC count).	No
Underwater noise effects on species populations – harbour seal		
Permanent auditory injury (PTS) from a single strike of impact piling (200kJ) on harbour seal.	0.00001 harbour seal (0.0000002% of the South-East England reference population; or 0.0000003% of The Wash and North Norfolk Coast SAC count).	No A Marine Mammal Mitigation Plan for piling would be implemented
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of impact piling (200kJ) on harbour seal.	0.008 harbour seal (0.0002% of the South-East England reference population (or 0.0002% of The Wash and North Norfolk Coast SAC count).	No
Temporary auditory injury (TTS) from a single strike of impact piling (200kJ) on harbour seal.	0.00003 harbour seal (0.0000006% of the South-East England reference population; or 0.0000009% of The Wash and North Norfolk Coast SAC count).	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of impact piling (200kJ) on harbour seal.	0.4 harbour seal (0.008% of the South-East England reference population; or 0.01% of The Wash and North Norfolk Coast SAC count).	No
Disturbance of harbour seal from impact piling.	43 harbour seal (0.87% of the South-East England reference population; or 1.19% of	No

Potential Effect	Assessment Of Harbour Seal	Potential For Adverse Effect On The Integrity Of The Site
	The Wash and North Norfolk Coast SAC count).	
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of drilling on harbour seal.	0.00008 harbour seal (0.000002% of the South-East England reference population; or 0.000002% of The Wash and North Norfolk Coast SAC count).	No
Permanent auditory injury (PTS) from cumulative exposure (24 hours, stationary model) of dredging on harbour seal.	0.002 harbour seal (0.00004% of the South-East England reference population; or 0.00006% of The Wash and North Norfolk Coast SAC count).	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of drilling on harbour seal.	0.00008 harbour seal (0.000002% of the South-East England reference population; or 0.000002% of The Wash and North Norfolk Coast SAC count).	No
Temporary auditory injury (TTS) from cumulative exposure (24 hours, stationary model) of dredging on harbour seal.	0.6 harbour seal 0.01% of the South-East England reference population; or 0.02% of The Wash and North Norfolk Coast SAC count).	No
Permanent auditory injury (PTS) for effects on harbour seal from UXO clearance.	0.4 harbour seal (0.009% of the South-East England reference population; reference population; 0.01% of The Wash and North Norfolk Coast SAC count).	No A Marine Mammal Mitigation Plan for UXO clearance would be implemented
Disturbance effects on harbour seal prey species		
Behavioural response of harbour seal prey species to impact piling.	0.4 harbour seal (0.008% of the South-East England reference population; or 0.001% of The Wash and North Norfolk Coast SAC count).	No
Physical interaction between species and project infrastructure		
Increased collision risk of harbour seal and vessels.	0.01 harbour seal (0.0002% of the South-East England reference population; or 0.0003% of The Wash and North Norfolk Coast SAC count).	No

Potential Effect	Assessment Of Harbour Seal	Potential For Adverse Effect On The Integrity Of The Site
Operation Of The Sizewell C Project Alone		
Water quality effects – marine environment		
Potential for water quality effects due to operational chemical discharges on foraging harbour seal and/or harbour seal prey species.	0.3 harbour seal (0.006% of the South-East England reference population; or 0.008% of The Wash and North Norfolk Coast SAC count).	No
Potential for water quality effects due to operational thermal discharge on foraging harbour seal and/or harbour seal prey species.	8.8 harbour seal (0.18% of the South-East England reference population; or 0.24% of The Wash and North Norfolk Coast SAC count).	No
Physical interaction between species and project infrastructure		
Increased collision risk of harbour seal and vessels.	0.01 harbour seal (0.0002% of the South-East England reference population; or 0.0003% of The Wash and North Norfolk Coast SAC count).	No
Impingement of prey species	1.6 harbour seal (0.03% of the South-East England Management Unit reference population; 0.04% of The Wash and Blakeney Point count).	No
In-combination effects		
Water quality effects	None of the projects included in the in-combination assessment for any changes to water quality would have the potential to have any in-combination effects on foraging harbour seal, or their prey species	No
Disturbance from underwater noise	186 harbour seal (3.75% of the South-East England Management Unit; or 5.2% of The Wash and North Norfolk Coast SAC count).	No
Increased collision risk with vessels.	0.44 harbour seal (0.009% of the South-East England reference population; or 0.01% of The Wash and North Norfolk Coast SAC count).	No

f) Conclusions

9.6.50. In relation to the conservation objective for harbour seal, there is no potential for adverse effects on the integrity of The Wash and North Norfolk Coast SAC to arise due to the Sizewell C Project either alone or in-combination with other plans or projects.

10 Information for Appropriate Assessment: Migratory Fish

10.1 Introduction

10.1.1. The information required to inform an Appropriate Assessment of the effects of the Sizewell C Project on the European sites and qualifying interest features screened in for migratory fish is presented below.

10.1.2. The following table sets out the structure of this section to assist in navigation.

10: MIGRATORY FISH	
10.1	**Introduction**
10.2	**Conservation objectives: Humber Estuary SAC**
10.3	**Assessment of effects: Humber Estuary SAC**
a)	Summary of screening outcomes
b)	Physical interaction between species and project infrastructure
c)	Summary of alone effects for the Humber Estuary SAC
d)	In-combination effects
10.4	**Site information: mainland European SACs**
a)	Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent Site of Community Importance (Belgium)
i.	Site Information
ii.	Conservation Objectives
b)	Weser Estuary (Germany)
i.	Site Information
ii.	Conservation objectives
c)	Elbe Estuary (Germany)
i.	Site Information
ii.	Conservation objectives
10.5	**Assessment of effects: mainland European SACs for twaite shad**
a)	Summary of screening outcomes
b)	Physical interaction between species and project infrastructure
c)	Summary of alone effects for the mainland European SACs
d)	In-combination effects

10.2 Conservation objectives: Humber Estuary SAC

10.2.1. The generic conservation objectives that apply to the Humber Estuary SAC are set out in section 9.2 a of this report.

10.3 Assessment of effects: Humber Estuary SAC

a) Summary of screening outcomes

10.3.1. The screened in effect pathway for the river and sea lamprey population of the SAC due to the influence of the Sizewell C Project is:

- physical interaction between species and project infrastructure.

10.3.2. This predicted effect is considered below for the operational phase of the project only (in this context construction and decommissioning are not relevant).

10.3.3. There are no screened in effect pathways for river and sea lamprey due to the influence of the associated development sites.

b) Physical interaction between species and project infrastructure

i. Operation

Impingement of fish

10.3.4. A study of the potential for fish species (including river and sea lamprey) to be impinged through the operation of the Sizewell C Project was undertaken by Cefas (Ref. 8.5). Twenty-four of the finfish species recorded at Sizewell over a nine-year impingement monitoring programme (undertaken between February 2009 and March 2013 and, following a break in sampling, between April 2014 and December 2017) were selected as being representative of the assemblage. This included species of importance commercially, ecologically and from a conservation perspective (river and sea lamprey are included in the latter category). Where possible, impingement predictions were compared with defined stock units for each species and compared against internationally coordinated stock assessments.

10.3.5. To estimate the (unmitigated) rate of impingement predicted to be associated with Sizewell C, the measured rate of impingement at Sizewell B was scaled by the ratio of the cooling water volumes extracted by the two stations. BEEMS Technical Report TR406 (Ref. 8.5) notes that the accuracy of the assessment depends upon whether:

- the fish community is the same at the location of the Sizewell C intakes (approximately 3km offshore) as at the Sizewell B intakes (approximately 700m offshore); and
- the Sizewell C intakes would abstract the same amount of fish per cumec as Sizewell B.

10.3.6. With respect to the first point, BEEMS Technical Report TR345 (Ref. 6.64) found – with the exception of bass – no significant difference in the fish community or fish length distributions between the locations of the Sizewell C and Sizewell B intakes.

10.3.7. With respect to the second point, the impingement calculations assumed that the Sizewell C intakes would abstract the same amount of fish per cumec as Sizewell B. This is precautionary.

10.3.8. Predictions of impingement were undertaken both without and with mitigation (FRR). The total mortality suffered by each species passing through the cooling water systems, taking into account FRR survival, was calculated by summing losses at the trash rack, band screen and drum screen.

10.3.9. As described in BEEMS Technical Report TR406 (Ref. 8.5), if the predicted impingement of a particular species is greater than 1% of the SSB or - if SSB has not been established for a particular species - fishery landings, further investigation is warranted to determine whether the effect could be significant at a population level.

10.3.10. For river lamprey, losses were compared against a spawning run size estimate for the Humber catchment made in 2018 by the Humber International Fisheries Institute. The run numbers were converted to weight to enable a comparative analysis for impingement. This run size was estimated to be 783,043 individuals, equating to 61.86 tonnes.

10.3.11. For sea lampreys, no stock data are available. As such, the impingement assessment is based on the impingement data collected for Sizewell B. The unmitigated impingement losses are estimated to be five fish per annum, dropping to two fish with the proposed intake head design, and dropping less than 0.13 fish per annum with when considering survival through the fitted FRR (i.e. taking account of mitigation). This is deemed to be ecologically negligible and negligible in the context of a stock that is widespread throughout the North Sea. For this reason, sea lamprey impingement losses are not considered in the assessment specific to the Sizewell C intake.

10.3.12. The impingement losses of river lamprey at Sizewell C with no mitigation in place were estimated to be less than 1%.

10.3.13. For river lamprey, the predicted, unmitigated impingement is 0.86% of the Humber run size, equating to 0.53 tonnes of river lamprey. This impingement prediction, with the proposed intake head design and FRR mitigation, is estimated to be 0.07% of the Humber catchment which equates to 530 individuals, or 0.04 tonnes of river lampreys. The Southern North Sea population of river lamprey are probably one stock with spawning taking place in the Ouse in the UK, but also in the Scheldt in the Netherlands where the adult population is estimated to be in the 100,000s (Ref. 10.1) and in other European rivers that drain into the North Sea (e.g. rivers Eider, Elbe, Weser and Ems). As such, the predicted impact on the river lamprey population arising from the intake pipe of Sizewell C is, therefore, considered to be negligible.

10.3.14. The above estimates are precautionary, as it is highly unlikely that the Sizewell C intake would be installed without any mitigation in place. Even so, the impingement loss estimates are very small and are considered to be insignificant.

