Department for Business, Energy & Industrial Strategy

RECORD OF THE HABITATS REGULATIONS ASSESSMENT UNDERTAKEN UNDER REGULATION 5 OF THE OFFSHORE PETROLEUM ACTIVITIES (CONSERVATION of HABITATS) REGULATIONS 2001 (As Amended)

Project Title*: *Spirit Energy A Fields (Ann A4, Ann, Alison, Audrey, Saturn (Annabel)) and Ensign Decommissioning HRA

Spirit Energy North Sea Limited

July 2021

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1 INTRODUCTION

1.1 This is a record of the Habitats Regulations Assessment (HRA) undertaken by the Department for Business Energy and Industrial Strategy (BEIS) in respect of planned decommissioning activities to be undertaken by Spirit Energy North Sea Limited (Spirit Energy hereafter) in the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC.

1.2 This HRA covers the planned decommissioning of oil and gas infrastructure for the following gas fields:

- Ann A4,
- Ann,
- Alison,
- Audrey,
- Saturn (Annabel),
- Ensign.

1.3 Collectively, Ann A4, Ann, Alison, Audrey and Saturn (Annabel) are referred to as the A-fields.

1.4 The planned decommissioning activities are presented in the relevant decommissioning plans and the associated Environmental Impact Assessments (EIA) (Centrica 2017a, b, Spirit Energy 2018; 2020a).

1.5 BEIS is the competent authority for applications submitted under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (S.I. 2001/1754) (As Amended) (referred to as the Offshore Habitats Regulations) and future decommissioning programmes submitted to the Department will be subject to the requirements of the regulations.

1.6 Spirit Energy, has previously submitted to BEIS Offshore Decommissioning Unit (ODU) Decommissioning Programmes for the A-fields. These were subsequently approved: Ann A4 on 2 March 2017 and the Ann, Alison, Audrey and Saturn (Annabel) fields on 24 April 2018. However, since the submission and approval of the decommissioning plans, Spirit Energy have written to BEIS requesting approval of a revised schedule, with decommissioning activities extending to at least 2022 (Spirit Energy 2020b).

1.7 Spirit Energy submitted to BEIS a decommissioning plan and associated EIA and comparative assessment for the Ensign field in October 2019.

1.8 BEIS recognises that there is potential for activities presented within decommissioning programmes to impact on sites designated under the European Habitats 92/43/EC and Birds Directives 209/147 EC. BEIS also recognises that there is potential for current

and future activities associated with oil and gas decommissioning to impact on these sites. Consequently, as the competent authority, BEIS has undertaken an assessment to determine whether the potential impacts from likely decommissioning activities as identified in the relevant decommissioning plans may cause likely significant or adverse effects to the qualifying features of European designated sites and thereby affect the integrity of the sites.

1.9 As part of the assessment, potential in-combination impacts from future plans or projects including other decommissioning activities within the European designated sites have been assessed to determine whether there is potential for likely significant or adverse effects on the integrity of the sites.

1.10 The in-combination assessment also includes potential future oil and gas related activities that are not the subject of any currently submitted projects or plans. By doing so it does not pre-empt the requirement to undertake HRA when future licence applications are submitted. It does not pre-determine any decision regarding future decommissioning programmes or projects. However, where possible, it does provide a strategic overview of potential in-combination impacts from forecast activities.

1.11 This document presents the finding of the assessment undertaken by BEIS.

Habitats Regulations Assessment

1.12 The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 make changes to three statutory instruments including The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (the Offshore Habitats Regulations), which is relevant to this assessment. The 2019 regulations ensure that the protection provided under the existing regulations, including the 2001 regulations remain as they were prior to the UKs exit of the EU. This includes the continued protection of designated sites along with their qualifying features and the requirement for a competent authority to undertake an assessment of any plans or projects that could impact on the sites or their features.

1.13 The Conservation of Habitats and Species Regulations 2017 (as amended) and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) provide for the designation of sites for the protection of habitats and species of national importance; these sites are called Special Areas of Conservation (SACs). For the protection of birds these sites are called Special Protection Areas (SPAs). Collectively, all existing and future SACs and SPAs form a national site network[1].

[1] For the purposes of this assessment a national site relates to cSAC/SAC. Prior to January 1 2021 national sites were referred to as European sites.

1.14 Possible SACs (pSACs), candidate SACs (cSACs) and potential SPAs (pSPAs) are afforded the same levels of protection by the UK Government as sites that have already been designated. Sites designated under the Ramsar Convention are also afforded the same level of protection as a designated site.

1.15 Any plan or project which either alone or in-combination with other plans or projects would be likely to have a significant effect on a qualifying site must be subject to an Appropriate Assessment to determine the implications for a site's integrity and conservation objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a national site unless there are imperative reasons of overriding public interest for carrying out the plan or project. Draft sites, i.e. those that have not been subject to any formal consultation, are not subject to the Appropriate Assessment process.

1.16 The Offshore Habitats Regulations transpose the Birds and Habitats Directives into UK law for offshore activities consented under the Petroleum Act 1998 and the Energy Act 2008.

1.17 Regulation 5(1) of the Offshore Habitats Regulations provides that: '*The Secretary of State shall, before granting any Petroleum Act licence, any consent, any authorisation, or any approval, where he considers that anything that might be done or any activity which might be carried on pursuant to such a licence, consent, authorisation or approval is likely to have a significant effect on a relevant site, whether individually or in-combination with any other plan or project, including but not limited to any other relevant project, make an appropriate assessment of the implications for the site in view of the site's conservation objectives'*.

1.18 Under the Convention on Wetlands, signed in Ramsar, Iran (1971) sites regularly supporting 20,000 water birds and/or support 1% of the individuals in the population of one species or subspecies of water bird, receive specific designation known as Ramsar designation. Although they do not form part of the national site network under UK guidance Ramsar sites are, as a matter of policy, afforded the same protection as European designations SPAs and SACs (ODPM 2005).

1.19 The planned decommissioning activities at the A-fields and at Ensign may cause a likely significant or adverse effect on the qualifying features of national sites and therefore, as the competent authority, BEIS is required to appropriately assess plans or projects in view of the site's management (conservation) objectives. The fields being decommissioned lie within, or are adjacent to, two national sites, namely the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC (Figure 1 and Figure 2).

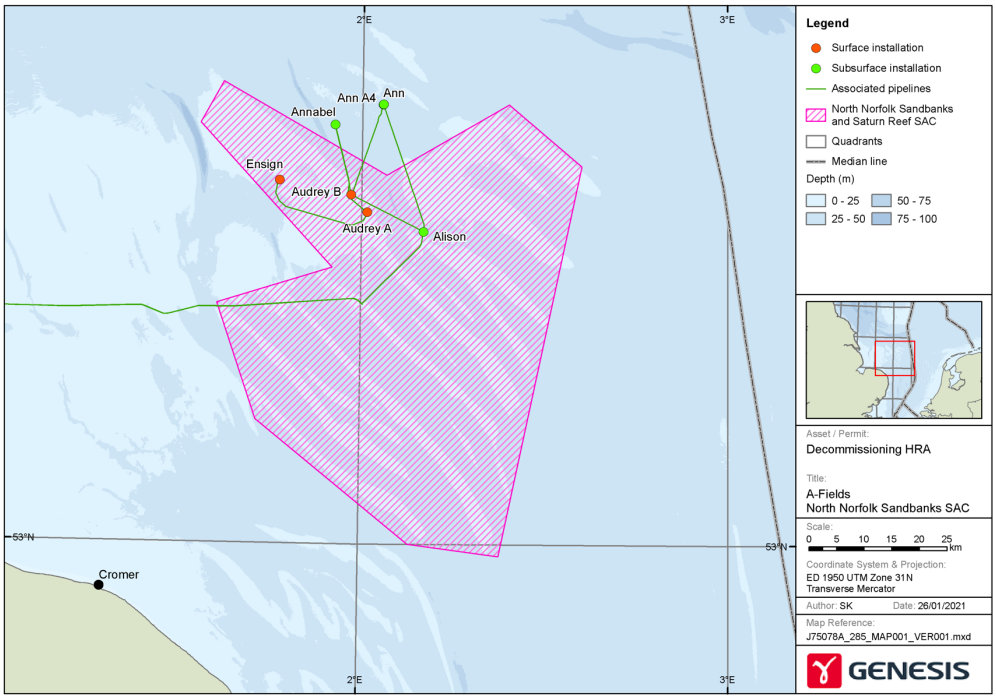


Figure 1: North Norfolk Sandbanks and Saturn Reef SAC and installations to be decommissioned as part of A-fields and Ensign decommissioning programmes.

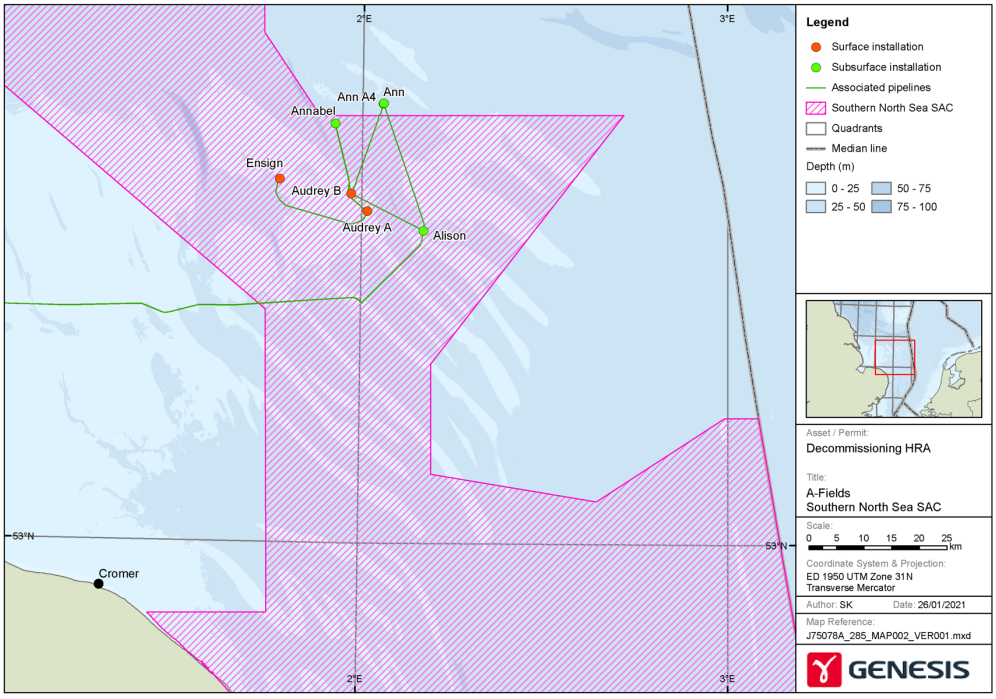


Figure 2: Southern North Sea SAC and installations to be decommissioned as part of the A-fields and Ensign decommissioning programmes.

1.20 This HRA is undertaken in accordance with The Offshore Habitats Regulations to satisfy the Appropriate Assessment requirement.

1.21 This HRA assesses potential impacts from activities for which the BEIS Secretary of State is the competent authority. It does not assess impacts from other activities alone, but where appropriate does take those activities into consideration when addressing potential in-combination impacts.

2 SPIRIT ENERGY SOUTHERN NORTH SEA DECOMMISSIONING

2.1 Spirit Energy are the operator of a number of gas fields in the southern North Sea that have been or will be subject to decommissioning programmes. The decommissioning programmes for five installations and their associated infrastructure have previously been approved and decommissioning activities have commenced. Activities that have been completed and those still to be undertaken for each of the A-fields are presented in Table 1 to Table 4.

Ann A4

2.2 The Ann A4 field comprises a single subsea well (49/6a-A4z) protected by a well head protection structure and is tied back to the Ann subsea manifold via a 124 m long, 6" pipeline (PL2164) and a 129 m long, 4" umbilical jumper (PL2165). The well ceased production on 1 May 2016.

2.3 The final decommissioning plan and associated environmental assessment were submitted by Centrica to BEIS in February 2017 and approval given in February 2017 (Centrica 2017a,c). The decommissioning plan included the removal of the wellhead, tree and wellhead protection and these were removed in July and August 2017. The remaining works include the removal of the pipelines and stabilisation features and post-decommissioning surveys. These were included in the Ann and Alison decommissioning programme and have yet to be undertaken (Table 1) (Centrica 2017b; Spirit Energy 2020b). The remaining decommissioning activities relating to the Ann A4 pipelines and stabilisation are:

- the complete removal of:
  - The surface laid Ann A4 6" pipeline spool piece.
  - The surface laid Ann A4 4" umbilical jumper.
  - Concrete mattresses,
- *Leave In situ* deposited rock.

Table 1: Decommissioning activity at Ann A4.

Ann A4	Date undertaken
Works Completed:	
Pipeline cleaning and flushing	August 2017
Well decommissioning (49/6-A4z)	July 2017
Wellhead Protection Structure removed	August 2017
Works to be Undertaken:	
Removal of pipelines and stabilisation features	2021+
Post decommissioning surveys including verification of clean seabed	2021+

2.4 The Ann A4 field and associated pipeline lie outwith the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC (Figure 1 and Figure 2). Activities associated with decommissioning to be undertaken will not impact on these sites.

Ann

2.5 The Ann field comprises two subsea wells (49/6a-A2, 49/6a-A3z), protected by a well head protection structure. Gas was exported via a 41.8 km long 12" pipeline (PL947) to the LOGGS platform complex. Power, controls and chemicals were provided to the Ann subsea template via a 17.6 km long, 4" umbilical (PL948) routed from the Audrey B (XW) platform (Centrica 2017b).

2.6 Production ceased on 1 May 2016. The decommissioning plan and associated environmental assessment were submitted by Centrica to BEIS in June 2017 and have been approved (BEIS 2021).

2.7 The Ann Installation Decommissioning Programme covers:

- Complete removal of the Ann template.
- Removal of the top of the Ann template piles.
- *In situ* decommissioning of the frond mattresses.

2.8 The Ann Pipelines Decommissioning Programme covers:

- Leave *In situ* the Ann 12" export pipeline (PL947) except for the following sections that will be completely removed:
    - The surface laid Ann 12" spool pieces of PL947 at the Ann template, between the Alison tee and the Alison template and at LOGGS PR.
    - The exposed spool pieces of PL947 at the Ann template and at LOGGS PR.
    - The exposed spool pieces of PL948 at the approaches to Audrey B (XW) and the Ann template
    - The surface laid Alison tee including the protection structure and concrete

blocks.