10.3.15. Although data on the size of the sea and river lamprey populations within the Humber Estuary SAC are limited, it is known that they are relatively small and local. The Humber International Fisheries Institute data can be used to estimate the population size of lampreys within the Humber Estuary SAC. The Humber International Fisheries Institute estimate covered the Humber catchment area, with the data based on tagged individuals of lampreys from the commercial fishery at Naburn (River Ouse).

10.3.16. In light of the above, an adverse effect on the integrity of the Humber Estuary SAC can be excluded due to impingement of river and sea lamprey during the operation of Sizewell C.

Entrainment of fish

10.3.17. Both sea and river lamprey species could be at risk from entrainment at the water intake for Sizewell C.

10.3.18. Twenty-four key fish species were identified at Sizewell (defined in the fish characterisation report - BEEMS Technical Report TR345 (Ref. 6.64) - on the basis of conservation importance, ecological importance and socio-economic value) as representative of the local assemblage. Only eight of these 24 species were detected in entrainment sampling carried out for Sizewell B.

10.3.19. Neither sea or river lamprey were detected in the entrainment sampling. As such, their respective populations are not considered to be at risk from entrainment.

10.3.20. In light of the above, adverse effect on the integrity of the Humber Estuary SAC can be excluded due to entrainment of river and sea lamprey during the operation of Sizewell C.

c) Summary of alone effects for the Humber Estuary SAC

10.3.21. **Table 10.1** summarises the potential effects of the Sizewell C Project on the Humber Estuary SAC alone.

Table 10.1: Summary of the potential effects of the Sizewell C Project on the Humber Estuary SAC alone

Potential Effect	Assessment Of Lampreys	Potential For Adverse Effect On The Integrity Of The Site
Operation Of Sizewell C		
Physical interaction between species and project infrastructure		
Impingement of fish	Sea lamprey - 5 individuals River lamprey – 0.86% of the Humber run size	No
Entrainment of fish	Lampreys not predicted to be at risk from entrainment.	No

d) In-combination effects

10.3.22. No other plans or projects screened in have the potential to cause the impingement or entrapment of lampreys and, therefore, there is no potential for an in-combination effect to arise.

10.4 Site information: mainland European SACs

10.4.1. The following European sites scoped in to the Shadow HRA (Ref. 8.5) are designated for spawning populations of twaite shad (*Alosa fallax*), a species which is of concern relating to the impingement assessment for the Sizewell C Project's intake.

a) Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent Site of Community Importance (Belgium)

i. Site Information

10.4.2. Designated in 2002, this SCI (site code: BE2300006) covers an area of 8,957 ha in the Scheldt estuary of the Antwerp region of Belgium. It is designated for, amongst 18 Annex I habitats and 8 Annex II species, the Annex II species twaite shad.

ii. Conservation objectives

10.4.3. A management plan is not yet in place for this site, as such, no conservation objectives are available.

b) Weser Estuary (Germany)

i. Site Information

10.4.4. There are multiple European sites within the Weser estuary, which is a known area for twaite shad spawning. The sites designated for twaite shad within this estuary that have been considered in this assessment are listed in **Table 10.2**.

Table 10.2: European sites for twaite shad in the Weser Estuary

Site Name	Site Code	Designation Date	Area Covered
Unterweser SCI	DE2316331	2006	3,512ha
Weser bei Bremerhaven SCI	DE2417370	2006	1,682ha
Nebenarme der Weser mit Strohauser Plate und Juliusplate SCI	DE2516331	1999	1,637ha

ii. Conservation objectives

10.4.5. A site-specific management plan is only in place for the Weser bei Bremerhaven SCI, titled Integrierter Bewirtschaftungsplan Weser für Niedersachsen und Bremen (Integrated Weser Management Plan for Lower Saxony and Bremen).

10.4.6. This management plan states that at present there are no restrictions for migrating fish in the Weser river, and that the river is an important living space for migratory fish species, such as twaite shad.

10.4.7. For the purposes of this assessment, the conservation objectives of the Weser bei Bremerhaven SCI that are relevant to species, rather than habitats, alongside the potential implication of the Sizewell C Project on these objectives are outlined in **Table 10.3**.

Table 10.3: Potential effects of the Sizewell C Project in relation to the conservation objectives of the Weser bei Bremerhaven SCI

Conservation Objective	Potential Effect
Securing and developing habitat conditions for the current population of migratory fish species and lamprey, as well as any areas of functionally linked land	No potential for effect. There would be no change to the habitat conditions currently supporting the fish and lamprey in the SCI.
Securing and developing the characteristic site conditions in the estuary, in particular the species composition of macrozoobenthos in their typical salinity zone	No potential for effect. There would be no change to the supporting estuarine conditions for the macrozoobenthos in the SCI.
Ensuring and developing habitat conditions for local and diadromous fish	No potential for effect. There would be no change in the habitats supporting local and diadromous fish within the SCI.
Ensuring good water quality with regard to physico-chemical parameters such as oxygen content and water temperature in the estuary	No potential for effect. There would be no changes to the water quality within the SCI.
Securing and developing or restoring the continuity of the estuary and the passage into the natural tributaries, in particular for diadromous fish, and also for aquatic invertebrates to create a network in the Weser linking it with its floodplain	No potential for effect. There would be no changes to the estuarine morphology of the SCI.
Development of a continuity for organisms (fish and invertebrates) from the Weser or its tributaries in the trenches of the foreland and inland to create a network of the Weser or its tributaries with their floodplains	No potential for effect. There would be no changes to the connectivity of the Weser Estuary with its surrounding water networks.
Preservation and promotion of vital, long - term viable populations of the characteristic species of fish species and lampreys, in particular the diadromous fish species	The operation of the cooling water intake pipe may cause impingement for twaite shad.
Preservation and development of unimpeded fish exchange possibilities between the different salinity zones within the estuary and between estuarine, natural tributaries and artificial settlement systems	No potential for effect. There would be no changes to the connectivity of the Weser Estuary with its surrounding water networks.

10.4.8. No site-specific conservation objectives or management plans are available for the remaining two sites listed in **Table 10.2**.

10.4.9. However, an integrated management plan has been published by the European Commission (EC), which covers the Weser estuary. The integrated management plan states that the main conservation objective for this area is to maintain the existing ecological dynamics typical for estuary habitats, the

functioning of the Weser as a migrating corridor for sea and freshwater (river) lamprey as well as the spawning areas of twaite shad. As stated in **Table 10.3**, there is no potential for effect on the typical estuarine habitats found at the Weser Estuary. Only the operation of the cooling water intake pipe has the potential to affect twaite shad.

c) Elbe Estuary (Germany)

i. Site information

10.4.10. There are multiple European sites within the Elbe Estuary, which is a known area for twaite shad spawning. The sites designated for twaite shad within this estuary that have been considered in this assessment are listed in **Table 10.4**.

Table 10.4: European sites for twaite shad in the Elbe Estuary

Site Name	Site Code	Designation Date	Area Covered
Elbe zwischen Geesthacht und Hamburg SAC	DE2526332	2004	573ha
Hamburger Unterelbe SAC	DE2526305	2004	739ha
Mühlenberger Loch/Neßsand SCI	DE2424302	1998	644ha
Rapfenschutzgebiet Hamburger Stromelbe SCI	DE2424303	2006	340ha
Unterelbe SCI	DE2018331	2000	18,790ha
Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI	DE2323392	2006	19,280ha

ii. Conservation objectives

10.4.11. Only the Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI has site-specific conservation objectives. The relevant objectives, specific to twaite shad, alongside the potential effect of the Sizewell C Project are included in **Table 10.5**.

Table 10.5: Potential effects of the Sizewell C Project in relation to the conservation objectives of the Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI

Conservation Objective	Potential Effect
Conservation and if necessary, restoration of the	The operation of the cooling water intake pipe may cause impingement for twaite shad.

Conservation Objective	Potential Effect
twaite shad populations in the estuary	

10.4.12. There is an integrated management plan for the Elbe Estuary, which covers the Mühlenberger Loch/Neßsand SCI and Rapfenschutzgebiet Hamburger Stromelbe SCI. The management targets relevant to twaite shad have been listed in **Table 10.6**, alongside the potential effect of the Sizewell C Project against each management target.

10.4.13. The remaining SCIs do not have any management plans or documents in place. As such, no conservation objectives are available for the Unterelbe SCI, Elbe zwischen Geesthacht und Hamburg SAC, and Hamburger Unterelbe SAC.

Table 10.6: Potential effects of the Sizewell C Project in relation to the management targets relevant to twaite shad for the Mühlenberger Loch/Neßsand SCI and Rapfenschutzgebiet Hamburger Stromelbe SCI

Conservation Objective	Potential Effect
Enhance population to a nearly natural abundance and population structure.	The presence of the cooling water intake pipe may cause impingement for twaite shad. This may cause a potential likely significant effect which will be considered further.
Maintaining and restoring the breeding and nursery areas of the twaite shad between Hamburg and Glückstadt and of the asp (*Aspius aspius*) between Geesthacht and Hamburg	The presence of the cooling water intake pipe may cause impingement for twaite shad. This may cause a potential likely significant effect which will be considered further.

10.5 Assessment of effects: mainland European SACs for twaite shad

a) Summary of screening outcomes

10.5.1. The screened in effect pathway for the mainland European SCIs designated for twaite shad due to the influence of the Sizewell C main development site is:

- physical interaction between species and project infrastructure.

10.5.2. This predicted effect is considered below for the operational phase of the project only (in this context construction and decommissioning are not relevant).

10.5.3. There are no screened in effect pathways for the mainland European SCIs designated for twaite shad due to the influence of the associated development sites.

b) Physical interaction between species and project infrastructure

i. Operation

Impingement of fish

10.5.4. Twaite shad that spawn in mainland European rivers (along the North Sea coastline ranging from Belgium to Germany) could be at risk of being impinged at the intake pipe for Sizewell C. Genetic analyses of twaite shad previously caught at Sizewell demonstrate that they do not originate from the UK-based spawning population in the Severn Basin District (Ref. 10.2). Sabatino and Alexandrino (2012) (Ref. 10.3) and identified a North Sea twaite shad population with low genetic diversity between fish sampled off Belgium (Scheldt) and Denmark and also the Solway Firth. These analyses identified separation between the Baltic and North Sea populations and the North Sea population would therefore appear to most likely originate from the German rivers of the Elbe/Weser and the Belgian river Scheldt. As such, it is thought that the twaite shad individuals caught at Sizewell are part of the wider, low genetic diversity North Sea population which spawn in the abovementioned mainland European rivers, all of which have several protected areas, where twaite shad is a designated species.