2.9 The Ann field lies outwith any national site but the 30.2 km of the PL947 and 6.4 km of the PL948 occur within the North Norfolk Sandbanks and Saturn Reef SAC. Similarly, 39.6 km of PL947 and 15.1 km of PL948 occur within the Southern North Sea SAC (Figure 1 and Figure 2).

Alison

2.10 The Alison field comprises a single well (49/11a-B3) and a subsea template[2]. Gas is exported into the Ann to LOGGS line via a short pipeline stub (PL947) connected to the Alison Tee piece. A 15.1 km long, 4" control umbilical (PL1099) connects the Audrey B installation to the Alison template.

2.11 Production ceased on 1 May 2016. The decommissioning plan and associated environmental assessment were submitted by Centrica to BEIS in June 2017 and approval of the decommissioning plan was given in April 2020 (BEIS 2021).

2.12 The Alison Field comprises:

- One subsea production piled template located in licence block 49/11-3.
- A 0.05 km long export stub (PL0947) connected between the Alison subsea template and the Alison Tee (tied into the main Ann gas export line (PL0947))
- A 15.1 km control and umbilical pipeline (PL1099) from Audrey installation to Alison template.
- A single wellhead and manifold protecting template.

2.13 The Alison Installation Decommissioning Programme covers:

- Complete removal of the Alison template.
- Complete removal of the top of the Alison template piles.
- Leave in situ frond mattresses.
- Post decommissioning clean seabed surveys.

2.14 The Alison Pipeline Decommissioning Programme covers:

- Complete removal of the first c.8 km of the Alison 4" umbilical (PL1099).
- Complete removal of the exposed spool pieces of PL1099 at Audrey B (XW) and the Alison template.
- Leave in situ c.7 km of the Alison 4" umbilical (PL1099).
- Complete removal of concrete mattresses and bitumen mattresses.
- Leave in situ deposited rock.

[2] Note there is a second well (49/11a-KX) connected to the template that is not part to the decommissioning programmes that are subject to this assessment.

- Post decommissioning clean seabed surveys.

2.15 The Alison field lies within the Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC (Figure 1 and Figure 2).

2.16 The combined decommissioning activities undertaken to date at both the Ann and Alison fields include the decommissioning of the three wells and cleaning and flushing of the pipelines. Activities still to be undertaken include the removal of both subsea templates, pipelines, stabilisation features and post decommissioning surveys (Spirit Energy 2020b) (Table 2).

Table 2: Decommissioning activity at Ann and Alison.

Ann and Alison	Date undertaken
Works Completed:	
Pipeline cleaning and flushing	July 2018
Well decommissioning (49/6-A2, 49/6a-A3z, 49/11a-B3)	August 2017
Works to be Undertaken:	
Removal of pipelines and stabilisation features	2021+
Removal of Ann and Alison templates	2021+
Post decommissioning surveys including verification of clean seabed	2021+

Audrey

2.17 The Audrey field comprises two platforms: Audrey A (Audrey WD) and Audrey B (Audrey XW), a subsea template (Audrey 11-a7). In total there are 15 wells, with fourteen topsides production wells on the Audrey installations and one subsea well at Audrey 11-a7. Gas was exported from the Audrey A platform to the LOGGS platform complex via a 16.89 km, 20" gas export line (PL496). A 3" methanol line (PL497) is piggy-backed onto PL496. Gas from the Audrey 11-a7 subsea installation was exported to the Audrey A platform via a 0.496 km, 8" gas export line (PL575) along with an associated 4" piggy-backed umbilical (PL576). Between the Audrey A and Audrey B installations there is a 4.34 km, 14" gas line (PL723) and a piggy-backed umbilical (PL724) (Centrica 2017a).

2.18 Production ceased on 1 May 2016. The decommissioning plan and associated environmental assessment were submitted by Centrica to BEIS in June 2017 and have been approved (BEIS 2021).

2.19 The Audrey Installations Decommissioning Programme covers:

- The complete removal and recovery of the:
  - Audrey A platform topsides and jacket.
  - Audrey B platform topsides and jacket.
  - Audrey A and Audrey B drilling templates.

- Audrey 11a-7 WHPS.
- Top section of platform piles.
- Top section of drilling template piles.
- Top section of WHPS piles.

2.20 The Audrey Pipelines Decommissioning Programme covers:

- Partial removal or leave *in situ* the 20" gas export line (PL496).
- Partial removal or leave *in situ* the 3" methanol line (PL497).
- Complete removal of the 8" gas export line (PL575).
- Complete removal of the 4" umbilical (PL576).
- Partial removal or leave *in situ* the 14" gas pipeline (PL723).
- Partial removal or leave *in situ* the 3" methanol line (PL724).
- Recovery of concrete mattresses.

2.21 Existing deposited rock and frond mattresses will be left *in situ*.

2.22 Decommissioning activities undertaken to date include the decommissioning of all 15 wells and the cleaning and flushing of pipelines. Work still to be undertaken include the removal of the two Audrey platforms and the subsea installation. Removal of subsurface conductors at Audrey B wells and post-decommissioning surveys (Spirit Energy 2020b) (Table 3).

2.23 The Audrey field lies within both the North Norfolk Sandbanks and Saturn reef SAC and the Southern North Sea SAC (Figure 1 and Figure 2).

Table 3: Decommissioning activity at Audrey.

Audrey	Date undertaken
Works Completed:	
Pipeline cleaning and flushing	August 2018
Well decommissioning: Audrey A (WD) 49/11-A1, 49/11-A2, 49/11-A3, 49/11-A4, 49/11-A5, 49/11-A6, 49/11-A7, 49/11-A8, 49/11-A9, 49/11-A10.	April 2019
Well decommissioning: Audrey B (XW) 48/15a-B1Z, 48/15a-B2, 48/15a-B3, 48/15a-B5, 48/15a-A4.	May 2018
Well decommissioning: Audrey 49/11a-7	May 2017
Works to be Undertaken:	
Removal of pipelines and stabilisation features	2021+
Removal of Audrey Installations (2 platforms, 1 WHPS)	2021+
Removal of final conductor from 49/11a-A1 well and final 3 m long subsurface conductors from all Audrey B (XW) wells.	2021+
Post decommissioning surveys including verification of clean seabed	2021+

Saturn (Annabel)

2.24 The Saturn (Annabel) field comprises two subsea wells (48/10a-12 (Annabel AB1) and 48/10a-14 (Annabel AB2)), one subsea template and two well head protection structures. Gas was exported from the Annabel AB1 well to the subsea template via a 0.03 km, 8" pipeline (PL2066 JW12) and from the Annabel AB2 well via a 0.13 km, 8" pipeline (PL2066JWAB2), where the gas from the two wells was comingled before being exported to the Audrey A installation via a 17.8 km, 10" export gas pipeline (PL2066). A 0.09 km, 4.5" control and umbilical line (PL2067JW12) connects the Annabel AB1 well to the subsea template and a 0.2 km control and umbilical line (PL2067JWAB2) connects the Annabel AB2 well to the template. A 13.4 km, 4.5" control and umbilical pipeline (PL2067) runs from between the template and the Audrey A installation (Centrica 2017a).

2.25 Production ceased on 1 May 2016. The decommissioning plan and associated environmental assessment were submitted by Centrica to BEIS in June 2017 and have been approved (BEIS 2021).

2.26 The Annabel Installations Decommissioning Programme covers the removal and recovery of the:

- Annabel template.
- Annabel AB1 wellhead protection structure.
- Annabel AB2 wellhead protection structure.

2.27 The Annabel Pipelines Decommissioning Programme covers:

- Leave *in situ* the 10" pipeline (PL2066).
- Complete removal of the 8" pipe spools (PL2066JW12).
- Complete removal of the 8" pipe spools (PL2066JWAB2).
- Leave *in situ* the 4½" umbilical (PL2067).
- Complete removal of the 4½" umbilical (PL2067JW12).
- Complete removal of the electro-hydraulic bundle (PL2067JWAB2).
- Recovery of concrete mattresses.

2.28 Existing deposited rock and frond mattresses will be left *in situ*.

2.29 Decommissioning activities undertaken to date include the decommissioning of both wells, the removal of both wellhead protection structures and the cleaning and flushing of pipelines. Work still to be undertaken include the removal of the subsea template, removal of pipelines and umbilicals and post-decommissioning surveys (Spirit Energy 2020b) (Table 4).

Table 4: Decommissioning activity at Saturn (Annabel).

Saturn (Annabel)	Date undertaken
Works Completed:	
Pipeline cleaning and flushing	August 2018
Well decommissioning: two wells 48/10a-12 and 48/10a-14	October 2018
Removal of two wellhead protection structures	May 2018
Works To be undertaken:	
Removal of pipelines and stabilisation features	2021+
Removal of subsea template	2021+
Post decommissioning surveys including verification of clean seabed	2021+

2.30 The Annabel field lies outwith the North Norfolk Sandbanks and Saturn Reef SAC. A total of 13.24 km of the gas export line (PL2066) and 8.7 km of the umbilical (PL2067) lie within the SAC. The Annabel field and the associated pipelines lie within the Southern North Sea SAC (Figure 1 and Figure 2).

Ensign

2.31 The Ensign gas field lies within the southern North Sea UK Block 48/14a. The field lies 109 km west of Easington on the coast of Norfolk in water depths of 25 m.

2.32 The field was developed using a four legged jacket platform. Gas was exported to the Audrey A installation via a 22.3 km long 10" pipeline (PL2838). A 2" methanol line is piggy-backed on the gas export line.

2.33 The Ensign field comprises a single installation and two platform wells (48/14a-7y, 48/14a-5) and one unused subsea well (48/14a-6 (Ensign ED)). Gas was exported from the Ensign installation to Audrey A via a 22.3 km, 10" export line (PL2838). A 2" methanol line (PL2839) was piggy-backed onto the export line. An unused 2.0 km, 10" gas export line (PL2841) and piggy-backed methanol line (PLU2840) run between the Ensign ED well and the Ensign installation (Spirit Energy 2019a,b; 2020a).

2.34 The decommissioning plan and associated environmental assessment were submitted by Spirit Energy to BEIS in October 2019 and are awaiting a decision (BEIS 2021).

2.35 The proposed work programme for the decommissioning of the Ensign field is the:

- Plug and abandon wells in accordance with the well abandonment programme.
- Preparation, final cleaning and removal of mobile hydrocarbons, production chemicals and mobile solids from pipelines and topsides (gas, methanol and corrosion inhibitors) and subsequent flooding of pipelines with seawater are (covered in separate environmental assessments for relevant environmental approvals).

- Leaving installations in cold suspension marked with appropriate navigational aids for up to four years.
- Removal of infrastructure by heavy lifting vessel including topsides, jackets, pigging/valve skids and manifolds. The disconnection of platforms between the riser base and point of pipeline burial and removal of well conductors which could not be removed during the preceding well abandonment.
- Leave in situ cleaned and disconnected pipelines and existing deposits with rock to stabilise cut pipeline ends.

Table 5: Decommissioning activity at Ensign.

Ensign	Date undertaken
Works Completed: None	
Works To be undertaken:	
Plug and Abandon wells	2021+
Well decommissioning	2021+
Pipeline cleaning and flushing	2021+
Removal of pipelines and stabilisation features	2021+
Removal of manifolds	2021+
Removal of installations	2021+
Post decommissioning surveys including verification of clean seabed	2021+

2.36 The Ensign field and the associated pipelines lie within the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC (Figure 1 and Figure 2).

2.37 A summary of the A-field and Ensign infrastructure still to be decommissioned is presented in Table 6 to Table 7.

Table 6: A-fields and Ensign installation infrastructure to be decommissioned.

Installation		Number	Number of piles
Installations			
Ann	Subsea template	1	3
Alison	Subsea template	1	3
Alison	Tee Piece	1	0
Audrey	Audrey A (WD) platform	1	4
Audrey	Audrey B (XW) platform	1	4
Audrey	Wellhead protection structure	1	4
Saturn (Annabel)	Subsea template	1	4
Ensign	Ensign platform	1	4

Table 7: A-fields and Ensign wells.

Field	No. of wells	Number decommissioned [1]	Number remaining
Ann A4	1	1	0
Ann	2	2	0
Alison	1	1	0
Audrey	15	15	(6)*
Annabel	2	2	0
Ensign	3	0	3

[1] – As of January 2021

* Note for six wells the conductors are still to be removed

Table 8: A-fields and Ensign pipeline infrastructure to be decommissioned.

Installation	Pipeline No.	Pipeline	Total length (km)	To be removed (km)
Ann A4	PL2164	6" pipeline spool piece	0.12	0.12
Ann A4	PL2165	4" umbilical jumper	0.13	0.13
Ann	PL947	12" spool pieces	41.8	0.07
Ann	PL948	4” umbilical	17.6	0.14
Alison	PL947	12” gas export (stub)	0.05	0.05
Alison	PL1099	4” umbilical	15.1	8.16
Audrey	PL496	20” gas export	16.89	0.230
Audrey	PL497	3” methanol line	16.96	0.282
Audrey	PL575	8” gas export	0.496	0.496
Audrey	PL576	4” methanol line	0.650	0.650
Audrey	PL723	14” gas export	4.34	0.353
Audrey	PL724	3” methanol line	4.42	0.302
Annabel	PL2066 JW12	8” gas export	0.03	0.03
Annabel	PL2067 JW12	4.5” control and umbilical	0.09	0.09
Annabel	PL2066 JWAB2	8” gas export	0.13	0.13
Annabel	PL2067 JWAB2	4.5” control and umbilical	0.2	0.2
Annabel	PL2066	10” gas export	17.8	0
Annabel	PL2067	4.5” control and umbilical	13.4	0
Ensign	PL2838	10” gas export	22.3	0.18
Ensign	PL2839	2” methanol line	22.3	0.16
Ensign	PL2841	10” gas export	2.0	0.08
Ensign	PLU2840	4.8” methanol line	2.2	0.24

Note there are two pipelines numbered PL947. One is a 12” gas export line from the Ann and Alison fields to LOGGS and includes a 50 m stub from the Alison field into the Ann to LOGGS export line. The other PL947 line is a 3” methanol line piggy-backed onto PL946 from Audrey A to LOGGS.

2.38 It is proposed that all platforms subject to these decommissioning programmes will be fully removed using a heavy lift vessel. All wells still to be decommissioned will be plugged and abandoned, and conductors removed as well as manifolds and the Alison pipeline tee.