10.5.5. The methodology for the prediction of impingement is as described above in section 10.3.b of this report. Predictions of impingement were undertaken both without and with mitigation (FRR). The total mortality suffered by each species passing through the cooling water systems, taking into account FRR survival, was calculated by summing losses at the trash rack, band screen and drum screen.

10.5.6. As described in BEEMS Technical Report TR406 (Ref. 8.5), if the predicted impingement of a particular species is greater than 1% of the SSB or - if SSB has not been established for a particular species - fishery landings, further investigation is warranted to determine whether the effect could be significant at a population level.

10.5.7. At present there is no SSB for the North Sea twaite shad population, no directed fishery, and they may not be landed commercially in the UK. As such, sourcing data to use as estimates of population sizes can be difficult. Although some landings data on bycatch, such as the ICES catch data are available, these tend to significantly underestimate the size of the parent stock, and do not provide a meaningful assessment.

10.5.8. The twaite shad caught at Sizewell are considered to be part of a wider North Sea population that spawns in the rivers of Europe (predominantly in the Elbe but also in the Weser and the Scheldt) (Ref. 10.4). Therefore, for the purposes of the impingement assessment, the numbers of individuals impinged at Sizewell C have been compared with population estimates from the spring monitoring surveys conducted on the Rivers Elbe and Scheldt.

10.5.9. Between 2009 and 2017, an average estimated 7.5 million adult twaite shad pass through these two river systems (Ref. 10.4). The estimated population size that fed in to the impingement assessment was 7,519,986 individuals.

10.5.10. Although there is a separate spawning population in the Weser, this was not included within the impingement assessment.

10.5.11. For twaite shad, the estimated unmitigated impingement loss is 3,601 individuals. This loss is reduced to 1,379 individuals with the effect of the low velocity side entry intake heads (FRR mitigation does not increase shad survival as the group is classed as pelagic).

10.5.12. In the absence of mitigation, the losses of twaite shad by Sizewell C represent 0.05% of these population numbers; with consideration of the intake head design losses fall to 0.02% of the population.

10.5.13. The use of a negligible effect threshold of 1% of SSB to determine the significance level of potential impingement was considered to be precautionary. Assuming that the North Sea twaite shad population size is representative of the twaite shad individuals that utilise the Elbe, Weser and Schelde estuaries (the designated areas of which are considered in this HRA), a very small proportion (0.05%) of twaite shad are at risk from being impinged from the operation of Sizewell C. This estimate is significantly under the precautionary threshold of 1%. Furthermore, it is highly unlikely that the Sizewell C intake would be installed without any mitigation in place. Even so, as the unmitigated impingement loss estimates are very low, these are considered to be insignificant.

10.5.14. In light of the above, adverse effects on the integrity of the mainland European SACs included in section 10.4 of this report can be excluded due to impingement of twaite shad during the operation of Sizewell C.

Entrainment of fish

10.5.15. Adult individuals of twaite shad could potentially be at risk from entrainment at the water intake for Sizewell C.

10.5.16. Twenty-four key fish species were identified at Sizewell (defined in the fish characterisation report, BEEMS Technical Report TR345 (Ref. 6.64) on the

basis of conservation importance, ecological importance and socio-economic value) as representative of the local assemblage. Only eight of these 24 species were detected in entrainment sampling carried out for Sizewell B.

10.5.17. Twaite shad was not detected in the entrainment sampling. As such, the population within the North Sea and around Sizewell is not considered to be at risk from entrainment.

10.5.18. In light of the above, adverse effect on the integrity of the mainland European SACs included in section 10.4 of this report can be excluded due to entrainment of twaite shad during the operation of Sizewell C.

c) Summary of alone effects for the mainland European SACs

10.5.19. **Table 10.7** summarises the potential effects of the Sizewell C Project on the mainland European SACs alone.

Table 10.7: Summary of the potential effects of the Sizewell C Project on the mainland European SACs alone

Potential Effect	Assessment Of Twaite Shad	Potential For Adverse Effect On The Integrity Of The Site
Operation Of Sizewell C		
Physical interaction between species and project infrastructure		
Impingement of fish	Twaite shad – 3,601 individuals (0.05% of the SSB, which was a combination of the ICES landings data and the North Sea population data)	No
Entrainment of fish	Twaite shad not predicted to be at risk from entrainment	No

d) In-combination effects

10.5.20. No other plans and projects screened in have the potential to cause the impingement or entrapment of twaite shad and, therefore, there is no potential for an in-combination effect to arise.

11 Conclusions

11.1 Stage 1 Screening

11.1.1. The Stage 1 Screening assessment concluded that likely significant effects could not be excluded for at least one screening category for 29 European sites; these sites were carried forward into the Appropriate Assessment stage. **Table 4.5** in section 5.5 of this report summarises the qualifying interest features 'screened in' for each European site taken forward to Appropriate Assessment.

11.1.2. The in-combination screening exercise identified a total of 29 other plans and projects that could have likely significant in-combination effect with the Sizewell C Project. This list can be found in **Appendix C** of this report.

11.2 Stage 2 Appropriate Assessment: Coastal, freshwater and terrestrial habitats

11.2.1. The following European sites with coastal, freshwater and terrestrial qualifying interest features were carried forward into the Appropriate Assessment:

- Alde, Ore and Butley Estuaries SAC.
- Alde-Ore Estuaries Ramsar site.
- Benacre to Easton Bavents Lagoons SAC.
- Dew's Ponds SAC.
- Minsmere to Walberswick Heaths and Marshes SAC.
- Minsmere-Walberswick Ramsar site (habitat features).
- Orfordness to Shingle Street SAC.

11.2.2. The following pathways for potential effect (or screening categories) on coastal, freshwater and terrestrial habitats were assessed (noting that not all these pathways are screened in for every European site listed above):

- alteration of coastal processes / sediment transport;
- water quality effects – marine environment;
- water quality effects – terrestrial environment;
- changes in air quality;

- alteration of local hydrology and hydrogeology; and
- disturbance due to increase in recreational pressure.

11.2.3. When the potential effect pathways are considered collectively, it is concluded that the outcome of the alone or in-combination assessment for each European site is unchanged from that reported in section 7 of this report for one or more of the following reasons:

- The predicted effects are sufficiently localised in nature that different pathways do not combine to cause a larger effect on the qualifying interest feature in question.
- Where effect pathways interact / combine and may influence the same qualifying interest feature, the scale of the predicted effect is sufficiently low that there is no realistic potential for an intra-Project effect to arise that could undermine the conservation objectives of the European site.
- There is only one identified potential effect pathway for the qualifying interest feature in question (i.e. there is no potential for a within-Project in-combination effect on a particular feature).

11.2.4. The Shadow HRA concludes that adverse effects on site integrity can be excluded for the European sites screened into the assessment (with respect to the non-bird qualifying interest features), both alone and in-combination with other plans and projects.

11.3 Stage 2 Appropriate Assessment: Birds

11.3.1. The following European sites with bird qualifying interest features were carried forward into the Appropriate Assessment:

- Alde-Ore Estuary SPA.
- Alde-Ore Estuary Ramsar site.
- Benacre to Easton Bavents SPA.
- Deben Estuary SPA.
- Deben Estuary Ramsar site.
- Minsmere-Walberswick SPA.
- Minsmere-Walberswick Ramsar site (bird features).
- Outer Thames Estuary SPA.

- Sandlings SPA.
- Stour and Orwell Estuaries SPA.
- Stour and Orwell Estuaries Ramsar site.

11.3.2. The Appropriate Assessment for birds included consideration of all of the potential effect pathways (screening categories), with the exception of radiological effects, which were screened out as not significant.

11.3.3. When the potential effect pathways on habitats that support bird qualifying interest features are considered collectively, it is concluded that the outcome of the alone or in-combination assessment for each European site is unchanged from that reported in section 8 for the reasons set out in section 11.2 of this report.

11.3.4. The assessment of potential effects on prey species for birds in the marine environment was undertaken on the basis of the exclusion of foraging within the ZOI of the chemical and thermal discharges; this represents a highly precautionary approach. Such effects cover the largest ZOI in the marine environment during the operational phase and, therefore, consideration of any combined effect with other effect pathways does not change the outcome of the alone assessment.

11.3.5. For all SPA and Ramsar qualifying features, with the exception of breeding marsh harrier at the Minsmere-Walberswick SPA and Ramsar site, it is concluded that construction, operation and decommissioning activities would not have an adverse effect on the integrity of the European sites, either alone or in-combination with other plans and projects.

11.3.6. For the breeding marsh harrier qualifying interest feature of Minsmere-Walberswick SPA and Ramsar site, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), an adverse effect on the integrity of these European sites cannot be excluded due to noise and visual disturbance during construction phase. Habitat improvement measures are proposed to compensate for the predicted effect on the marsh harrier population.

11.4 Stage 2 Appropriate Assessment: Marine mammals

11.4.1. The following European sites with marine qualifying interest features were carried forward into the Appropriate Assessment:

- Humber Estuary SAC.
- Southern North Sea SAC.

- The Wash and North Norfolk Coast SAC.

11.4.2. The following pathways for potential effect on marine mammals were assessed within the Appropriate Assessment (noting that not all these pathways are screened in for every European site listed above):

- water quality effects – marine environment;
- direct habitat loss and direct/indirect habitat fragmentation;
- disturbance effects on species populations; and
- physical interaction between species and project infrastructure.

11.4.3. The assessment of potential effects on marine mammal populations was based on a prediction of the number of individuals present within the ZOI of the Sizewell C Project in the context of the relevant management unit for the population in question. By taking this approach, consideration of the interaction or combination between within-Project effects cannot alter the findings of the alone assessment (i.e. the predicted effect based on the largest ZOI is the maximum predicted effect of the whole Sizewell C Project).

11.4.4. The assessment of the Humber Estuary SAC (for grey seals), the Southern North Sea SAC (for harbour porpoise) and The Wash and North Norfolk Coast SAC (for harbour seals) (based on the proportion of the management unit population potentially affected) concludes that there would be no adverse effect on the integrity of the above SACs. The in-combination assessment also concluded that there would be no adverse effect on integrity when the Sizewell C Project is assessed in-combination with other plans and projects.

11.5 Stage 2 Appropriate Assessment: Migratory fish

11.5.1. The following European sites with marine qualifying interest features were carried forward into the Appropriate Assessment:

- Humber Estuary SAC.
- Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent SCI.
- Unterweser SCI.
- Weser bei Bremerhaven SCI.
- Nebenarme der Weser mit Strohauser Plate und Juliusplate SCI.
- Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SCI.
- Unterelbe SCI.

- Mühlenberger Loch/Neßsand SCI.
- Rapfenschutzgebiet Hamburger Stromelbe SCI.
- Hamburger Unterelbe SCI.
- Elbe zwischen Geesthacht und Hamburg SCI.

11.5.2. The only pathway for potential effect on migratory fish is physical interaction between species and project infrastructure. As there is only one identified potential effect pathway for the qualifying interest features, there is no potential for a within-Project in-combination effect on a particular feature.

11.5.3. For all European sites with migratory fish as qualifying interest features (river lamprey, sea lamprey and twaite shad), it is concluded that construction, operation and decommissioning activities of the Sizewell C Project would not have an adverse effect on the integrity of these European sites.

11.5.4. No plans or projects screened in to the in-combination assessment were identified to have the potential to cause the impingement or entrapment of migratory fish and, therefore, there is no potential for an in-combination effect to arise.

11.6 Mitigation

11.6.1. In reaching conclusions regarding the effects of the Sizewell C Project on the integrity of European sites, proposed mitigation has been taken into account.

11.6.2. **Table 11.1** summarises the mitigation that has been considered in this Shadow HRA, including embedded mitigation (i.e. measures that are incorporated into the design of the Sizewell C Project in order to minimise or avoid a negative effect). **Table 11.1** also sets out the proposed timing of the additional mitigation measures.

11.6.3. As noted in section 11.3 of this report, an adverse effect on the integrity of Minsmere-Walberswick SPA and Ramsar site cannot be excluded due to noise and visual disturbance during the construction phase. Habitat improvement measures are proposed to compensate for the predicted effect on the marsh harrier population.

Table 11.1: Schedule of mitigation measures, timing and securing permissions relevant to the HRA

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
Alteration of coastal processes / sediment transport		
To minimise ecological effects on habitat and associated species.	Construction of the new sea defence would include retention and extension of the existing 5m high sacrificial sand dune in front of the hard coastal defence feature (HCDF).	All
To enhance stability on the shoreline and reduce natural erosion rates	Provision of relatively small quantities of beach grade sediment during storms (up to $1m^3$ per metre of beach during severe storms) over several decades, until the feature is completely depleted. The episodic addition of sediment would provide extra material when needed, enhance stability on the shoreline and potentially reduce natural erosion rates in the northern part of the Sizewell C frontage and the Southern Barrier, including the southern part of the Minsmere to Walberswick Heaths and Marshes SAC and Minsmere-Walberswick SPA. The soft coastal defence feature (SCDF) would increase longevity of a natural beach fronting the HCDF. Reduction in the natural erosion rate on sections of the Minsmere to Walberswick Heaths and Marshes SAC will increase the longevity of the annual vegetation of drift lines habitat.	All
Water quality effects – marine environment		
To act in accordance with the best environment practice.	Any coatings or treatments applied to the BLF or other infrastructure must be suitable for use in the marine environment in accordance with best environmental practice (Guidance for Pollution Prevention). Therefore, no effects from chemicals leaching from structures is predicted.	All

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To mitigate impacts on sediment quality	To accommodate the safe passage of barges and accompanying tugs to the BLF, a navigational channel and grounding area would be required in the nearshore zone occupied by the two longshore bars. Plough dredging is the preferred option to create a planar surface for the barges to come aground. A 20m wide navigational channel and grounding surface would be profiled within the shallow subtidal zone (less than 6m water depth) using a plough dredger. Plough dredging agitates the sediment, which is then transported away by the tide. Sediment is not removed from the system as such a disposal licence is not required for plough dredging activities.	All
To mitigate vessel waste	Vessel waste management procedures outline in vessel management plan and Site Waste Management Protocols would be in place to mitigate impacts of marine litter.	All
To mitigate marine waste	The offshore cooling water infrastructure consists of two subterranean intake tunnels and one outfall tunnel. Tunnels would be excavated by tunnel boring machines from land. Each tunnel boring machines would be drilled beyond the end of the tunnel and disposed of in situ after the removal of most salvageable parts and oils/greases.	Construction
To mitigate impacts of tunnel boring machine spoil and chemicals (including groundwater) being discharged to sea.	Spoil from the cutting face of the tunnel boring machines would be removed by a screw conveyor, then transported by conveyor belt to the landward muck bay. Groundwater would be generated from digging the galleries allowing access to the tunnels. During the transport of spoil material, groundwater and tunnel boring machine chemicals can leach from the conveyor belts and fall to the tunnel floor. Wastewater on the tunnel floor would be discharged via the CDO. Discharges would be treated with a silt-buster or similar technology to minimise sediment inputs. Groundwater discharges are not considered to represent an environmental risk during the tunnelling phase as other phases of construction that have higher groundwater loadings provide a conservative assessment.	Construction

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To minimise impact from chemicals in relation to tunnelling	Fuel and lubricants would be subject to management protocols and oil/chemical spills will be contained by appropriate treatment and disposal. Sealants and greases are impervious to water and will remain associated with the tunnel walls or be removed with the spoil.	Construction
To minimise impact from ground conditioning chemicals	Ground conditioning chemicals are used at the cutter head to optimise tunnel boring machines efficiency and include anti-clogging agents, anti-wear components and soil conditioning compounds. The exact chemical constituents of the ground conditioning chemicals are dependent upon the ground conditions encountered on site and therefore cannot be precisely specified in advance of drilling trials by the tunnelling contractor. To enable the discharge to be assessed, wastewater discharge parameters and representative chemicals are taken from those applied for Hinkley Point C assessments to envelope potential drilling scenarios.	Construction
To minimise the impact on the marine environment.	A single 8m internal diameter outfall tunnel serving both UK EPR™ reactor units would return the cooling water to the sea from the outfall pond, with a pair of vertical shafts at its seaward end, each leading upwards to a single outfall headworks, again mounted on the seabed.	Operation
To minimise the impact on the marine environment.	The cooling water outfall tunnel would terminate in two concrete headworks. The optimal location of the outfall heads was investigated using hydrodynamic modelling in compliance with Environment Agency guidelines to reduce environmental impacts of the thermal plume and minimise recirculation of heated water at the Sizewell B intakes.	Operation

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To minimise effects on benthic habitats	The outfalls of the cooling water infrastructure would be located east of the Sizewell-Dunwich Bank approximately 3km offshore. The water depth at the outfalls would mean that the thermal plume would have minimal impact at the seabed thereby minimising effects on benthic habitats. The selection of an offshore location reduces the area of thermal impact exceedance inshore of the Sizewell-Dunwich Bank.	Operation
To reduce entrapment of marine organisms	Each cooling water intake tunnel would also terminate in two concrete head structures. The intake heads would also be located east of the Sizewell-Dunwich Bank where the water is deeper and they are not at risk from the westwards movement of the sandbank. This location reduces entrapment of marine organisms in line with the Environment Agency guidance.	Construction
To minimise the impact on the marine environment.	After the headworks are installed and scour protection placed in-situ, soft-sediment would be back-filled.	Construction
To monitor impact of dredging and disposal activates	The MMO would be consulted in relation to all dredging options and disposal routes, which would be subject to conditions on the Marine Licence to be deemed within the DCO. Dredging and disposal activities would undergo the necessary monitoring to ensure sediment samples were acceptable for disposal at sea. A Dredge Disposal Site Characterisation Report has been submitted as part of the DCO Deemed Marine Licence application. Dredging and disposal activities would undergo the necessary monitoring to ensure sediment samples were acceptable for disposal at sea	Construction

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To minimise chlorine effects on marine life.	Seasonal chlorination would be applied to achieve protection of critical plant (essential cooling water systems for the nuclear island and the turbine hall, and the condensers). However, spot-chlorination may be required to protect critical plant outside these periods. Chlorination would be applied at a dose level to produce a total residual oxidant concentration of 0.2mg/l after the drum screens. The total residual oxidants discharge concentration from the cooling water systems at the outfall would be 0.15mg/l. A conservative scenario for water quality modelling considers the impacts of 0.15mg/l total residual oxidants released at the outfalls in 132m^3/s.	Operation
To minimise chlorine effects on marine life.	The chlorination strategy involves seasonal chlorination, this is currently based on the period of the year when water temperatures exceed 10ºC. By 2030, predicted water temperatures at the Sizewell C intakes would exceed 10ºC from the beginning of May until the start of December.	Operation
To reduce hydrazine in concentrations in the discharge to sea.	Hydrazine is used in power plants to inhibit corrosion in steam generation circuits. Daily hydrazine discharges within the cooling water flow is modelled based on the two potential discharge scenarios dependent on whether the hydrazine load is distributed and discharged from one or two wastewater tanks; a) 69ng/l for 2.3h a day, and b) 34ng/l for 4.6h a day. The worst-case daily hydrazine discharge would be after wet lay-up of steam generators. However, hydrazine discharges would be treated until the hydrazine concentration falls below a level that is acceptable for a batch discharge. Wet lay-up is not expected in a normal refuelling outage. In the case of Sizewell B, wet lay-up first occurred ~15 years after first operation.	Operation
No chlorination of FRR system.	The FRR wash water would not be chlorinated. Therefore, impinged biota would not be subjected to chlorination.	Operation