2.39 Of the 22 pipelines, associated methanol lines and umbilicals included as part of A-fields and Ensign decommissioning plans, eight will be totally removed. The others will be either partially removed or cut and left *in situ* (Table 8). Mattresses, grout bags and other deposits laid during operational life for stabilisation may be removed or left *in situ*. In order to reduce the risk of exposure to other sea users, the ends of any cut pipelines will be buried or covered using rock.

2.40 Decommissioning activities are proposed to be undertaken over a number of years with completion of all decommissioning activities by 2024, subject to regulatory approvals and operational impacts.

2.41 Proposed activities that could cause a physical impact to habitat include:

- The use of anchors and chains during the locating of a heavy lift vessel, if not using dynamic positioning.
- The lowering of spud cans by a drilling rig during well abandonment.
- The removal of jacket piles (platforms), subsea infrastructure including manifolds and wellhead protection structures (some piled), disconnected sections of pipelines, well conductors and temporary placement of debris baskets to recover items.

2.42 Physical impacts to qualifying features may occur during decommissioning activities and these may be temporary, where the habitat may recover overtime.

2.43 Proposed activities that could cause a physical loss of habitat include:

- The placement of rock over pipeline ends and to remediate any hazardous free spans.
- The leaving *in situ* of pipelines exposed on the seabed.

2.44 The physical loss of habitat is, for the purposes of this assessment, considered to be a permanent loss of habitat.

3 DESIGNATED SITES

3.1 The proposed decommissioning activities will occur within two designated sites (Figure 1 and Figure 2), namely:

- The North Norfolk Sandbanks and Saturn Reef SAC,
- The Southern North Sea SAC,

3.2 Based on the information presented within the decommissioning plans and environmental appraisals it is determined that there is potential for a likely significant effect on the: The North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC.

3.3 The North Norfolk Sandbanks and Saturn Reef SAC covers an area of 3,603 km^2 and lie entirely within UK territorial waters adjacent to the counties of Norfolk. It was formally classified as a SAC on 29 September 2017 on account of its Sandbanks which are slightly covered by sea water all the time [Habitat code 1110] and Reefs [Habitat code 1170]. The basis for the classification is set out in a Natura 2000 Standard Data Form (JNCC 2017a).

3.4 The Southern North Sea SAC covers an area of 36,951 km^2 extending from the central North Sea, north of the Dogger Bank, to the Strait of Dover and is designated for harbour porpoise (*Phocoena phocoena*). It was formally classified as a SAC in February 2019 and the basis for the classification is set out in a Natura 2000 Standard Data Form (JNCC 2019a).

4 CONSERVATION OBJECTIVES

4.1 Conservation Objectives outline the desired state for any national site, in terms of the interest features for which it has been designated. If these interest features are being managed in a way which maintains their nature conservation objectives, they are assessed as being in a 'favourable condition'. An adverse effect on integrity 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 its designation (English Nature 1999).

4.2 Favourable Conservation Status is defined in Article 1(e) of the Habitats Directive as:

> *Conservation status of a natural habitat 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;*

4.3 The conservation status of a natural habitat will be taken as "favourable" when:

> *its natural range and areas it covers within that range are 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 as defined in (i).*

4.4 The objective to restore arises where there is evidence that indicates that some of a feature's extent is lost and needs to be restored. The objective to maintain is given to a feature where extent is not lost but needs to be maintained in order to ensure the feature is in overall favourable condition (JNCC 2017b)

4.5 Advice from the JNCC is that, in their view, both Annex 1 sandbank habitats and Annex 1 reef habitats within the North Norfolk Sandbanks and Saturn Reef SAC are in unfavourable condition. This is based on their understanding that one or more of the sites attributes need to be restored or where restoration is not considered to be possible through human intervention (JNCC 2017b).

4.6 The harbour porpoise within the Southern North Sea SAC has a favourable conservation status (JNCC and NE 2019).

4.7 There are no set thresholds at which impacts on site integrity are considered to be adverse. This is a matter for interpretation on a site-by-site basis, depending on the designated feature and nature, scale and significance of the impact.

4.8 The European Court of Justice has defined '*adverse effect on site integrity*' as a plan or project that is '*liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural habitat whose*

conservation was the objective justifying the designation of the site in the list of sites of Community importance' (Sweetman 2013).

4.9 When assessing potential small scale impacts on Annex I habitats it is the relative importance of the area affected in terms of the rarity, location, distribution, vulnerability to change ecological structure which is most influential (Chapman and Tyldesley 2016).

4.10 The integrity of a site is defined as being '*the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified*' (ODPM Circular 06/2005).

4.11 Conservation Objectives have been used by the Department BEIS to consider whether the proposed activities have the potential for causing an adverse effect on a site's integrity, either alone or in-combination.

North Norfolk Sandbanks and Saturn Reef SAC Conservation Objectives

4.12 The Conservation Objectives of each site are required in order to undertake an Appropriate Assessment. The following Conservation Objectives have been produced by the JNCC for North Norfolk Sandbanks and Saturn Reef SAC (JNCC 2017c).

North Norfolk Sandbanks and Saturn Reef SAC Conservation Objectives:

For the features to be in favourable condition thus ensuring the integrity of the site in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I reefs. This contribution would be achieved by maintaining or restoring, subject to natural change:

- The extent and distribution of the qualifying habitats in the site;
- The structure and function of the qualifying habitats in the site; and
- The supporting processes on which the qualifying habitats rely.

Source JNCC 2017c

4.13 It is noted that the qualifying features of the site are in *unfavourable condition* (JNCC 2017b).

4.14 Supplementary advice on the Conservation Objectives of the site relating to Annex 1 sandbanks slightly covered by seawater all the time states that:

A restore objective is advised for extent and distribution of the sandbank feature. This objective is based on expert judgment; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. those associated with the oil and gas industry and cabling. Our confidence in this objective would be

improved with longer-term monitoring and access to better information on the activities taking place within the site. Activities must look to minimise, as far as is practicable, changes in substratum and the biological assemblages within the site to minimise further impact on feature extent and distribution (JNCC 2017b).

4.15 The JNCC consider the entire site to represent an integrated sandbank system, with the qualifying feature occupying the entire site (JNCC 2017b).

4.16 Supplementary advice on the Conservation Objectives of the site relating to Annex 1 Reef – *Sabellaria spinulosa* biogenic reef states that:

JNCC understands that the site has been subjected to activities that have resulted in a change to the extent and distribution of the feature within the site. Installation and/or removal of infrastructure may have a continuing effect on extent and distribution of the biogenic reef within the site. As such, JNCC advise a restore objective which is based on expert judgment; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. those associated with the oil and gas industry and demersal fishing. Our confidence in this objective would be improved with longer-term monitoring and access to better information on the activities taking place within the site. Activities must look to minimise, as far as is practicable, damaging the established i.e. high confidence reef within the site. (JNCC 2017b).

4.17 The JNCC advise that due to the cyclical nature of reef formation and decay, it is important to conserve the feature's overall extent within a site, and that this approach includes conserving both established reef and areas of potential reef. Assessments should focus on reef extent occurring at that specific point in time, therefore a repeat survey may be required at the point of assessment. (JNCC 2017b).

Southern North Sea SAC Conservation Objectives

4.18 The following Conservation Objectives have been produced by the JNCC for the Southern North Sea SAC (JNCC and NE 2019).

Southern North Sea SAC Conservation Objectives:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status 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.

Source: JNCC and NE 2019

4.19 The intent of the first objective is 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 those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated*' (JNCC and NE 2019).

4.20 Within the Conservation Objectives '*Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site*'. Guidance has been published on how to assess the significance of disturbance (JNCC and NE 2019, JNCC 2020a).

4.21 The third objective *'encompass the movements and physical properties of the habitat. 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*' (JNCC and NE 2019).

4.22 JNCC advise that it is not appropriate to use the site population estimates in any assessments of effects of plans or projects (i.e. Habitats Regulation Assessments), as it is necessary to take into consideration population estimates at the management unit level to account for daily and seasonal movements of the animals (JNCC and NE 2019).

4.23 The purpose of an Appropriate Assessment is to determine whether a plan or project adversely affects a site's integrity. The critical consideration in relation to site integrity is whether the plan or project affecting a site, either individually or in combination, affects the site's ability to achieve its conservation objectives and favourable conservation status.

4.24 The Appropriate Assessment has been carried out in light of best scientific knowledge with reference to the Conservation Objectives of the qualifying sites and the potential impacts on the integrity of the site (EC 2010, EC 2019).

5 SCOPE OF THE ASSESSMENT

5.1 Based on the likely activities predicted to occur during decommissioning it has been determined that the HRA should consider alone and in-combination the potential direct and indirect impacts on:

- Sandbanks,
- Biogenic reefs,
- Harbour porpoise.

Sandbanks

5.2 Sandbanks which are slightly covered by seawater all the time are an Annex I habitat under the Habitats Directive and are described as *Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20 m below Chart Datum*.

5.3 Annex I Sandbanks are defined by their physiographic nature rather than by a specific biological community. They are variable in both shape and topography but their crests are usually less than 20 m below the sea surface (Natural England *undated*). There has been no significant change in recent geological times and although there may have been localised declines the overall geographic spread and distribution of offshore sand banks have not been reduced (JNCC 2019b).

5.4 Sandbank habitat occurs widely in UK coastal and offshore waters. The total area of sandbank habitat identified in UK waters is reported to be 105,785 km^2, of which 21,979 km^2 lies within designated sites (JNCC 2019b,c). In offshore waters the total area of Annex I sandbank habitat is 17,141 km^2 of which 16,804 km^2 is located in SACs, accounting for 98% of all sandbank habitat in UK offshore waters (JNCC 2019d). There are twenty designated sites in UK waters for which this habitat is a primary feature and a further 16 sites in which the habitat occurs but not identified as a primary reason for site selection (JNCC 2020b).

5.5 The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters (JNCC 2020c). The SAC has within its boundaries a series of sandbanks including Leman, Ower, Inner, Well, Broken, Swarte and Indefatigable banks. They extend from between 40 km and 110 km off the coast of Norfolk in water depths of up to 40 m (Figure 3).

5.6 The extent of sandbank habitat within the SAC covers 3,603 km^2, accounting for 3.4% of the total sandbank habitat in UK waters and 21.0% located in offshore waters (JNCC 2019b, c and JNCC 2020c).

5.7 The Norfolk sandbanks are very slowly migrating north-east. Published studies have suggested that the lateral rate of movement occurs at a rate of between 1 – 5 m/year (ABPmer 2005, Cooper *et al*. 2008). However, the internal structure of the Norfolk Banks

indicates that it is at a rate of *c.*1 m/yr (Cooper *et al.* 2008). At this rate it would take over one hundred years to detect any movement of the sandbanks greater than 100 m, which is within the distance of survey and charting errors (Cooper *et al*. 2008). Furthermore, the outer Indefatigable and Swarte banks may be moribund, with their crests in deeper water, and therefore may not be mobile (Cooper *et al*. 2008). Although, there may be linear movements of the sandbanks, particularly at their ends, where movements of up to 40 m per year have been reported (ABPmer 2005). Surveys undertaken in 2016 reported no changes in the structure of the indefatigable sandbank over a period of three years. However, at the Leman Bank a change in the shape of the main bank has occurred with a partial movement of 30 m north-west over a three year period (Eggleton *et al*. 2020).

5.8 Sandwaves and mega-ripples are both features of sandbanks. They are smaller and known to be more mobile than sandbanks and their movement is more readily detectable over shorter periods of time. For example, Surveys undertaken in 2010 and 2018 along the Ensign to Audrey A pipeline (PL2838 and PL2839) recorded a north-westerly movement of sandwaves over the eight year period (Spirit Energy 2020a).

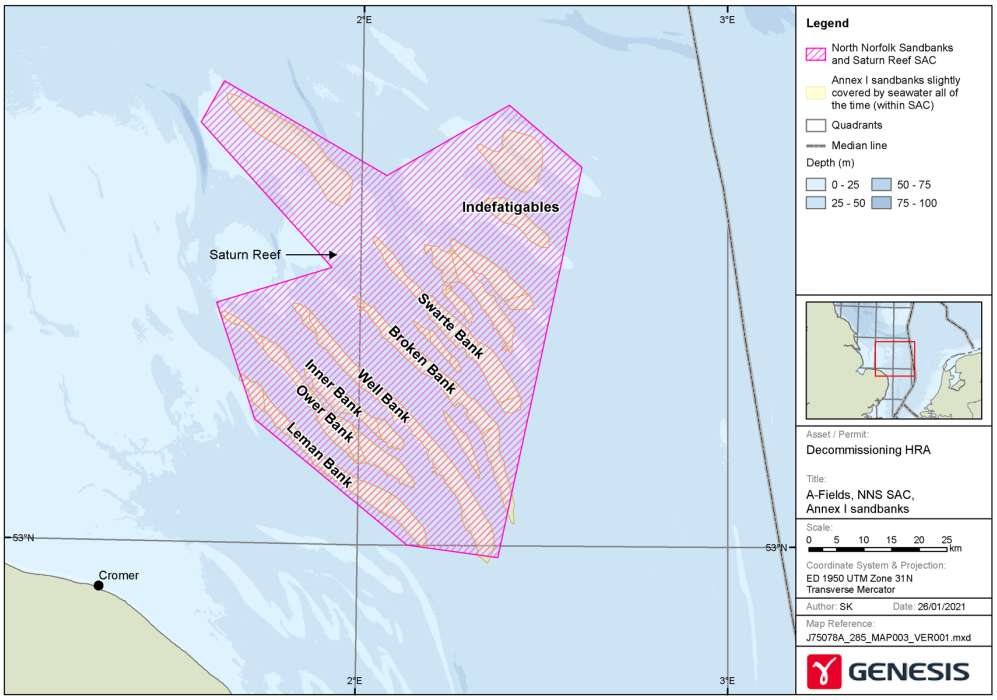


Figure 3: Sandbanks within North Norfolk Sandbanks and Saturn Reef SAC.

5.9 The North Norfolk Sandbank SAC comprises seven habitat types with Infralittoral fine sand or infralittoral muddy sand habitats occurring predominantly along the sandbanks and circalittoral fine sand or circalittoral muddy sand occurring predominantly between

the sandbanks. Infralittoral and circalittoral course sediment habitats also occurs within the SAC (Parry *et al*. 2015, ABPMer and Ichthys Marine 2015, Eggleton *et al*. 2020).

5.10 The biological communities present on the sandbanks are representative of the infralittoral mobile sand biotope. Characteristic species recorded during surveys within the SAC include infauna species *Ophelia borealis, Fabulina fabula, Nephtys cirrosa* and *Scoloplos armiger* and the amphipod*, Bathyporeia elegans.* Epifaunal species present include *Ophiura Spp., Ammodytes Spp.* and *Buglossidium luteum*. Differences in communities are slight with substrate type not having a very strong effect on differences in community although abundance is generally higher in coarser sediment (Parry *et al*. 2015, Eggleton *et al*. 2020).

5.11 Species within infralittoral mobile sand biotopes are adapted to high levels of disturbance. However, the mobility of the sediment leads to a relatively species-poor community. They are able to withstand mobile sediments and are opportunistic (Tillin *et al*. 2019). The faunal community is highly resilient to any level of impact with recovery often within a few days or weeks. Following severe disturbances recovery is expected to occur within 12 months (Tillin *et al.* 2019).

5.12 The communities have low sensitivity to smothering and abrasion or disturbance to the seabed surface. However, they are highly sensitive to changes to different types of sediment and the physical loss of suitable habitat (Tillin *et al*. 2019).

5.13 Sandbanks are characterised by relatively strong currents which produce characteristic features such as mega ripples. During certain conditions, e.g. storms, the tops of sandbanks can be removed and replaced later during calmer conditions (Elliot *et al.* 1998).

5.14 Surveys undertaken across the sandbanks and results from modelling indicate that sediments across the site are highly mobile with mobile bedforms present on the tops of the sandbanks for 85–95% of the time and in the deeper areas between the sandbanks for around 10– 80% of the time for 250 µm grain size, and 0–20% for 63 µm grain size (Collins *et al*. 1995, ABPMer and Ichthys Marine 2015).

5.15 Subtidal sandbanks are subject to continued reworking of the sediment by wave action and tidal streams and thus are dominated by species capable of tolerating severe changes in the hydrophysical regime.

5.16 Sandbanks are highly motile and so introducing solid structures to this environment can create localised artificial habitats, scouring and sediment deposits. Removal of the sandbank features, including the substratum, could result in some localised temporary loss of its ecological communities. The structure and diversity of sandbank communities are determined by environmental characteristics such as sediment particle size distribution, seabed slope and water depth. Any change in these environmental

parameters (e.g. by removing or smothering part of the feature) could result in a loss of habitat and a possible shift in community organisation.

5.17 The pressures and sensitivities on the sandbank feature of the SAC to oil and gas decommissioning related activities are presented in Table 9 (JNCC 2017d).

5.18 Studies undertaken to assess the sensitivity of Marine Conservation Zone (MCZ) and Marine Protected Area (MPA) features on a broad range of pressures have identified that subtidal sand had a low to medium sensitivity from physical disturbance of the substrate. Similarly, the habitat is identified as being highly sensitive to change to another seabed type (Tillin *et al.* 2010, Tillin and Tyler-Walters 2015). The sensitivity is determined by the magnitude of the pressures and set against a benchmark. The studies recognise that the sensitivity of a habitat to a pressure may also vary depending on the frequency and duration of the pressures and their spatial extent. The temporal and spatial aspects of the pressure and spatial scale of the feature being exposed to the pressure should be considered when determining the sensitivity of habitat to a pressure (Tillin *et al.* 2010).

5.19 Potential impacts arising from the removal of infrastructure, the use of anchors by vessels and rock dumping could cause physical loss and physical impacts to sandbank habitats within the SAC.

Reefs

5.20 Reefs are an Annex I habitat under the Habitats Directive and are described as *rocky marine habitats or biological concretions that rise from the seabed. They are generally subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to the air at low tide.* (JNCC 2021). Two main types of reef are recognised: those where animal and plant communities develop on rock or stable boulders and cobbles, and those where structure is created by the animals themselves (biogenic reefs) (JNCC 2021). It is biogenic reef habitat formed by the tubeworm *Sabellaria spinulosa* that occurs within the North Norfolk Sandbanks and Saturn Reef SAC.

5.21 The biogenic reef habitat formed by *S. spinulosa* occurs in both inshore and offshore waters. There are five designated sites in UK waters for which this specific reef habitat is a primary feature, of which the North Norfolk Sandbanks and Saturn Reef SAC is one (JNCC 2021).

5.22 *Sabellaria spinulosa* occurs widely and is found in the subtidal and lower intertidal/sublittoral fringe, especially in areas of turbid seawater with a high sediment load. *Sabellaria* reef habitats are uncommon with relatively few examples occurring in UK waters.

5.23 The SAC has within its boundaries the Saturn *Sabellaria spinulosa* biogenic reef. In 2003, the reef covered an area approximately 750 m by 500 m, just to the south of Swarte Bank, varying in density over an area of 1.08 km^2 (JNCC 2017b, JNCC 2021). More recent surveys in the area have not found the extensive reef recorded in 2003, but whether this absence is as a result of damage to the reef structures (e.g. by bottom trawling) or whether such reefs are naturally ephemeral is not yet known. However, formation of such a substantial reef of *S. spinulosa* in this area in 2003 indicates favourable conditions for reef formation (JNCC 2010).

5.24 The polychaete *Sabellaria spinulosa* is, in its adult form, a sedentary species of tube worm with a distribution ranging from north of Shetland to the Mediterranean and occurring throughout UK waters, including the North Sea. The species can occur in very high densities, in excess of 4,000 ind./m^2 and can form reefs (Jackson and Hiscock 2008).

5.25 *Sabellaria spinulosa* grows rapidly with adults reaching maximum biomass within months of settling from the juvenile stage (Pearce *et al*. 2007). *Sabellaria spinulosa*'s life history favours settlement and adaptation to live in frequently disturbed environments and rapid reproduction (planktotrophic larvae) rates during January and February (George and Warwick 1985, Jackson and Hiscock 2008).

5.26 *Sabellaria spinulosa* preferentially colonise areas of hard substratum, typically on shell, sandy gravel or rocky substrates with moderate tidal flow. The species requires sand grains in order to form its tubes and will therefore occur in very turbid waters where sand is placed in suspension by water movement (Jones, Hiscock and Conner 2000).

5.27 Where *S. spinulosa* reefs occur, there may be an increase in both the diversity and abundance of other species (Jones, Hiscock and Conner 2000). However, this may not always be the case with studies showing areas of *S. spinulosa* reef having significant increases in abundance but not necessarily increases in biodiversity (Pearce *et al*. 2007).

5.28 Studies undertaken at aggregate extraction sites in the southern North Sea and English Channel indicate that *S. spinulosa* are able to tolerate levels of disturbance from aggregate extraction including significant levels of sediment disturbance and can re-colonise areas that had previously been dredged to a level of high abundance within three years, with re-colonisation starting within 12 months of dredging activities ceasing (Pearce *et al.* 2007; Pearce *et al*. 2011). Consequently, it is possible for re-colonisation to occur relatively quickly if conditions are suitable.

5.29 Monitoring undertaken along a surface laid pipeline, placed 550 m from a *S. spinulosa* reef in the Southern North Sea was unable to detect any evidence of an impact from anchors or anchor wires on the seabed or the *S. spinulosa* reef less than three years

after the activities had taken place. Further monitoring along the pipeline route indicated that the laying of the pipeline impacted *S. spinulosa* aggregations over an area of five metres either side of the pipeline (Witteveen and Boss 2010). Indicating the *S. spinulosa* will occur adjacent to surface infrastructure.

5.30 Pressures and threats from oil and gas activities, including infrastructure, to reef habitats are ranked as low in the latest Article 17 report published by the Government (JNCC 2019c,d). The pressures and sensitivities on *Sabellaria* biogenic reefs from oil and gas decommissioning activities are presented in Table 9 (JNCC 2017d).

5.31 Potential impacts arising from the removal of infrastructure, the use of anchors by vessels and rock dumping could cause physical loss and physical damage to *Sabellaria spinulosa* reefs within the SAC.

Table 9: Pressures and sensitivities on sandbanks and biogenic reef habitats within the North Norfolk Sandbanks and Saturn Reef SAC (selected to relate to oil and gas decommissioning activities) (JNCC 2017d).

Pressure	Biogenic reef *Sabellaria spinulosa*	Subtidal coarse sediment	Subtidal mixed sediments	Subtidal sand
Abrasion/disturbance of the substrate on the surface of the seabed	S	S	S	S
Changes in suspended solids (water clarity)	NS	S	S	S
Habitat structure changes – removal of substratum (extraction)	S	S	S	S
Introduction of other substances (solid, liquid or gas)	S	S	S	S
Introduction of spread of non-indigenous species	S	S	S	S
Litter	S	S	S	S
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	S	S	S	S
Physical change (to another seabed habitat)	S	S	S	S
Siltation rate change (low), including smothering (depth of vertical sediment overburden)	S	S	S	S
Vibration	IE	IE	IE	IE
Waterflow (tidal current) changes – local, including sediment transport considerations	S	S	S	S

S = Sensitive, IE = Insufficient Evidence, NS = Not sensitive

Harbour porpoise

5.32 The harbour porpoise (*Phocoena phocoena*) is the smallest and most abundant cetacean species in UK waters. They occur widely across shelf waters predominantly either individually or in small groups but larger aggregations have been reported (Defra 2015), with group sizes varying with season (Clark 2005).

5.33 Harbour porpoise are opportunistic feeders, foraging close to the seabed or near the sea surface, preying on a wide range of fish species including, herring, cod, whiting and sandeels, and their prey will vary during and between seasons (Santos and Pierce 2003). Studies undertaken in Denmark indicate that their local distribution may be correlated with prey availability (Sveegaard 2011). Their prey preferences within the SAC is not well known although species known to occur within the SAC include herring, cod, whiting, sandeels and sprats, all of which may be prey for harbour porpoise (JNCC and NE 2019).

5.34 Data from ESAS and other databases indicate harbour porpoise are widespread across the North Sea and adjacent waters (Reid *et al*. 2003). Evidence from SCANS surveys indicates that there may have been a southward shift in the distribution of harbour porpoise from occurring predominantly around eastern Scotland and the northern North Sea to the southern North Sea since the early 1990's (Hammond *et al*. 2013, 2017).

5.35 Surveys across the SAC have indicated that harbour porpoise occur widely across the site, with some evidence of seasonal movements southwards during the winter and north during the summer. There is no clear preference to habitats within the site (Heinänen and Skov 2015).

5.36 Sound arising from proposed decommissioning activities have the potential to impact on harbour porpoise within or adjacent to the SAC. The range at which marine mammals, including harbour porpoise, may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound. Other factors that can affect the potential impact include ambient background noise, which can vary depending on water depth, seabed topography and sediment type. Natural conditions such as weather and sea state and existing sources of human produced sound can also reduce the auditory range.

5.37 Porpoises are generally considered to be 'high frequency' specialists with a relatively poor ability to detect lower frequency sounds (NMFS 2018, Southall *et al*. 2019). Studies undertaken on captive harbour porpoises indicate that porpoises have a functional hearing range of between 250 Hz and 180 kHz with their best hearing between 16 to 140 kHz and their maximum sensitivity between 100 and 140 kHz. This is within the frequency range of 130 to 140 kHz that harbour porpoise echolocate (Miller and Wahlberg 2013). Their ability to detect sound below 16 kHz or above 140 kHz falls

sharply (Kastelein *et al.* 2012, 2015, Southall *et al*. 2007). Harbour porpoise are therefore most sensitive to sound sources between 16 to 140 kHz and, although audible, they are unlikely to be sensitive to sound either above or below those frequencies.

5.38 Harbour porpoise use echolocation to communicate and detect prey. Reported sound levels produced range from between 166 to 194 re: 1 µPa (rms) @ 1m and 178 and 205 dB re. 1 µPa $_{(peak - peak)}$, with a mean level of 191 dB re. 1 µPa $_{(peak - peak)}$ and within the peak frequency range of 110 to 150 kHz (Villadsgaard, *et al*. 2007, Miller and Wahlberg 2013, MMO 2015a).

5.39 Sound arising from decommissioning activities may also impact on the prey species of harbour porpoise, which could have a negative impact on harbour porpoise. Fish hearing is based on detecting particle motion directly stimulating the inner ear. However, those with swim bladders are also able to detect pressure waves and can detect a wider range of frequencies and sounds of lower intensity than fishes without swim bladders (Popper 2003). Fish with swim bladders, e.g. herring, are recognised to be hearing specialists. Those without, e.g. sandeels, are considered to have a relatively low sensitivity to noise. Most fish with swim bladders are able to detect sound within the 100 Hz to 2 kHz range, those without swim bladders are unlikely to detect sound above 400 Hz (Popper 2012).

5.40 Potential impacts on harbour porpoise or their prey arising from decommissioning include sound from vessels and cutting equipment.

6 EXTENT OF ANNEX I HABITAT AND HARBOUR PORPOISE

6.1 The total area of sandbank habitat classified within the North Norfolk Sandbanks and Saturn Reef SAC is, for the purposes of this assessment, 3,603 km^2 (JNCC 2020b).

6.2 Within the SAC there are seven recognised sandbank habitats, predominantly comprising of Infralittoral fine sand or Infralittoral muddy sand and Circalittoral fine sand or Circalittoral muddy sand (Table 10).

Table 10: Area of sandbank habitat types within the North Norfolk Sandbanks and Saturn Reef SAC (Source ABPMer and Ichthys Marine 2015).

Habitat	Habitat Area (km^2)	% of SAC
Moderate energy infralittoral rock	9.1	0.3
Infralittoral coarse sediment	459.6	12.7
Circalittoral coarse sediment	332.0	9.2
Deep circalittoral coarse sediment	6.3	0.2
Infralittoral fine sand or Infralittoral muddy sand	1,142.0	31.7
Circalittoral fine sand or Circalittoral muddy sand	1,609.1	44.6
Deep circalittoral sand	45.4	1.3

6.3 The total area of Annex I reef habitat classified within the site at the time of designation was 1.08 km^2 (JNCC 2017a). However, since the time of designation additional reef habitat of between low and high reefiness has been identified:

- 0.375 km^2 Saturn Reef (Jenkins *et al*. 2015, JNCC 2017b),
- 1.57 km^2 Baird Gas Storage (BSCL 2011),
- 0.70 km^2 Leman uptime compression surveys (Fugro EMU 2013),
- 0.19 km^2 Leman AC work barge deployment (Gardline 2014, Perenco 2014a),
- 0.53 km^2 Viking to LOGGS pipeline (ConocoPhillips 2008),
- 0.14 km^2 Carrack to Clipper pipeline (Shell 2014).
- 0.05 km^2 Leman tie-back[3] (Perenco 2012).
- 1.28 km^2 Dredging Area 484 (Fugro Emu 2014).
- 1.74 km^2 Leman Field (Shell 2015).
- >1.5 km^2 SAC Management Investigations Survey (Jenkins *et al*. 2015).
- 0.007 km^2 Wenlock Installation (Benthic Solutions 2020)

[3] A total of 0.63 km^2 of *S. spinulosa* reef was identified within the pipeline route surveys of which approximately 0.33 km^2 is estimated to be outwith the SAC and 0.25 km^2 is covering the same area as the later 2013 Leman AC surveys, where it was found that the area of reef had reduced.