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To implement the CDO as the primary site discharge outfall.	The CDO would be constructed early in the construction phase and act as the primary site discharge outfall. The CDO would be in a similar position on the seaward flank of the outer longshore bar as the FRR to allow mixing and avoid effluent contact with the shore.	Construction
To transport arisings to landward for disposal.	The CDO tunnel would be drilled beneath the seabed with arisings transported to landward for disposal. The tunnels would be connected to a concrete outfall structure anticipated to be of similar dimensions to the FRR headworks.	Construction
Removal of overlying soft sediment in the shallow subtidal	Prior to installation of the CDO outfall headwork, overlying soft sediment in the shallow subtidal (less than 6m) would be removed by dredging via a Cutter Suction dredger with spoil disposed locally within a licenced disposal site.	Construction
To discharge tertiary treated sewage	The CDO would discharge tertiary treated sewage, dewatered groundwater, surface run-off, tunnelling wastewater, and commissioning discharges. Discharges would be treated with oil separators to minimise potential hydrocarbon contamination from mobile or fixed plant operations and a silt buster or similar technology to reduce sediment loading.	Construction
To manage surface run-off	Engineered drainage will be incorproated into the design and construction of the SSSI crossing to manage surface run-off, being mindful of quantity and potential pollutant load.	Construction and Operation
To minimise risk of leaching from materials	Working with construction waste, materials and stockpiling would be managed by good working practice and addressed under the **CoCP** (Doc Ref. 8.11), Materials Management Strategy, **Construction Waste Management Strategy** and **Outline Soils Management Plan**.	Construction and Removal and Reinstatement
To minimise the potential for surface runoff reaching groundwater aquifers	Engineered drainage has been proposed in the area of the borrow pits to manage surface runoff and protect groundwater.	Construction

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
unimpeded and increasing the risk of contamination.		
To prevent untreated surface water runoff from leaving the site and promote infiltration to ground	Ditches, swales and bunds would be constructed where required to prevent untreated surface water runoff from leaving the site. Oil/petrol interceptors would be incorporated into the drainage design. A construction phase drainage system would then be implemented, incorporating SuDS measures such as open ditches and swales to promote infiltration to ground. Road drainage will be guided by Design Manual for Roads and Bridges and surface water runoff will primarily be directed to swales and infiltrate to ground. Groundwater from the dewatering operation will be disposed of to sea via the CDO. The water management zones would incorporate an underground piped network and storage tanks and ponds. These systems would be designed to discharge treated water to the surface water drainage network or to ground at greenfield runoff rates. Where complete infiltration to ground is not feasible, water management basins have been embedded into the design. These would collect surface water runoff, sediment and contaminants. Active management and maintenance of the drainage infrastructure is required to ensure the continued efficacy of the surface water drainage system.	Construction
To minimise risk to groundwater of surface water receptors	Foul water would be pumped to a number of modular sewage treatment plants and the treated water would then enter the site drainage systems before being discharged to sea.	Construction and Operation
To minimise pollution and spillage	Controls to be implemented will be: Implementation of appropriate pollution incident control e.g. plant drip trays and spill kits. Spill kits would be available on site at all times. Sand bags or stop logs would also be available for deployment on the outlets from the site drainage system in case of emergency spillages. Implementation of appropriate and safe storage of fuel, oils and equipment during works. For example, all fuels, oils, lubricants and other chemicals would be stored in an impermeable bund with	Construction and Removal & reinstatement

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
	at least 110% of the stored capacity. All refuelling would take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils should be used where possible. The wheels of all vehicles would be free of contamination before arriving at site. All vehicles would be inspected prior to leaving site and should contaminative substances be identified suitable measures (e.g. wheel washing) will be implemented. Concrete and cement mixing and washing areas would be situated at least 10m away from surface water receptors. These would incorporate settlement and recirculation systems where possible to allow water to be re-used. All washing out of associated equipment would be undertaken in a contained area.	
Alteration of local hydrology and hydrogeology		
To minimise the effect on water levels from the realignment of Sizewell Drain	Sizewell Drain would be diverted north, parallel to the base of the platform slope. At its northern extent, it would discharge to the Leiston Drain upstream of the SSSI crossing. Realignment has been engineered to maintain a surface water level that will prevent alteration of the groundwater flow regime. A control structure has been incorporated into the design to manage water flow and prevent changes to groundwater. At the western perimeter of the power station platform, a filter drain would be installed to capture surface water runoff and prevent direct discharge to Sizewell Drain.	Construction and Operation
To minimise impact on existing hydrological conditions within Leiston Drain	The design of the SSSI crossing accounts for the existing hydrological conditions within the Leiston Drain and localised effect that the diverted Sizewell Drain will have on these conditions.	Construction and Operation

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
To minimise impact of the operational site on local drainage.	Significant reinstatement of temporary construction areas is proposed. Completion of the power station and associated permanent structures (both reactors, ancillary building and car parking areas) will increase the impermeable surface area at the site, compared to the baseline. For these remaining areas of the proposed development, an operational phase drainage system would be implemented, including SuDS measures to intercept water, sediment and contaminants.	Removal and reinstatement
Changes in air quality		
To reduce traffic emissions	*"The two off-site park and ride facilities, together with the siting of the accommodation campus on the main development will reduce construction worker traffic to main development site, and therefore help reduce transport related emissions.*	Construction
To minimise the impact from combustion derived pollutant emissions from the diesel generators	*Diesel generator stack heights set as high as practicable for the power station and emissions of nitrogen oxides controlled through primary means. Diesel generator stack heights set as high as practicable for the power station and emissions of nitrogen oxides controlled through primary means.* *The combined heat and power plant will be designed and operated in accordance with Medium Combustion Plant Directive requirements and the combustion plant emission stack height optimised to minimise ground-level air quality impacts balanced against the visual impacts of taller stacks.*	Operation
To minimise impact of construction dust	The **CoCP** (Doc Ref. 8.11) sets out control measures to manage construction impacts on air quality, including:	Construction

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
	- Site access located as far as practicable from sensitive receptors, to minimise impacts from transport-related emissions, including vehicle exhaust emissions and fugitive dust emissions from trackout of mud onto the road. - Hard-surfaced roadways used as far as practicable, to minimise trackout and dust raising from vehicle movements within the construction site. - Use of earth bunds with grassing/seeding, including a bund along the length of the southern temporary construction area boundary (5m height), and early planting to supplement existing vegetation and hedging, to screen sensitive boundaries from fugitive dust from construction activities. - Wheel wash-facilities would be installed at strategic points within the main development site, and maintained for the duration of earthworks and excavations, to minimise tracked out materials from high risk to lower risk areas. - Concrete batching plant located as far as practicable from sensitive receptors, to minimise emission impacts. - Mobile crushing and screening plant located as far as practicable from sensitive receptors, to minimise emission impacts. - Mobile crushing and screening plant located as far as practicable from sensitive receptors, to minimise emission impacts. - Use of modular (pre-fabricated) buildings as far as practicable for temporary accommodation and site facilities during construction phase to minimise dust raising during the construction and final removal and reinstatement phases. - Use of contractor vehicles as far as practicable that meet the Euro V emissions standards. - Use of non-road mobile machines as far as practicable that meet the Stage IV engine standards of the NRMM Emission Standards Directive to minimise NOx and particulate emissions on site.	
To minimise impact of construction dust	The outline **Dust Management Plan** sets out activity-specific measures to control, manage and monitor the impacts of dust on air quality for defined zones (A-F).	Construction

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
Disturbance effects on species populations		
To minimise ecological effects on habitat and associated species.	Boundary treatment are included within the Construction Phase parameter plan construction masterplan to minimise noise, lighting and visual disturbance to adjacent designated sites or valuable habitats. Boundary treatment would also limit the extent of air borne dust pollution.	Construction
To minimise ecological effects on habitat and associated species.	Lighting would be implemented in accordance with the **Lighting Management Plan (Appendix 2B** of **Volume 2** of the **ES)**. The **Lighting Management Plan** includes measures such as: - within lighting zones where lighting is proposed , use of lighting would be avoided if when and where it is safe to do so; - only minimal lighting levels required to ensure the required work can occur safely would be used; - when and where lighting is required, light sources would be used which minimise the ultraviolet (UV) content of emitted light (UV light having been shown to attract greater numbers of insects); - light sources used would emit a warm colour temperature (2700K and below); - tuneable LED luminaires would be used, and would be mounted at the minimum effective height, to minimise lateral light-spill; - lighting columns would be positioned on the perimeter of working areas facing inwards to minimise light-spill into ecologically sensitive areas. In some locations, such as the SSSI Crossing, additional rear shielding may be used if required to prevent light-spill; and - where retained hedgerows are crossed by haul roads (such as two locations on Upper Abbey Bridleway and at the crossroads adjacent to Fiscal Policy) lighting columns would be positioned to leave a dark buffer zone around the hedgerow, if this is practically possible and safe to do so. A gap of up to 30m can be left between indicative footprints of light sources on either side of these features, retaining them as a dark corridor for commuting and foraging bats. Where lighting is proposed parallel to retained hedgerows a 10m buffer zone would be left.	All phases
To minimise ecological effects on habitat and associated species.	The **oLEMP** (Doc Ref. 8.2) outlines the expected management specification and measures that are proposed to help return existing arable land on the EDF Energy estate post-construction to Suffolk Sandlings habitat comprising acid grassland with additional areas of scrub and woodland. In the	Operation

Effect	Mitigation / Commitment	Project Phase In Which The Mitigation Would Apply
	operational phase of the development, this landscape-scale habitat creation approach would replace existing intensively managed arable farmland with habitats of greater biodiversity value and would increase habitat connectivity. The **oLEMP** (Doc Ref. 8.2) also includes long-term management measures and a monitoring programme for habitats created ensuring that these areas deliver the habitats proposed.	
Disturbance due to increased recreational pressure		
To minimise ecological effects on habitat and associated species.	Right of Way and Access Strategy: The application includes the provision of recreational facilities for new construction workers both at the onsite campus and in Leiston to reduce the recreational use of local PRoW by workers. - Campus based workers would not be able to bring dogs to site. - **The** Rights of Way and Access Strategy for the EDF Energy estate has been designed to minimise the displacement of people away from the proposed development area and minimise the potential displacement to nearby European sites to minimise disturbance to ground-nesting bird species and trampling of vegetation. - A monitoring programme would be developed, for recreational displacement and identify local mitigation measures, to be agreed with local land managers, which could be introduced to further reduce recreational disturbance.	Construction and Operation

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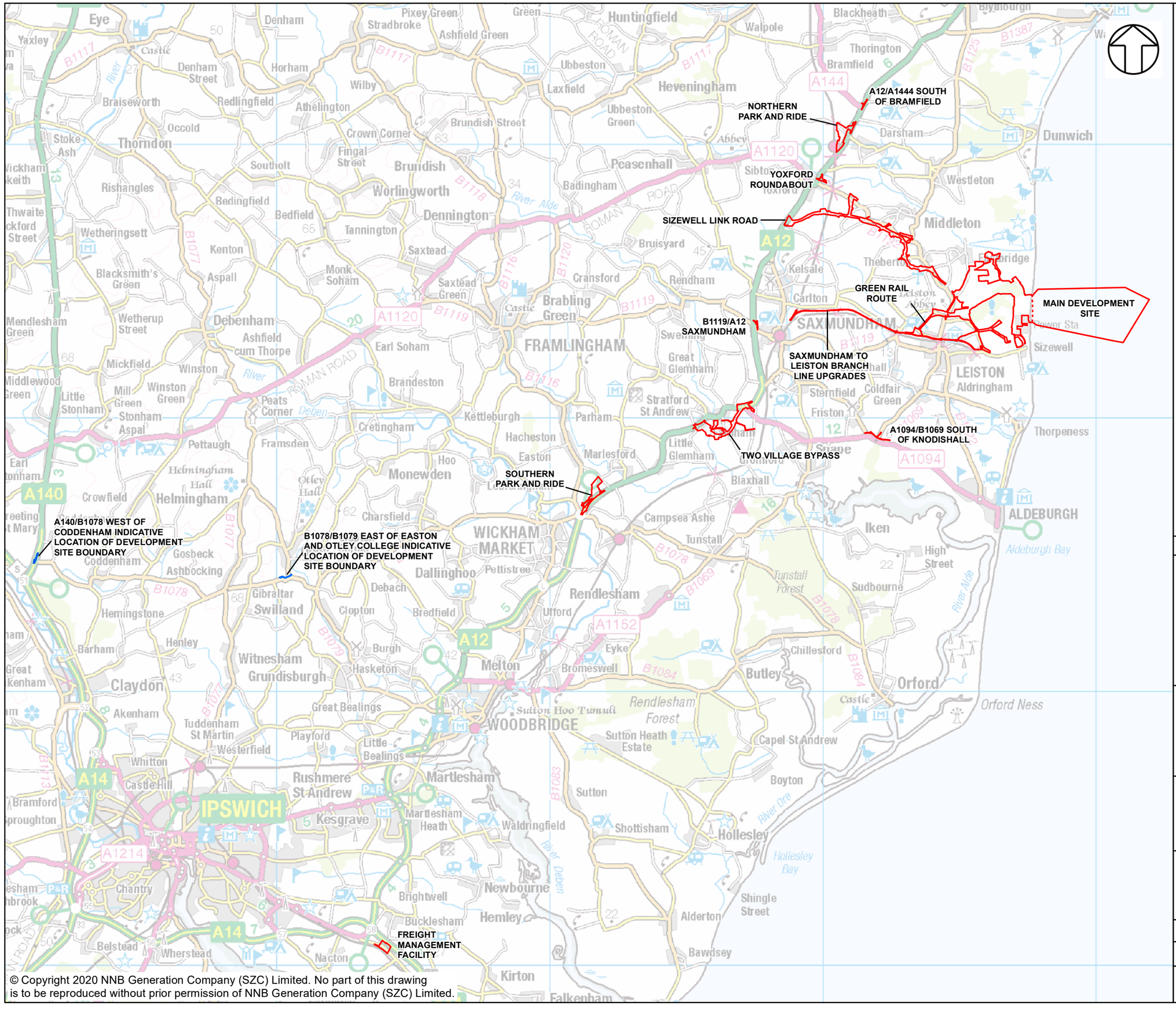
Ref.	Source
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Ref.	Source
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Ref.	Source
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Ref.	Source
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Appendix A: Figures



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NOTES

KEY

- SIZEWELL C AND ASSOCIATED DEVELOPMENT SITE BOUNDARIES
- DEMARCATION LINE
- INDICATIVE LOCATION OF DEVELOPMENT SITE BOUNDARIES

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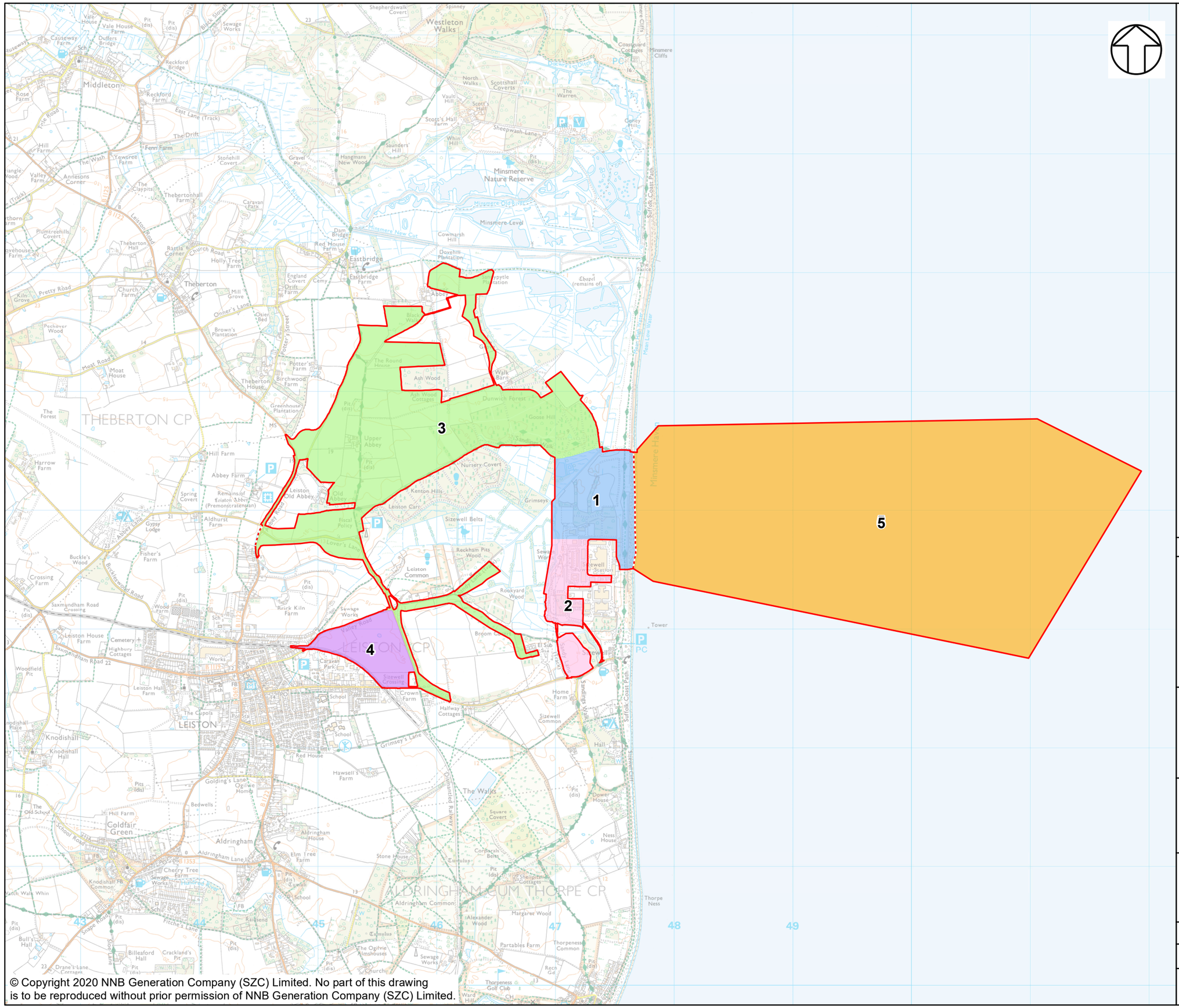
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SHADOW HRA REPORT
CHAPTER 2
SUMMARY OF THE PROJECT

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NOTES

KEY

- SIZEWELL C MAIN DEVELOPMENT SITE BOUNDARY
- DEMARCATION LINE

MAIN DEVELOPMENT SITE AREAS

- 1. MAIN PLATFORM
- 2. SIZEWELL B RELOCATED FACILITIES AND NATIONAL GRID LAND
- 3. TEMPORARY CONSTRUCTION AREA
- 4. LAND EAST OF EASTLANDS INDUSTRIAL ESTATE - LEEIE
- 5. OFFSHORE WORKS AREA

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CHAPTER 2
SUMMARY OF THE PROJECT

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MAIN DEVELOPMENT SITE:
SITE AND SUB-AREAS