6.4 Based on the above survey data, the total area of confirmed reef habitat within the SAC is 8.08 km^2 (0.22% of the SAC). However, large areas of the SAC will not have been surveyed and other reef habitat will occur within the site.

6.5 Reef type habitat defined as 'medium reefiness' has been recorded at three locations along the buried Ensign to Audrey A pipeline (PL2838). The extent of the reef has not been quantified (Spirit Energy 2020a).

6.6 An undefined area of 'low reef' was identified at sample site DD_01, located at the Ensign ED well 48/14-7Y (Spirit Energy 2020a).

6.7 Reef type habitat has been recorded at one location along the Ann to LOGGS gas export line (PL947). Described as being '*a few tens of centimetres high and 2 m-3 m in length*' and '*representing a Sabellaria spinulosa reef zone'*. The extent of the reef has not been quantified (Centrica 2017b).

6.8 No reef type habitat has been recorded within 1.2 km of the Ensign installation nor during surveys undertaken at the Audrey fields (Centrica 2017a, Spirit Energy 2019a, 2020a).

6.9 No reef type habitat has ever been recorded at the Annabel fields or along their associated pipelines (Venture 2009, Centrica 2017a).

6.10 No reef type habitat has previously been recorded at the Ensign field nor along the export lines (Venture 2007, Centrica 2010). However, undefined patches of reef type habitat have been identified along the Ensign to Audrey and Ann to LOGGS export pipelines (Centrica 2017a).

6.11 These unquantified areas of reef increase the area of confirmed reef habitat within the SAC but it is not known to what extent.

6.12 It is noted that *Sabellaria* reef is an ephemeral feature and can colonise suitable areas and disappear from established areas. The Saturn Reef was discovered in 2002 but subsequent surveys across the area have found no presence of it (Limpenny *et al.* 2010, Vanstaen and Whomersley 2015). However, having previously had *Sabellaria* reef present it is considered as suitable Annex I habitat for *Sabellaria* reef features. Similarly, surveys undertaken between 2010 and 2018 at the Ensign ED well have recorded a reduction in the extent of reef in the area (Spirit Energy 2020).

6.13 Aggregations of *Sabellaria spinulosa* have been largely found by industry when undertaking baseline environmental surveys in support of potential developments. Other aggregations have been reported, e.g. Vanstaen and Whomersley (2015) and Jenkins *et. al.* (2015), with patches of *Sabellaria* ranging in size from between 0.004 km^2 to 1.5 km^2. However, the total area of *Sabellaria* reef habitat recorded during the surveys is not quantified and therefore it is not possible to include all the additional surveyed reef habitat within this HRA.

6.14 Similarly, surveys have been undertaken along the export cable route for the proposed Hornsea Three Offshore Wind Farm export cable, part of which lies within the SAC. The surveys identified two patches of *Sabellaria* described as being 'low reef', one of which was within the SAC. However, it was not possible to delineate the extent of the reef within the SAC due to patchiness of the aggregations and the lack of a clear signature in the side scan sonar data (Ørsted 2018a).

6.15 The location of known *Sabellaria* reef including a 500 m 'buffer' area around each location is presented in Figure 4 (JNCC 2019e).

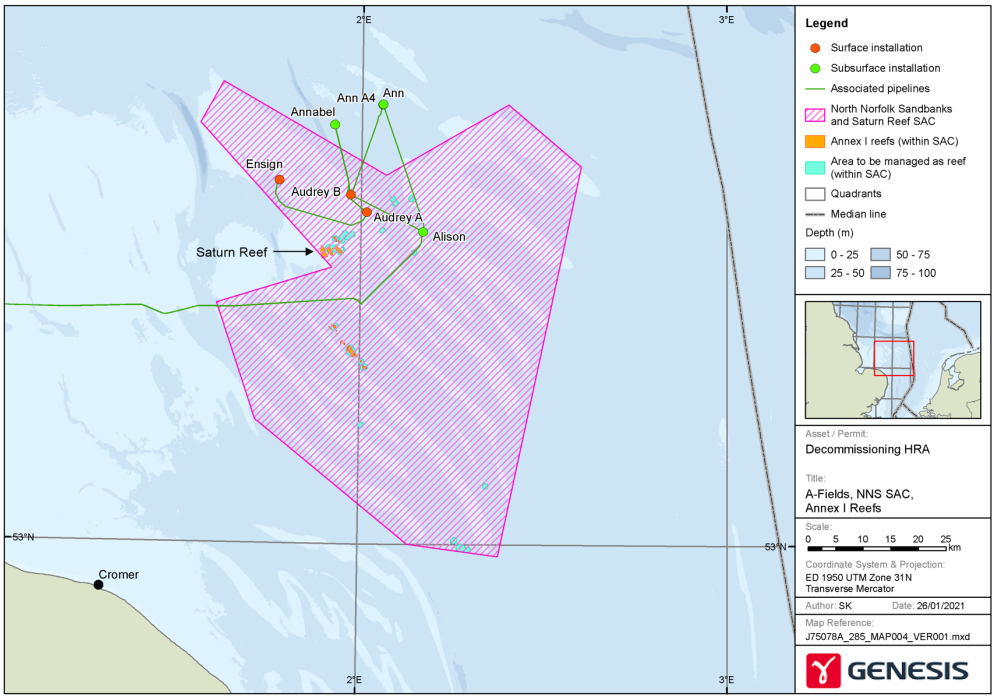


Figure 4: Locations of known *Sabellaria* reef within the North Norfolk Sandbanks and Saturn reef SAC (including 500 m 'buffer' around each reef area).

6.16 The majority of the SAC has not been surveyed and it is therefore highly likely that *Sabellaria* reefs occur elsewhere within the SAC. The exact extent of Annex I reef habitat within the SAC is unknown and the known area of 8.08 km^2 of *Sabellaria* reef used in this assessment is considered to be a minimum.

Harbour Porpoise

6.17 The Southern North Sea SAC lies in an area extending from the central North Sea, north of the Dogger Bank, to the Strait of Dover and covers an area of 36,951 km^2 (JNCC and NE 2019). The site recognises the seasonal variations in harbour porpoise distribution with identified 'summer' and 'winter' areas. The northern 'summer' area is approximately 27,028 km^2 and covers the period from between April to September. The southern

'winter' area is approximately 12,696 km^2 and covers the period between October and March (JNCC 2020a). The proposed decommissioning activities occur in an area of SAC recognised for its summer populations of harbour porpoise.

6.18 Based on data collected during the SCANS-II survey it is estimated that the site potentially supports approximately 18,500 harbour porpoise (95% Confidence Interval: 11,864 - 28,899) for at least part of the year as seasonal differences are likely to occur (JNCC 2017e, 2019f). The European Atlantic Shelf harbour porpoise population is estimated to be 375,358 (95% CI 256,304 - 549,713) individuals, of which 227,298 (95% CI 176,360 - 292,948) occur in the North Sea Management Unit. In the UK sector of the North Sea Management Unit, the harbour porpoise population is estimated to be 110,433 (80,866 - 150,811) (IAMMWG 2015). The Southern North Sea SAC therefore potentially supports 17.5% of the harbour porpoise population within the UK sector of the North Sea Management Unit (JNCC 2017e).

6.19 Densities of harbour porpoise will vary across the site and across seasons. Although no mean densities are provided, modelling used to identify the site boundaries indicate that densities of >3.0 harbour porpoise/km^2 occur widely across the SAC (Figure 5) (Heinänen and Skov 2015).

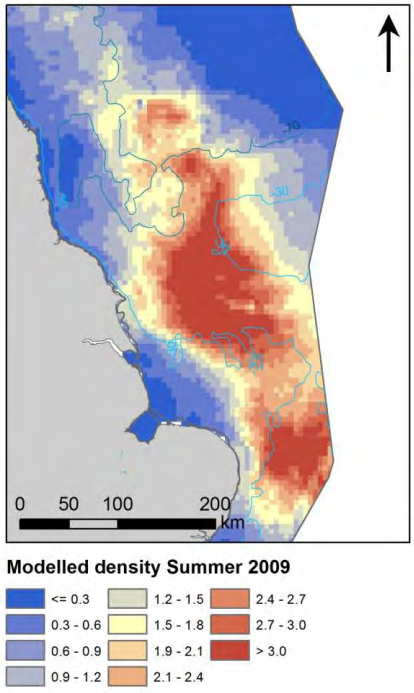


Figure a.

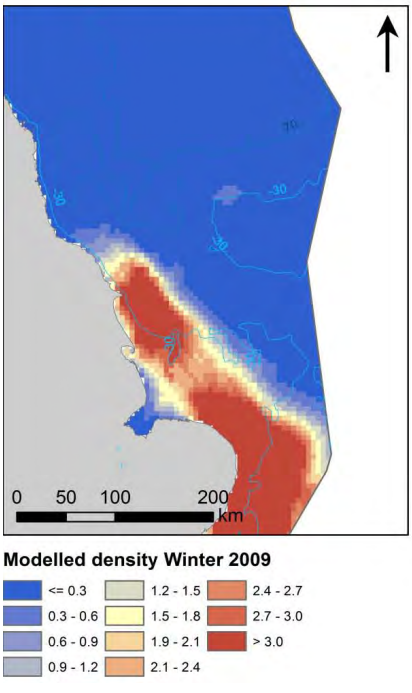


Figure b.

Figure 5: a) Estimated summer densities of harbour porpoise in the Southern North Sea. b) Estimated winter densities of harbour porpoise in the southern North Sea.

7 POTENTIAL IMPACTS

7.1 The potential impacts arising from the planned activities identified in the likely work programme that could affect qualifying features and the three Conservation Objectives of the North Norfolk Sandbanks and Saturn Reef SAC along with those which have an associated impact on the habitat supporting harbour porpoise in the Southern North Sea SAC (Conservation Objective 3 of the SAC) are:

- Physical impacts during removal of platforms,
- Physical impacts from removal of subsea infrastructure,
- Physical impacts from the cutting and removal of pipeline ends,
- Physical impacts from the plugging and abandonment of wells including conductor removal,
- Physical impacts from vessel anchoring and setting down spud cans,
- Physical impact from recovery of stabilisation material,
- Physical loss of habitat due to rock placement at cut pipeline ends,
- Physical loss of habitat due to existing presence of pipelines and associated deposits.

7.2 Physical loss to habitat is, for the purpose of this HRA, defined as being permanent, in that the habitat is unable to recover unless the cause of the impact is removed. Physical impacts are defined as being disturbance to the seabed and are generally considered as being temporary impacts on the basis that there is a very high likelihood of recovery after the activity causing of the impact has ceased.

7.3 The potential impacts arising from the planned activities identified in the likely work programme that could affect qualifying features and Conservation Objectives one and two of the Southern North Sea SAC are sound arising from:

- Physical injury or disturbance from vessel activities.
- Physical injury or disturbance from cutting equipment.
- Physical impacts to their relevant habitats from the cutting of jacket piles, cutting and removal of pipeline ends and tee-pieces, manifolds, and well conductor removal.

7.4 Impacts arising from noise cease once the activity has stopped, although the effects of the impact on the qualifying features may last longer.

7.5 No other sources of potential impact likely to cause a significant effect have been identified.

7.6 Potential activities related to the A Field and Ensign decommissioning programme will occur within the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC. Three assets: Ann A4, Ann and Annabel lie outwith the North Norfolk

Sandbanks and Saturn Reef SAC (Figure 1). The Ann A4 and Ann lie outwith the Southern North Sea SAC (Figure 2).

Physical impacts on the seabed from Ann A4 decommissioning

7.7 Decommissioning at the Ann A4 field has commenced, although some activities have been delayed and remain to be undertaken. Activities still be carried out that could cause a physical impact on the seabed are the removal of the pipeline ends, the removal of grout bags and mattresses and post-decommissioning over-trawl surveys (Table 1). All activities to be undertaken lie outwith any SAC and the impacts arising will be localised and not impact on the qualifying features of any site.

Physical impacts on the seabed from Ann decommissioning

7.8 Decommissioning at the Ann field has commenced, although some activities have been delayed and remain to be undertaken. Activities still be carried out that could cause a physical impact on the seabed are the removal of the subsea template, the cutting and removal of the pipeline ends, the removal of grout bags and mattresses and, if undertaken, a post-decommissioning over-trawl survey (Table 2).

7.9 The Ann field lies outwith the North Norfolk Sandbanks and Saturn Reef SAC and therefore impacts at the field will not impact on the qualifying features of the site. However, approximately 30.18 km of the Ann to LOGGS (PL947) pipeline and 6.37 km of the Ann to Audrey (PL948) pipeline occurs within the SAC. Approximately 39.43 km of the Ann to LOGGS (PL947) pipeline and 6.37 km of the Ann to Audrey (PL948) pipeline occurs within the Southern North Sea SAC (Table 12).

Removal of Ann subsea template piles

7.10 The Ann subsea template lies outwith any SAC and therefore will not impact on qualifying features of any designated site.

Removal of cut pipeline and umbilicals

7.11 The ends of two pipelines within the SACs will be cut and removed:

- Ann to LOGGS pipeline PL947 – 43.6 m at the LOGGS PR installation,
- Ann to Audrey B (XW) umbilical PL948 – 32 m at the Audrey B (XW) installation.

7.12 In total 76 m of pipeline will be removed. Based on an area of impact of 5 m either side of the pipelines, the total area of seabed impacted by the removal of the pipelines is estimated to be 760 m^2 (0.001 km^2).

Removal of grout bags and mattresses

7.13 There are 190 grout bags at the Ann field and therefore outwith the SACs (Centrica 2017b,c). There are a total of 1,635 grout bags and 19 concrete mattresses along the Ann to LOGGS pipeline and will be removed. A further 33 grout bags and four concrete

mattresses are to be removed from the Ann to Audrey B (XW) umbilical (PL948) (Centrica 2017b). A total of 1,668 grout bags and 23 concrete mattresses will be removed. For the purposes of this assessment it is estimated that each mattress is 6 m by 3 m and an area of seabed five metres either side and around each of the items to be removed may be impacted (Centrica 2017b, Spirit Energy 2020a) [4]. Based on the above figures it is estimated that the area of seabed impacted by the removal of grout bags will be 130,938 m^2 (0.131 km^2) [5] and from the removal of mattresses the area of seabed disturbed is 3,544 m^2 (0.003 km^2) [6]. The total area impacted is estimated to be 134,482 m^2 (0.134 km^2).

Post-decommissioning over-trawl surveys

7.14 Over-trawl surveys may be undertaken over a 200 m wide corridor along the pipelines and within the 500 m safety zone located at the Ann installation. The Ann field lies outwith the SACs and therefore the over-trawl survey within the safety zone will not impact on their qualifying features.

7.15 The total length of pipeline and umbilical within the North Norfolk Sandbanks and Saturn reef SAC is 36,570 m. Consequently, an area of 7,314,000 m^2 (7.314 km^2) of seabed may be impacted if over-trawl surveys are undertaken.

7.16 The total length of pipeline and umbilical within Southern North Sea SAC is 54,370 m. Consequently, an area of 10,874,000 m^2 (10.874 km^2) of seabed may be impacted if over-trawlability surveys are undertaken. It has been proposed, but not yet agreed, that no over-trawl surveys will be undertaken along the pipelines (Centrica 2017b). Guidance on decommissioning advises that environmental sensitivities may preclude the use of trawl gear to undertake post-decommissioning seabed clearance surveys and alternative methods may be considered (BEIS 2018).

Physical impacts on the seabed from Alison decommissioning

7.17 Decommissioning at the Alison field has commenced, although some activities have been delayed and remain to be undertaken. Activities still be carried out that could cause a physical impact on the seabed are the removal of the subsea template, the cutting and removal of pipeline ends, the removal of grout bags and mattresses and post-decommissioning over-trawl surveys (Table 2).

[4] This is highly precautionary as many of the grout bags and mattresses will be overlaying each other and therefore impacting the same area of seabed.
[5] Calculation based on 5 m radius of impact for each grout bag and therefore an area impacted of 78.5 m^2.
[6] The area impacted by each mattress is estimated to be 186.5 m^2.

Removal of piles

7.18 In order to remove the Alison subsea template the seabed around each of the piles may need to be cleared so that the piles can be cut. Based on a 12.2 m diameter pit around each pile plus an additional 5 m diameter area of impact (see Spirit Energy 2020a), the total area of seabed disturbed around each pile is 929 m^2 and the total area of seabed impacted by the cutting of the four piles is therefore 3,716 m^2 (0.004 km^2).

Removal of cut pipeline and umbilicals

7.19 The ends of two pipelines within the SAC will be cut and removed:

- Audrey B to Alison template PL1099 – 8,000 m,
- Alison to the Ann / LOGGS export line PL947 (stub) – 50 m.

7.20 In total 8,050 m of pipeline will be removed. It is estimated that an area of seabed 5 m either side of the pipelines will be impacted. Consequently, the total area of seabed impacted by the cutting and removal of the lines is estimated to be 80,500 m^2 (0.081 km^2).

Removal of Alison tee and protection structure

7.21 The Alison Tee and the protection structure will be removed. Removal of the Alison Tee will involve the removal of grout bags and concrete mattresses. The disturbance on the seabed from these activities are accounted for below and there will be no additional area of seabed impacted by the removal of the Alison Tee and the protection structure.

Removal of grout bags, mattresses and concrete blocks

7.22 A total of 210 grout bags and 24 concrete mattresses occur along the Audrey B to Alison template umbilical (PL1099), 60 grout bags occur on the Alison spool (PL947 stub) and 634 bags are at the Alison Tee. A further six concrete blocks are present at the Alison Tee and are to be removed (Centrica 2017b). For the purposes of this assessment it is estimated that an area of seabed five metres either side and around each of the items to be removed may be impacted (Spirit Energy 2020a). Based on the above figures it is estimated that the area of seabed impacted by the removal of grout bags will be 70,964 m^2 (0.071 km^2) [7] and from the removal of mattresses the area of seabed disturbed is 2,611 m^2 (0.003 km^2) [8]. The removal of the six concrete blocks at the Alison Tee will impact a total area of 846 m^2 (0.008 km^2) [9]. The total area impacted is estimated to be 74,421 m^2 (0.074 km^2).

[7] A total of 904 grout bags to be removed and the total area impacted = 70,964 m^2.
[8] The area impacted by each mattress is estimated to be 186.5 m^2. A total of 14 mattresses to be removed and the total area impacted = 2,611 m^2.
[9] The area impacted by each concrete block is estimated to be 141 m^2. A total of 6 concrete blocks to be removed and the total area impacted = 846 m^2

Post-decommissioning over-trawl surveys

7.23 Over-trawl surveys may be undertaken over a 200 m wide corridor along the pipelines and within the 500 m safety zone located at the Alison installation.

7.24 The total length of pipeline and umbilical within both the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC following decommissioning is 6,200 m. Consequently, an area of 1,240,000 m^2 (1.24 km^2) of seabed may be impacted. In addition a further 785,398 m^2 of seabed may be impacted if an over-trawl survey is undertaken within the 500 m safety zone of the Alison field. In total up to 2,025,398 m^2 (2.02 km^2). However, it has been proposed, but not yet agreed, that no over-trawl surveys will be undertaken (Centrica 2017b).

Physical impacts on the seabed from Audrey decommissioning

Removal of Audrey installations

7.25 The removal of the two Audrey installations will be undertaken using a heavy lift vessel. The environmental appraisal assumes that the heavy lift vessel will have 12 anchors and require two movements at each of the installations. The assessment estimates that each anchor will impact on an area of 8.3 m^2 and each associated anchor chain will impact an area of seabed 500 m in length and 10 m in width. In total each of the 12 anchors and chains will impact an area of 5,008 m^2 on four occasions. The total area of seabed disturbed from the removal of the two Audrey installations by a heavy lift vessel will be 244,800 m^2 (0.245 km^2) (Centrica 2017a).

Removal of platform piles

7.26 In order to remove each platform, the two drilling templates and the well-head protection structure, the seabed around each of the platform's piles may need to be cleared so that the piles can be cut. The number of piles associated with each structure is assumed to be four; a total of 20 piles. No estimate on the area of seabed impacted by the removal of piles is presented within the environmental appraisal. For the purposes of this assessment it is presumed to be 12.2 m diameter and an additional 5 m diameter area of seabed disturbance occurs around each pile (Spirit Energy 2020a).

7.27 The total area of seabed disturbed around each pile is 929 m^2 and the total area of seabed impacted by the cutting of the 20 piles is 19,580 m^2 (0.019 km^2) [10].

Removal of cut pipeline and umbilicals

7.28 The following pipelines will be cut and removed:

[10] Note that this figure is precautionary as the close proximity of the piles to one another will mean that impacts will overlap.

- Audrey A to LOGGS gas export pipeline PL496 – 230 m,
- Audrey A to LOGGS methanol line PL497 – 282 m,
- Audrey 11-a7 subsea installation to Audrey A gas export line PL575 – 496 m,
- Audrey 11-a7 subsea installation to Audrey A methanol PL576 – 650 m,
- Audrey A to Audrey B gas line PL723 – 353 m,
- Audrey A and Audrey B methanol line PL726 – 302 m.

7.29 In total four pipelines (including two piggy-backed lines) will be cut and left *in situ* and two (including one piggy-backed) will be completely removed. The total length of line to be removed is 2,313 m (Centrica 2017a) [11].

7.30 An area of seabed 5 m either side of the pipelines to be removed will be impacted. Consequently, the total area of seabed impacted by the removal of the Audrey field pipelines is estimated to be 23,130 m^2 (0.023 km^2).

Removal of drilling templates and well-head protection structure

7.31 The removal of the drilling templates and the well-head protection structure will disturb the seabed. However, the seabed will be impacted by the removal of the piles and no previously undisturbed seabed will be impacted by the lifting of the subsea equipment.

Removal of grout bags, mattresses and concrete blocks

7.32 A total of 308 grout bags and 61 concrete mattresses occur around the two Audrey installations and along the lines (Centrica 2017b). For the purposes of this assessment it is estimated that each grout bag is 0.25 m by 0.45 m and each mattress is 6 m by 3 m. An area of seabed five metres either side and around each of the items to be removed may be impacted (Spirit Energy 2020a). Based on the above figures it is estimated that the area of seabed impacted by the removal of grout bags will be 24,178 m^2 (0.024 km^2) [12] and from the removal of mattresses the area of seabed disturbed is 11,376 m^2 (0.011 km^2) [13]. The total area impacted is estimated to be 35,554 m^2 (0.035 km^2).

Post-decommissioning over-trawl surveys

7.33 Over-trawl surveys may be undertaken over a 200 m wide corridor along the pipelines and within the 500 m safety zones located at the two Audrey installations.

[11] It is noted that some of the umbilical/methanol lines may be piggy-backed onto the gas pipelines and therefore a proportion of the seabed impacts will occur over the same areas. However, it is not known how much of the line is piggy-backed and therefore a precautionary assumption has been made that the impacts from all pipelines impact on separate areas of seabed.
[12] Calculation based on 5 m radius of impact around each grout bag.
[13] The area impacted by each mattress is estimated to be 186.5 m^2. A total of 61 mattresses to be removed and the total area impacted = 11,376 m^2.

7.34 The total length of pipeline across which over-trawl surveys may be undertaken within both SACs is 20,808 m. The area of seabed impacted along the pipelines is 4,161,600 m^2 (4.16 km^2) (Table 12).

7.35 The area of seabed impacted within the two 500 m safety zones located at the two Audrey platforms is 1,570,796 m^2 (1.57 km^2).

7.36 The total area of seabed impacted by over-trawl surveys is 5.73 km^2.

Physical impacts on the seabed from Annabel decommissioning

7.37 Decommissioning at the Annabel field has commenced, although some activities have been delayed and remain to be undertaken. Activities still be carried out that could cause a physical impact on the seabed are the removal of the subsea template, the removal of pipelines, grout bags and mattresses and post-decommissioning over-trawl surveys (Table 4).

Removal of Annabel subsea template

7.38 The Annabel subsea template is a gravity based structure and not secured by piles. The size of the template is unknown and therefore the area of seabed impacted can only be estimated. For this assessment it is estimated to be the same size as the Ann subsea template, 16 m by 12 m. Assuming an area of seabed 5 m around the template is disturbed when it is lifted, the total area of seabed disturbed is 550 m^2 (0.0005 km^2).

Removal of cut pipeline and umbilicals

7.39 The ends of two pipelines within the SAC will be cut and removed:

- Annabel to Audrey A PL2066,
- Annabel to Audrey A PL2067.

7.40 Both the PL2066 pipeline and PL2067 umbilical will be cut and left *in* situ. The estimated area of seabed impacted at each cut end is, for the purposes of this assessment presumed to be 22 m^2 [14]. Consequently, the total area of seabed impacted by the cutting and removal of the lines is estimated to be 44 m^2 (0.00004 km^2).

Removal of grout bags and mattresses

7.41 A total of 105 grout bags occur along the Annabel export line PL2066 and a further eight occur along the umbilical PL2067. A total of 117 concrete mattresses occur along the PL1066 export line, of which an estimated 41 mattresses occur within the North Norfolk sandbanks and Saturn Reef SAC and will be removed. A total of 66 mattresses occur

[14] The area is based on Chrysaor 2020a.

along the PL2067 umbilical, of which an estimated 30 occur within the SAC and will be removed (Spirit Energy 2020a).

7.42 For the purposes of this assessment it is estimated that an area of seabed five metres either side and around each of the items to be removed may be impacted (Spirit Energy 2020a). Based on the above figures it is estimated that the area of seabed impacted by the removal of grout bags will be 9,225 m^2 (0.009 km^2) [15] and from the removal of mattresses the area of seabed disturbed is estimated to be 29,467 m^2 (0.029 km^2) [16]. The total area of seabed impacted is estimated to be 38,692 m^2 (0.039 km^2).

Post-decommissioning over-trawl surveys

7.43 Over-trawl surveys may be undertaken over a 200 m wide corridor along the pipelines and within the 500 m safety zone located at the Annabel installation.

7.44 The total length of pipeline and umbilical within the North Norfolk Sandbanks and Saturn Reef SAC is 22,050 m. Consequently, an area of 4,410,000 m^2 (4.41 km^2) of seabed may be impacted. In the Southern North Sea SAC 31,200 m of pipeline may be over-trawled, impacting an area of 6.24 km^2. In addition, a further 785,398 m^2 of seabed may be impacted if an over-trawl survey is undertaken within the 500 m safety zone of the Annabel field. In total up to 7,025,398 m^2 (7.02 km^2).

Physical impacts on the seabed from Ensign decommissioning

Removal of installations

7.45 The removal of the Ensign platform will be undertaken using a heavy lift vessel. Spirit Energy have stated that anchors may be required for the heavy lift vessel and the associated transport barge, upon which the topsides will be placed once separated from the jacket. Both the heavy lift vessel and the transport barge will each have eight anchors (Spirit Energy 2020a).

7.46 Based on information presented within the Ensign decommissioning assessment it is estimated that each anchor will impact on an area of seabed 30 m^2 and the associated chain will impact an area no greater than 5 m on either side of the 500 m anchor chain (Spirit Energy 2020a). Each anchor and associated chain will impact an area of 5,030 m^2 (0.005 km^2). In total an estimated 32 separate anchors will be required for the heavy lift vessel and transport barge. Consequently, the total area of seabed estimated to be impacted is 160,960 m^2 (0.161 km^2).

[15] A total of 113 grout bags to be removed within the SAC and the total area impacted = 9,225 m^2.
[16] The area impacted by each mattress is estimated to be 186.5 m^2. A total of 14 mattresses to be removed and the total area impacted = 2,611 m^2.