DRAWING NO:
FIGURE 2.2

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NOTES

KEY

NORTHERN PARK AND RIDE DEVELOPMENT SITE BOUNDARY

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NORTHERN PARK AND RIDE DEVELOPMENT SITE LOCATION PLAN

DRAWING NO:
FIGURE 2.3A

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SOUTHERN PARK AND RIDE DEVELOPMENT SITE BOUNDARY

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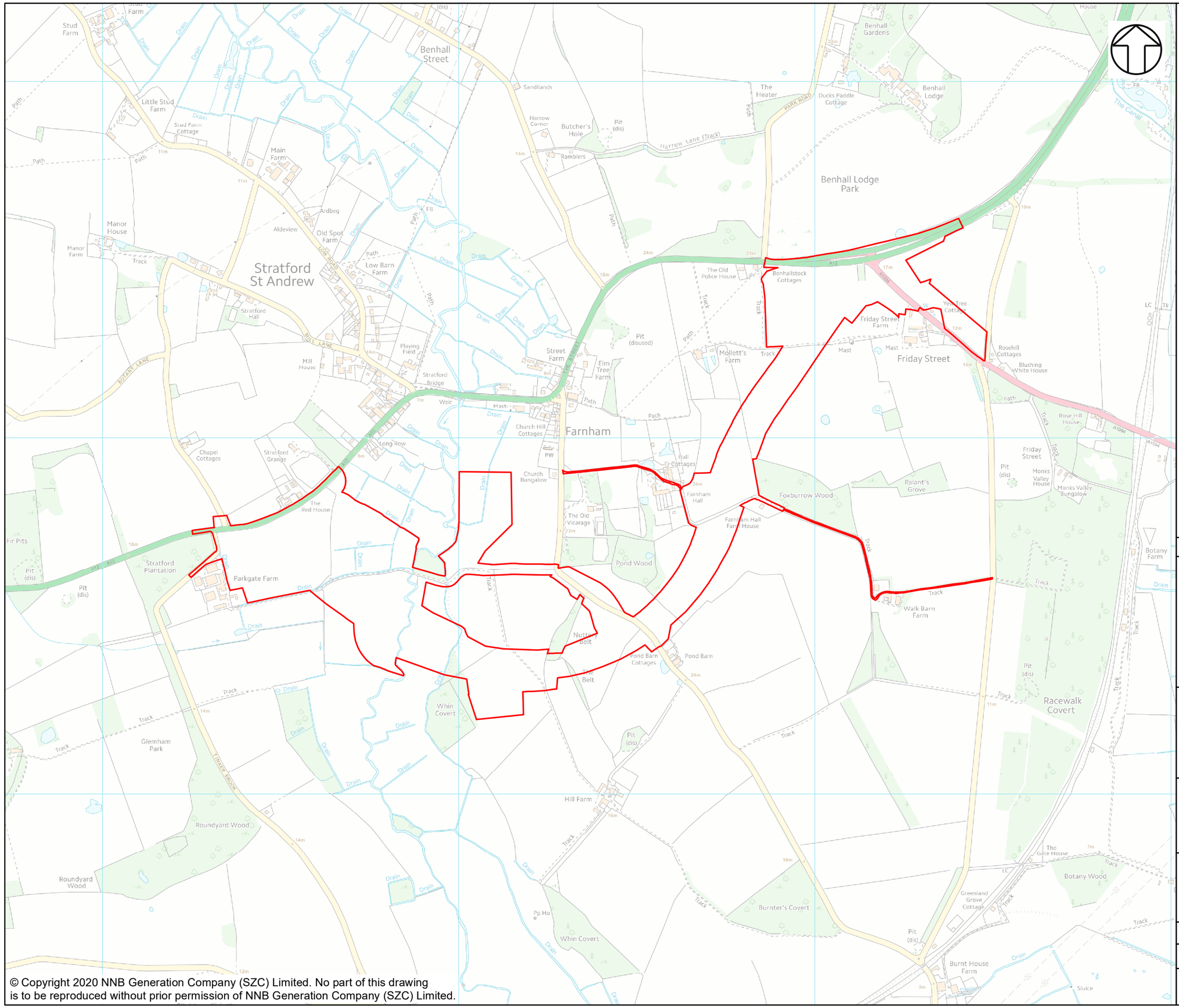
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DEVELOPMENT SITE LOCATION
PLAN

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FIGURE 2.3B

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NOTES

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TWO VILLAGE BYPASS DEVELOPMENT SITE BOUNDARY

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CHAPTER 2
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TWO VILLAGE BYPASS DEVELOPMENT SITE LOCATION PLAN

DRAWING NO:
FIGURE 2.4

DATE:	DRAWN:	SCALE :
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NOTES

KEY

SIZEWELL LINK ROAD DEVELOPMENT SITE BOUNDARY

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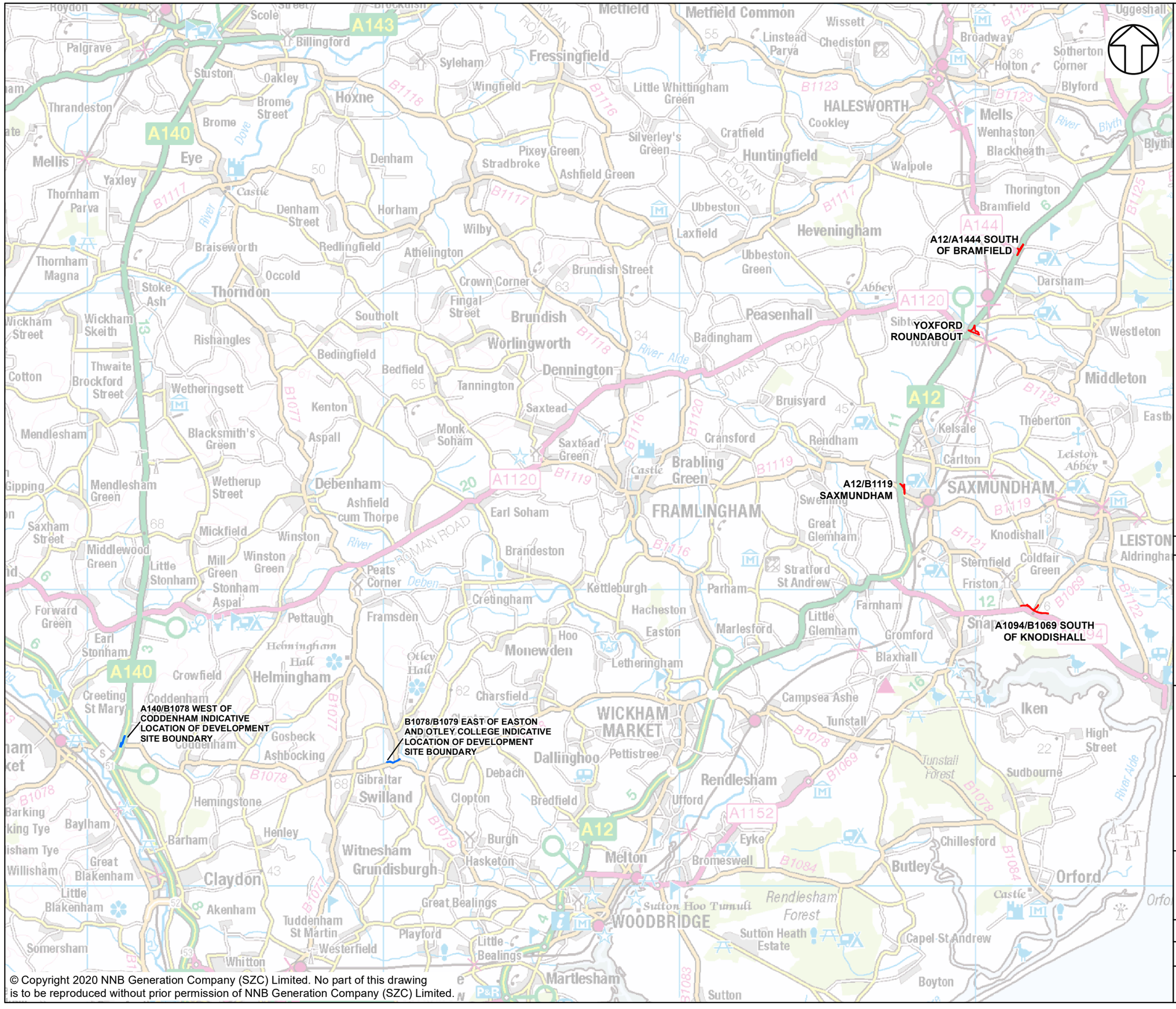
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LOCATION PLAN

DRAWING NO:
FIGURE 2.5

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NOTES

KEY

DEVELOPMENT SITE BOUNDARIES

INDICATIVE LOCATION OF DEVELOPMENT SITE BOUNDARIES

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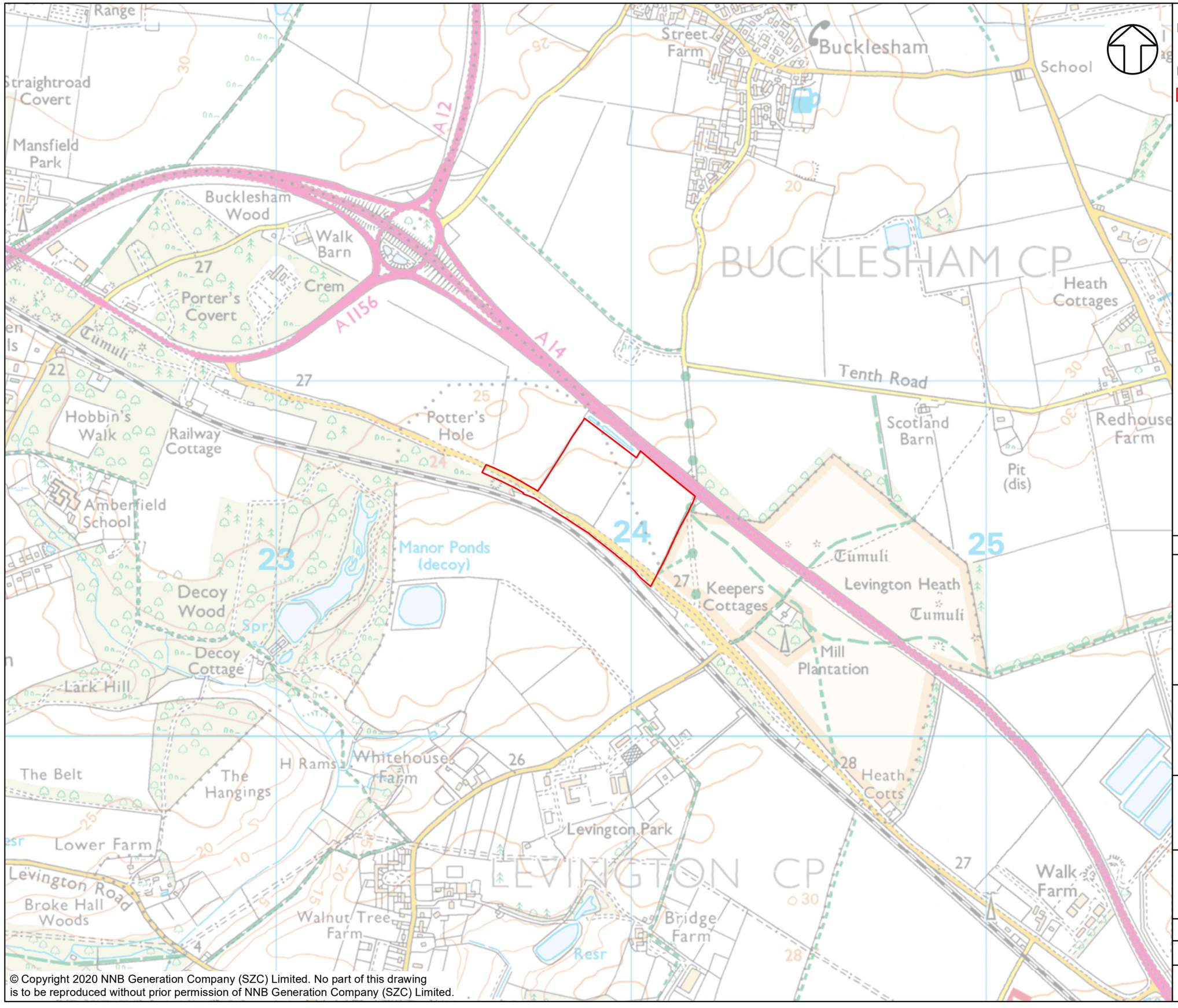
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CHAPTER 2
SUMMARY OF THE PROJECT