Removal of piles

7.47 In order to remove each platform the seabed around each of the platform's piles may need to be cleared so that the piles can be cut. Based on the worst-case scenario of a 12.2 m diameter pit around each pile plus an additional 5 m diameter area of impact, the total area of seabed disturbed around each pile is 929 m^2 and the total area of seabed impacted by the cutting of the four piles is 3,716 m^2 (0.004 km^2) (Spirit Energy 2020a).

Removal of cut pipeline and umbilicals

7.48 The ends of four pipelines will be cut and removed:

- Ensign to Audrey A gas export pipeline PL2838 – 177 m,
- Ensign to Audrey A methanol line PL2839 – 159.8 m,
- Ensign ED well to Ensign umbilical PLU2840 – 245 m,
- Ensign ED well to Ensign gas export pipeline PL2840 – 81.2 m.

7.49 In total 663 m of pipeline will be removed. It is estimated an area of seabed 5 m either side of the pipelines will be impacted. Consequently, the total area of seabed impacted by the removal of the pipelines is estimated to be 6,630 m^2 (0.007 km^2).

Removal of grout bags and mattresses

7.50 There is potential for seabed disturbance to arise during the removal of mattresses and grout bags.

7.51 A total of 358 grout bags and approximately 95 concrete mattresses will be removed during the Ensign decommissioning. Each grout bag is estimated to be 0.25 m by 0.25 and each mattress is 6 m by 3 m. An area of seabed five metres either side and around each of the items to be removed may be impacted (Spirit Energy 2020a). Based on the above figures it is estimated that the total area of seabed impacted by the removal of grout bags is 28,103 m^2 [17] and from the removal of mattresses the area of seabed disturbed is estimated to be 17,721 m^2 [18]. In total the area of seabed disturbed by the removal of grout bags and mattresses is estimated to be 45,825 m^2 (0.046 km^2).

Post decommissioning over-trawl survey

7.52 Spirit Energy have confirmed that post-decommissioning over-trawl survey associated with the Ensign decommissioning will be non-intrusive and will not impact on the seabed (Spirit Energy 2020a).

[17] Calculation based on 5 m radius of impact from each of the 358 grout bags.
[18] Calculation based on 5 m impact around a 6 m by 3 m mattress. Therefore, area impacted per mattress is 186.54 m^2. A total of 95 mattresses to be removed. Therefore, total area impacted = 17,721 m^2.

Physical impacts from well abandonment

7.53 A total of 24 wells across the A-fields and Ensign have been, or will be, abandoned (Table 7). A total of four wells (One at Audrey and three at Ensign) are still to be abandoned. The removal of the subsurface conductors at all five Audrey B wells are also still to be undertaken.

7.54 Each well abandonment activity is also assessed separately at the time of abandonment via the use of MATS/SATs environmental approvals which inform the decision process of the consenting authority, the OGA. The well abandonment programme is integral to the impacts arising from the decommissioning programmes and therefore the impacts from well abandonment are included in this assessment.

7.55 The wells will be plugged and abandoned using a jack-up rig and therefore the spud cans, anchors and associated chains will have a direct physical impact on the seabed (Spirit Energy 2019b). The drill rig to be used for future well abandonment is unknown. For the purposes of this assessment the potential area of physical disturbance is based on known dimensions of drill rigs used for well abandonment activities in the area. The area of direct physical impact on the seabed from the drill rig spud cans is estimated to be 589 m^2 (0.0006 km^2) at each well abandonment location (Chrysaor 2020a).

7.56 Once in position the drill rig lowers three legs onto the seabed until stable. To assist in rig stabilisation during well abandonment operations a single anchor and associated anchor chains may be required. The area impacted by the anchor and chains is estimated to be 2,400 m^2 (0.002 km^2) at each rig location (Chrysaor 2020a). The estimated area of impact on the seabed at each well abandonment location is estimated to be 2,989.8 m^2 (0.003 km^2). There may be up to three abandonment locations[19], including the use of a jack-up rig for the removal of the remaining five subsurface conductors at Audrey B. The estimated area of seabed physically impacted from all well abandonment activity is 8,964 m^2 (0.009 km^2).

Extent of seabed disturbance in North Norfolk Sandbanks and Saturn Reef SAC

7.57 The estimated total area of seabed disturbance from planned decommissioning activities at the A-fields and the Ensign field, including the impacts from intrusive over-trawl surveys, is 20.051 km^2 (Table 11).

7.58 If non-intrusive over-trawl surveys are undertaken that do not impact on the seabed, the estimated area of seabed disturbance from decommissioning activities at the A-fields and the Ensign field is 0.880 km^2 (Table 11).

[19] This is based on one jack-up movement at each of the three locations at which well abandonment is to be undertaken (One at Audrey and two at Ensign).

Extent of seabed disturbance in Southern North Sea SAC

7.59 The estimated total area of seabed disturbance from planned decommissioning activities at the A-fields and the Ensign field, including the impacts from intrusive over-trawl surveys in the Southern North Sea SAC, is estimated to be 26.535 km^2 (Table 11).

7.60 If non-intrusive over-trawl surveys are undertaken that do not impact on the seabed, the estimated area of seabed disturbance from decommissioning activities at the A-fields and the Ensign field within the Southern North Sea SAC is 0.884 km^2 (Table 11).

Table 11: Potential extent of physical impact on the seabed as a result of decommissioning activities.

Field	Activity	Area Impacted (km^2)	
		NNS&SR	SNS
Ann	Removal of piles from subsea template	0.000	0.000
	Removal of pipeline ends	0.001	0.001
	Removal of grout bags and mattresses	0.135	0.135
	Post-decommissioning over-trawl surveys	7.314	10.874
Alison	Removal of piles from subsea template	0.004	0.004
	Removal of pipeline ends	0.081	0.081
	Removal of grout bags and mattresses	0.074	0.074
	Post-decommissioning over-trawl surveys	2.025	2.025
Audrey	Removal of Audrey A and B installations	0.240	0.240
	Removal of piles	0.019	0.019
	Cutting pipeline ends and removal of pipelines	0.023	0.023
	Removal of grout bags and mattresses	0.036	0.036
	Post decommissioning over-trawl surveys	5.732	5.732
Annabel	Removal of subsea template	0.001	0.005
	Removal of cut pipeline ends	0.000	0.039
	Removal of grout bags and mattresses	0.039	0.000
	Post decommissioning over-trawl surveys	4.100	7.020
Ensign	Removal of Installation	0.161	0.161
	Removal of piles	0.004	0.004
	Removal of pipeline ends	0.007	0.007
	Removal of grout bags and mattresses	0.046	0.046
	Well abandonment at Audrey and Ensign	0.009	0.009
North Norfolk Sandbanks and Saturn Reef SAC			
Maximum area of seabed disturbance (excluding over-trawl surveys) = 0.880 km^2			
Maximum area of seabed disturbance (including over-trawl surveys) = 20.051 km^2			
Southern North Sea SAC			
Maximum area of seabed disturbance (excluding over-trawl surveys) = 0.884 km^2			
Maximum area of seabed disturbance (including over-trawl surveys) = 26.535 km^2			

Physical loss of habitat at the Ann A4 field

7.61 There will be no additional rock required at the cut pipeline ends and therefore no activities that will cause any additional loss of habitat from the remaining activities to be undertaken at the Ann A4 field (Table 1) (Centrica 2017c).

Physical loss of habitat at the Ann field

7.62 There will be no additional rock required at the cut pipeline ends. No free-spans that require remediation have been recorded along any of the pipelines. Consequently, there are no activities that will cause any additional loss of habitat from the remaining activities to be undertaken at the Ann field (Table 2) (Centrica 2017b).

Physical loss of habitat at the Alison field

7.63 There will be no additional rock required at the cut pipeline ends. No free-spans that require remediation have been recorded along any of the pipelines. Consequently, there are no activities that will cause any additional loss of habitat from the remaining activities to be undertaken at the Alison field (Table 2) (Centrica 2017b)

Physical loss of habitat at the Audrey field

7.64 There will be no additional rock required for either drill rig stabilisation or for securing the cut pipeline ends. No free-spans that require remediation have been recorded along any of the pipelines. Consequently, there are no activities that will cause any additional loss of habitat from the remaining activities to be undertaken at the Audrey field (Table 3) (Centrica 2017a).

Physical loss of habitat at the Annabel field

7.65 There will be no additional rock required for securing the cut pipeline ends. No free-spans that require remediation have been recorded along any of the pipelines. Consequently, there are no activities that will cause any additional loss of habitat at the Annabel field (Table 3) (Centrica 2017a).

Physical loss of habitat at the Ensign field

7.66 There will be no additional rock required for rig stabilisation during well abandonment. Existing rock at the cut pipeline ends (PL2838 and PL2841) may be required to be re-distributed or additional rock may be deposited to ensure the cut pipeline ends remain buried. However, any additional rock will be placed over existing rock and not increase the area of impact on the seabed (Spirit Energy 2019c, 2020a).

Physical loss of habitat from existing pipelines and rock dump

7.67 A total of 109.7 km of pipeline subject to A-fields and Ensign decommissioning will be left *in situ* within the North Norfolk Sandbanks and Saturn Reef SAC following decommissioning and 136.7 km will remain within the Southern North Sea SAC (Table 12). Surveys undertaken along each of the pipelines have indicated that all lines are buried and not exposed on the seabed except near to installations, where they will be removed, or at pipeline crossings where they are covered by rock and other stabilising materials. Consequently, the physical presence of the pipelines themselves will not cause a permanent loss of habitat within the SACs.

7.68 Rock has previously been used to address free-spans that have formed along the pipelines following their installation and to reduce the risk of upheaval buckling. Rock is also used in the construction of pipeline crossings. The exact extent of existing rock along the pipelines is largely unknown and it is not possible to quantify the area of seabed impacted by existing rock from the information presented within the decommissioning plans. However, it is known that a total of 2,544 m of the Ensign PL2838 / 2839 pipelines are covered by rock and at least 259 m of rock occurs along the Ensign PL2841 / PLU2840 pipeline (Spirit Energy 2019c). A total of 1,700 m of rock along these lines has been deposited for mitigation in order to reduce the risk of upheaval buckling; the remaining rock is for pipeline crossings. Assuming a 10 m wide area of impact, the estimated area of seabed impacted by reported existing rock deposited for upheaval buckling is estimated to be 17,000 m^2 (0.002 km^2).

7.69 The number of pipeline crossings that will remain following decommissioning is presented in Table 13. The area of impact at each pipeline crossing is unknown but for the purposes of this assessment it is estimated that each pipeline crossing extends along 250 m of pipeline and impacts an area 5 m either side of the pipeline[20]. On this basis, it is estimated that a total length of rock at pipeline crossings is 8,000 m and will cover an area of seabed 80,000 m^2 (0.08 km^2).

7.70 No new mattresses or grout bags are to be placed on the seabed. Existing mattresses and grout bags that are covered by rock will be left *in situ*. No additional rock is planned to be deposited at cut pipeline ends.

7.71 BEIS is aware that the estimated extent of impact from proposed activities is based on the best available information at the time of decommissioning. Unforeseen circumstances can require the deposit of additional material which could increase the estimated area of seabed impacted. These unplanned deposits will be infrequent and very likely impact on relatively very small areas of seabed. All additional deposits will require environmental assessment, including an assessment under the Habitats Regulations prior to possible consent.

[20] The estimated length of rock at each pipeline crossing is based an average of four known rock dump deposits reported at crossings along pipelines associated with the Ensign decommissioning (Spirit Energy 2019c).

Table 12: Length of A-field and Ensign pipeline within SACs following decommissioning.

Installation	Pipeline No.	Length of line (km)	
		NNS&SR	SNS
Ann A4	PL2164	0	0
Ann A4	PL2165	0	0
Ann	PL947	30.18	39.43
Ann	PL948	6.37	14.94
Alison	PL947	0	0
Alison	PL1099	6.2	6.2
Audrey	PL496 and PL497	16.89	16.89
Audrey	PL575	0	0
Audrey	PL576	0	0
Audrey	PL723 and PL724	3.99	3.99
Annabel	PL2066 JW12	0	0
Annabel	PL2067 JW12	0	0
Annabel	PL2066 JWAB2	0	0
Annabel	PL2067 JWAB2	0	0
Annabel	PL2066	13.35	17.8
Annabel	PL2067	8.70	13.4
Ensign	PL2838 and PL2839	22.12	22.12
Ensign	PL2841 and PLU2840	1.92	1.92
	Total length of line	109.7	136.7

Table 13: Estimated extent of seabed impacted by pipeline crossings.

Field	No. of pipeline crossings	Estimated length of rock dump (m)
Ann A4	0	0
Ann	13	3,250
Alison	0	0
Audrey	10	2,500
Annabel	0	0
Annabel	5	1,250
Ensign	4	1,000
Estimated total length of seabed impacted		8,000

Chemical usage and discharge

7.72 Chemicals may be used and discharged during the well abandonment and plugging operations. The exact type and volume of chemical used may vary across individual

wells, they largely comprise of cement and spacer chemicals washed out after completing these activities which is used to plug the wells and water based muds (WBM) used to mill out wells requiring remedial cementing and for well control. The chemicals used during well abandonment at the A-fields and Ensign are not known. Previous assessments undertaken in the area have estimated 10 tonnes of cement cuttings per well may be discharged along with 200 bbls of water-based mud and associated brine. In total up to 600 bbls of waste may be discharged for each well, along with 300 bbls of 'slops' from the drilling rig (Chrysaor 2020b). Any waste fluids for discharge follows a hierarchy of disposal down a donor well, if that is not available, waste is returned to shore, WBM may be re-used and discharge is only permitted when there is no risk to the marine environment.

7.73 If the existing contents of wells are assessed not to pose a risk to the marine environment they may be discharged. Typical well contents and quantities, in tonnes, are presented in Table 14 (ConocoPhillips 2017).

Table 14: Typical wellbore and annulus contents (source ConocoPhillips 2017).

Chemical used	Closest equivalent today	Estimated amount per well (Tonnes)
Magnesium chloride	Magnesium chloride	2
Sodium chloride	Sodium chloride	17
Potassium chloride	Potassium chloride	3
DF Viscosifier (Xanthan Gum)	Flowzan® Biopolymer, Drispac® Regular Polymer	0.4
Bentonite	Bentonite	40
Barite	Barite	1
Caustic soda	Caustic soda	1
FLR-100, idflo	Impermex	1

Vessel noise

7.74 The offshore oil and gas industry have used, and will continue to use, vessels in support of the vast majority of offshore activity. Vessels are used extensively as supply vessels support operating platforms along with safety vessels permanently present in development areas. During decommissioning, drill rigs are used for the abandonment of wells, accommodation work vessels may be used for cleaning and preparatory decommissioning activities associated with platforms and pipelines and heavy lift vessels for platform and other asset removal are used.