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YOXFORD AND OTHER HIGHWAYS IMPOVEMENTS SITE LOCATION PLAN

DRAWING NO:
FIGURE 2.6

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NOTES

KEY

FREIGHT MANAGEMENT FACILITY DEVELOPMENT SITE BOUNDARY

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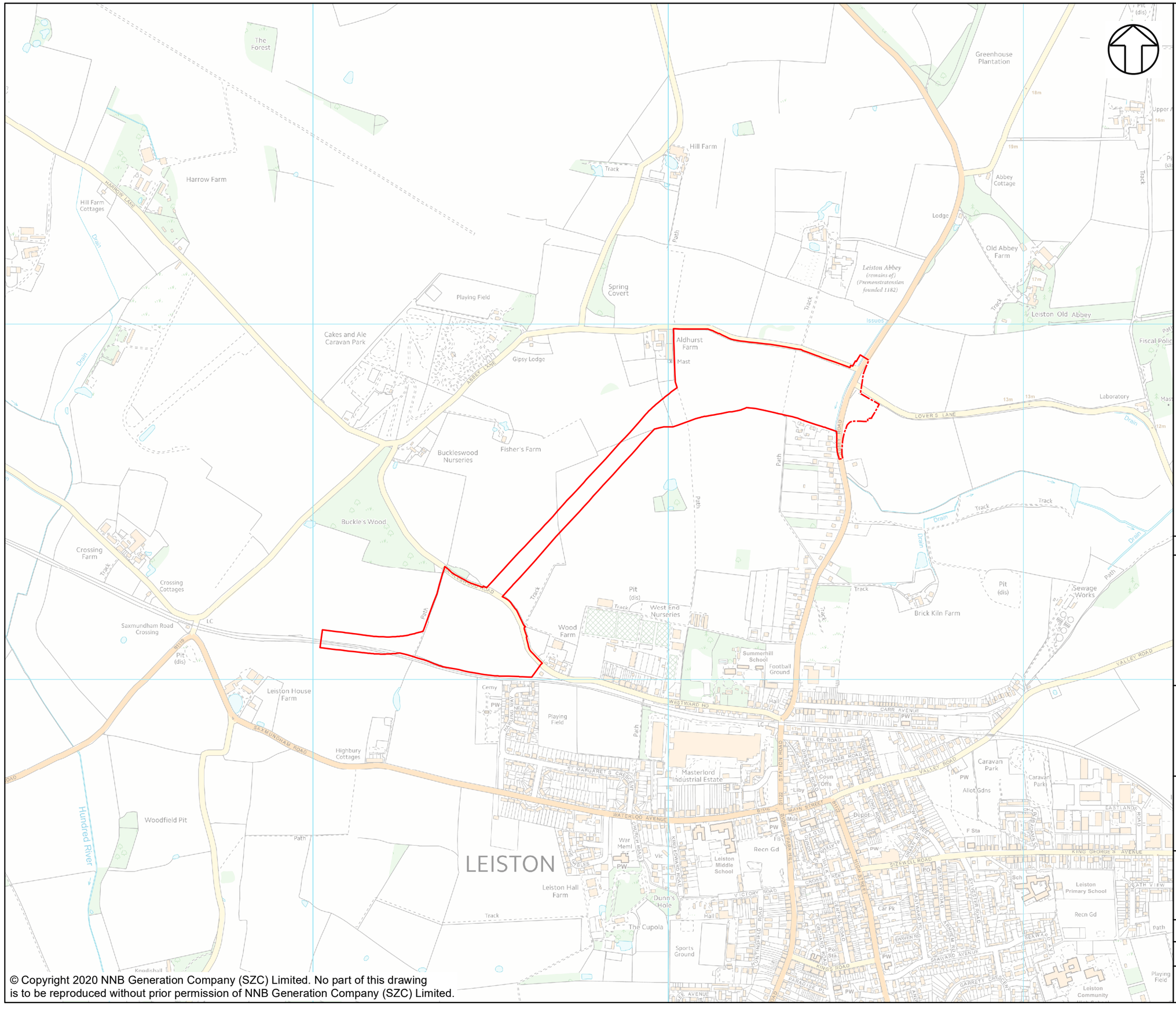
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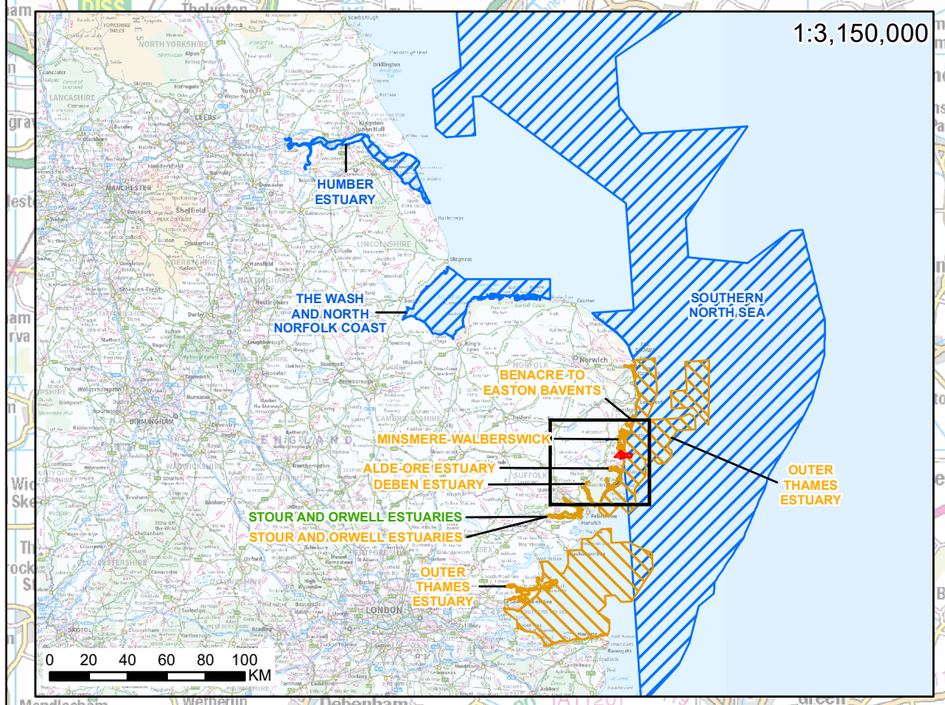
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DRAWING NO:
FIGURE 2.7

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LEISTON
Harrow Farm
Hill Farm Cottages
HARROW LANE
Drain
The Forest
Hill Farm
Track
Path
Spring Covert
Playing Field
Cakes and Ale Caravan Park
Gipsy Lodge
ABBEY LANE
Aldhurst Farm
Mast
Fisher's Farm
Buckleswood Nurseries
Buckle's Wood
Crossing Farm
Crossing Cottages
Saxmundham Road Crossing
LC
B1122
Pit (dis)
Leiston House Farm
SAXMUNDHAM ROAD
Highbury Cottages
Woodfield Pit
Hundred River
Path
Knodishall
Greenhouse Plantation
18m
Upper A
16m
19m
Abbey Cottage
Lodge
Old Abbey Farm
Leiston Abbey
(remains of)
(Premonstratensian
founded 1182)
17m
Track
Leiston Old Abbey
Issues
Fiscal Police
13m
Laboratory
LOVERS LANE
12m
Mast
Brick Kiln Farm
Pit (dis)
Sewage Works
West End Nurseries
Wood Farm
Summerhill School
Football Ground
Cemy
PW
Hall
WESTWARD HO
CARR AVENUE
BULLER ROAD
KITCHENER ROAD
Masterlord Industrial Estate
Coun Offs
Liby
Caravan Park
Ailot Gdns
WATERLOO AVENUE
MAIN STREET
Mus
War Meml
Vic
Recn Gd
Leiston Middle School
Depot
F Sta
SIZEWELL ROAD
Sch
Leiston Primary School
KING GEORGE'S AVENUE
Leiston Hall Farm
Dunn's Hole
The Cupola
Sports Ground
VICTORY ROAD
Car Pk
KINGS ROAD
SEAWARD AVENUE
Leiston Community
Playing Field
VALLEY ROAD
Track
Drain
Path
Pit (dis)
Sewage Works
Brick Kiln Farm
Track
Drain
Track
Drain
Path
Track
Track
Drain
Path
Track
Track
Drain
Path
Track



BENACRE TO EASTON BAVENTS

BENACRE TO EASTON BAVENTS LAGOONS

DEW'S PONDS

MINSMERE TO WALBERSWICK & MINSMERE TO WALBERSWICK

MINSMERE TO WALBERSWICK HEATHS & MARSHES

SOUTHERN NORTH SEA

SANDLINGS

ALDE-ORE & BUTLEY ESTUARIES

ALDE-ORE ESTUARY

ALDE-ORE ESTUARY

SANDLINGS

STAVERTON PARK AND THE THICKS, WANTISDEN

SANDLINGS

ORFORDNESS-SHINGLE STREET

OUTER THAMES ESTUARY

A140/B1078 WEST OF CODDENHAM INDICATIVE LOCATION OF DEVELOPMENT SITE BOUNDARY

B1078/B1079 EAST OF EASTON AND OTLEY COLLEGE INDICATIVE LOCATION OF DEVELOPMENT SITE BOUNDARY

DEBEN ESTUARY & DEBEN ESTUARY

STOUR AND ORWELL ESTUARIES & STOUR AND ORWELL ESTUARIES

NOTES

KEY

- SIZEWELL C AND ASSOCIATED DEVELOPMENT SITE BOUNDARIES
- DEMARCATION LINE
- INDICATIVE LOCATION OF DEVELOPMENT SITE BOUNDARIES

DESIGNATIONS

- SPECIAL AREA OF CONSERVATION (SAC)
- SPECIAL PROTECTION AREA (SPA)
- RAMSAR SITE

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CHAPTER 4
SCOPING OF EUROPEAN SITES

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EUROPEAN SITES SCOPED-IN TO THE HRA PROCESS

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