7.75 Vessel movements are the largest contributor to anthropogenic ocean noise and in deeper water are the dominant noise source in the lower frequencies, between 50-

300 Hz (Ulrick 1967). Measurements undertaken in the Southern North Sea indicate that shipping noise is the dominant anthropogenic noise in the region predominantly in the frequency range of between 40 and 200 Hz (de Haan *et al.* 2007). In general, vessels that use dynamic positioning thrusters tend to generate higher levels of underwater sound. The individual noise output produced by a vessel is dependent upon a number of factors including the speed of the vessel, age, load, maintenance and oceanographic conditions.

7.76 Shipping noise is continuous and varies depending on the type of vessel being used. The primary sources of sound from vessels are propellers, propulsion and other machinery; the dominant noise source is from propeller cavitation (Ross 1976, Wales and Heitmeyer 2002, Arveson and Vendittis 2000). Source levels typically increase with increasing vessel size, with smaller vessels (< 50 m) having source levels 160-175 dB re 1µPa (rms SPL), medium size vessels (50-100 m) 165-180 dB re 1µPa (rms SPL) and larger vessels (> 100 m) 180-190 dB re 1µPa (rms SPL) (summarised by Richardson *et al*. 1995). Commercial vessels in transit have reported sound source levels of between 178.6 and 190.3 dB re 1 µPa -m (Genesis 2011, Johanson and Anderson 2012), whereas supply and maintenance vessels produce generally lower sound source levels of between 130 and 184 dB re 1 µPa (rms SPL), with frequencies of between 20 Hz and 10 kHz. However, sound levels depend on the operating status of the vessel with vessels equipped with dynamic positioning systems exhibiting increased sound levels in the spectrum from 3 Hz to 30 Hz (Nedwell and Edwards 2004, OSPAR 2009). Most of the acoustic energy from vessels is below 1 kHz, typically within the 50-300 Hz range, although cavitation from propellers produces sounds at frequencies of between 1 kHz and 125 kHz (Genesis 2011, Hermannsen *et al.* 2014). Consequently, vessel noise has historically thought to have a greater potential to impact marine mammals with relatively low frequency sensitivities e.g. seals and baleen whales rather than high frequency specialists, e.g. porpoise (Okeanos 2008). However, more recent studies indicate that high frequency sound from vessels of between 0.25 and 63 kHz and at mean sound levels of 123 dB re 1 µPa (rms SPL) can cause increased porpoising behaviour in harbour porpoise at distances greater than 1 km from the sound source (Dyndo *et al*. 2015).

7.77 Studies undertaken to measure ambient noise levels in the southern North Sea and Irish Sea indicate that at frequencies below 1 kHz, general shipping noise increases background noise levels to above 120 dB re 1 µPa (rms SPL), with levels of exceeding 140 dB re 1 µPa (rms SPL) in areas of intensive shipping (Nedwell *et al*. 2003).

7.78 Current levels of shipping noise within the SAC has been shown to influence on the presence or absence of harbour porpoise and could cause displacement and disturbance of harbour porpoise within the SAC (Heinänen and Skov 2015).

7.79 Studies undertaken on seven harbour porpoise in Danish waters indicated that there was variation in how individual porpoises responded to vessel noise with some individuals showing a behavioural response to vessel noise at levels of 96 dB re 1 µPa (rms SPL), causing changes in the foraging behaviour and others showing no behavioural response. Individuals exposed to relatively high levels of sound ceased foraging and swam to deeper water (Wisniewska *et al*. 2018a). Other studies have indicated that noise arising from shipping is capable of causing disturbance to beyond 1 km from a vessel (Dyndo *et al*. 2015, Hermannsen *et al*. 2014, Wisniewska *et al*. 2018b). Studies on the behavioural effects of shipping on harbour porpoise indicate that the level of displacement effects from shipping on harbour porpoise decrease with increasing distance from the vessel with some levels of displacement occurring out to 400 m from the vessel (Akkaya Bas *et al*. 2017, Polacheck 1990). However, the behavioural impacts are temporary with porpoises resuming activities relatively quickly once the vessel has passed (Hermannsen *et al*. 2014, Wisniewska *et al*. 2018b).

7.80 Based on an avoidance or a behavioural response out to 400 m from a vessel, an area of 0.5 km^2 may be impacted around each vessel. The number of vessels occurring in the area at any one time is uncertain. Similar decommissioning activities have confirmed between four and eight vessels may operate simultaneously (Chrysaor 2020b, NEO 2020a,b). Although, vessels may be operating in the same area and noise from the vessels could overlap, a worst-case scenario is that up to eight vessels each impact an area of 0.5 km^2 and therefore a total area of 4 km^2 may be affected by vessel noise at any one time.

Cutting noise

7.81 Cutting equipment will be required to cut the jacket legs and the pipeline ends. The cutting equipment to be used is unknown but is typically either diamond wire cutters or water jetting tools. Perforating guns or jet explosive cutters may be used when undertaking well abandonment operations.

7.82 Noise studies undertaken during diamond wire cutting of a conductor in the North Sea indicate that sound levels in the one-third octave band increased between 4 dB and 15 dB at frequencies above 5 kHz (Pangerc *et al.* 2016). However, other sources of sound from the associated vessels may have masked sound at lower frequencies. The level of sound arising from cutting tool is relatively low and is not predicted to be significantly, if at all, greater than that arising from the accompanying vessels.

7.83 There is limited information available on the sound levels arising from the use of water jetting tools, with one study reporting sound from high pressure water jets of 175.5 (A) re 1 µPa (Molvaer and Gjestland 1981). However, this figure is weighted for human hearing frequencies.

7.84 There is limited information on the noise arising from perforating guns or explosive cutters. The equipment is used below the mudline and their use will be limited in duration being required only at each of the wells to be abandoned. The impacts from noise within the water column arising from the use of this equipment is predicted to be minimal due to the activities being undertaken below the seabed [21].

7.85 Although the information available is limited, it is predicted that noise from cutting equipment will not be significantly greater than that arising from the accompanying vessels and therefore no additional impacts beyond that estimated from noise arising from the accompanying vessels are predicted to occur.

Potential impacts – Summary

7.86 Based on the above it is recognised that there is potential for impacts arising from the proposed decommissioning activities to cause physical impact and loss of habitat to the qualifying features of the North Norfolk Sandbanks and Reef SAC and the Southern North Sea SAC.

7.87 If non-intrusive over-trawl surveys are undertaken the total area of physical impact arising from decommissioning activities within the North Norfolk Sandbanks and Saturn Reef SAC is estimated to be 0.880 km^2 and within the Southern North Sea SAC is estimated to be 0.884 km^2 and (Table 11). This increases to 20.051 km^2 and 26.535 km^2 for each of the SACs respectively if intrusive over-trawl surveys are undertaken across the A-fields.

7.88 The total area of physical loss of habitat within both SACs is estimated to be 0.0082 km^2 (Para 7.68, 7.69).

7.89 Noise arising during the decommissioning activities is not predicted to extend beyond that caused by vessels, i.e. c.400 m. Consequently, noise likely to cause significant disturbance will occur over an area of 0.5 km^2 for each vessel and maximum area of 4 km^2 for a worst-case scenario of eight vessels being present at any one time.

[21] Examples of use of using perforating airguns during well abandonment indicate that they are operated at significant depth below the seabed, e.g. approximately 200 ft (Chrysaor 2020a).

8 IN-COMBINATION IMPACTS

8.1 Under the Habitats Regulations there is a requirement for the competent authority to consider the in-combination effects of plans or projects on designated sites when undertaking an HRA. In-combination effects refer to effects, which may or may not interact with each other, but which could affect the same receptor or interest feature (i.e. a habitat or species for which a national site is designated).

8.2 The in-combination assessment includes plans or projects that are:

- Under construction,
- Permitted application(s), but not yet implemented,
- Submitted application(s), not yet determined,
- Projects identified in the relevant Development Plan (and emerging Development Plans),
- Sites identified in other policy documents, as development reasonably likely to come forward.

8.3 For the purposes of this assessment, on-going impacts from current activities have not been included within the in-combination assessment where the influence of the projects upon a receptor, that may also be predicted to be significantly affected by the development, is considered to be captured within the baseline. For some on-going activities, e.g. fishing, shipping and dredging disposal, it is technically not possible to determine what the baseline conditions would be without the influence the impacts from these on-going activities have on the qualifying features of the sites. However, it is recognised that they may be having an effect on the qualifying features of the sites.

LOGGS and Viking decommissioning

8.4 Decommissioning plans (LDP2 to LDP5) have been submitted to BEIS for Planned decommissioning of oil and gas infrastructure proposed for the Lincolnshire Offshore Gas Gathering Station (LOGGS) decommissioning programmes (LDP) numbers 2 to 5. The plans include the decommissioning of the following fields:

- Saturn, Mimas, Tethys (LDP2),
- Jupiter, Europa, Ganymede (LDP3),
- Valiant, Vanguard and Vulcan fields (LDP4),
- LOGGS (LDP5).

8.5 The LOGGS LDP2 to LDP5 decommissioning programmes are part of a series of decommissioning activities being undertaken by Chrysaor since the initial plans were submitted by ConocoPhillips for VDP1 and LDP1 in 2015 (ConocoPhillips 2015a). Subsequent to those, additional decommissioning programmes have been submitted

and approved for VDP2 and VDP3 in 2017 and include the following fields (ConocoPhillips 2015b; Chrysaor 2020a):

- Viking (VDP1 and VDP2),
- Vixen (VDP2),
- Victor (VDP3),
- Vulcan, Valkerie, Vampire, Viscount (LDP1).

8.6 All activities associated with these decommissioning plans have been subject to a HRA (BEIS 2019, BEIS *in prep.*).

8.7 For each of these decommissioning programmes the physical impacts on the seabed and habitat loss arising from the plans have been estimated. A summary of the physical impacts and habitat loss arising from activities associated with the decommissioning programmes is presented in Table 15.

8.8 The estimated area of seabed physically impacted by previous and planned decommissioning activities undertaken by ConocoPhillips / Chrysaor is estimated to be 0.26 km^2 and a further 64.8 km^2 has been disturbed by over-trawl surveys. The total area estimated to have been physically impacted within the North Norfolk Sandbanks and Saturn Reef SAC is 36.35 km^2 and within the Southern North Sea SAC it is 42.74 km^2 (Table 15).

8.9 A total of 0.13 km^2 of seabed may have been lost due to the addition of material associated with decommissioning and 0.38 km^2 may be impacted by exposed pipelines. Within the North Norfolk Sandbanks and Saturn Reef SAC an estimated 0.33 km^2 of habitat many have been lost by decommissioning activities associated with LDP1 / VDP1 and VDP2 / VDP3 and 0.39 km^2 within the Southern North Sea SAC (Table 16).

Table 15: Estimated area of physical impact arising from LDP and VDP decommissioning programmes.

Activity	Area (km^2)			
	VDP1 and LDP1	VDP2 and VDP3	LDP 2 to LDP5	Total
Platform removal – Cutting of piles [1]	0.0087	0.0096	0.0108	0.0291
Heavy lift vessel anchors [1]	0.0120	0.0180	0	0.030
Accommodation works vessel – spud cans [1]	0.0630	0.0394	0.0014	0.1038
Removal of subsea infrastructure	n/a	0.0037	0.0008	0.0045
Cutting of subsea structure piles and pipeline ends [6]	0	0	0.0015	0.0015
Well abandonment –spud cans, anchors and chains [1, 2]	0.0239	0.0149	0.0538	0.0926
Removal of conductors [1, 2]	0.0001	0.0001	0.0002	0.0004
Total	0.1077	0.0857	0.0685	0.2619
Total over-trawl survey [1, 3]	17.2	47.6	0	64.80
Over-trawl survey within NNSSR SAC [4]	17.2	18.9	0	36.1
Over-trawl survey within SNS SAC [5]	17.2	25.3	0	42.5
Total area of physical impact	17.30	47.69	0.0685	65.05
Total area of physical impact in NNSSR SAC	17.30	18.98	0.0685	36.35
Total area of physical impact in SNS SAC	17.30	25.38	0.0577	42.74

1 - Figures for LDP1/VDP1 and VDP2/3 obtained from Chrysaor (2020c).

2 - From ConocoPhillips (2018a).

3 - Figures for area of impact from over-trawl surveys are estimated based on 200 m wide corridor along pipelines and 500 m radius around each installation (ConocoPhillips 2018b).

4 - Based on 54.8 km of pipeline within NNSSR SAC for LDP1/VDP1 and 109.5 km of pipeline for VDP2/VDP3.

5 - 54.8 km of pipeline in SNS SAC for LDP1/VDP1 and seven platforms and one manifold plus 106.5 km of pipeline for CDP2/VDP3.

6 for VDP1, VDP2, VDP3 and LDP1 the impacts arising from the cutting of the pipeline ends have been included in the footprint of the impacts from platform removal.

Where available the extent of actual impacts from now decommissioned assets have replaced previously forecasted estimated impacts used in previous HRAs.

Table 16: Estimated area of habitat loss arising from LDP and VDP decommissioning programmes.

Activity	Area (km^2)			
	VDP1 and LDP1	VDP2 and VDP3	LDP 2 to LDP5	Total
Accommodation works vessel – stabilisation [1]	0.0473	0.0394	0.0171	0.1038
Redistribution of rock	0.0037	0.0038	0.0017	0.0092
Cutting pipeline ends – rock protection [1]	0.0002	0.0004	0.0004	0.001
Free-span remediation – rock protection [1]	0.0002	0.0004	0.0005	0.0011
Well abandonment – rig stabilisation [1]	0.0032	0.002	0.0096	0.0148
Total	0.0546	0.046	0.0293	0.1299
Existing impacts				
Leave *in situ* existing pipelines [2]	0.0498	0.2001	0.1300	0.3799
Total area of habitat loss	0.1044	0.2461	0.1593	0.5098
Total area of habitat loss in NNSSR SAC including *in situ* loss	0.1036	0.0560	0.1717	0.3313
Total area of habitat loss in SNS SAC including *in situ* loss	0.1036	0.1430	0.1487	0.3953

1 - Figures obtained from Chrysaor (2020c).
2 - Based on 9.1% of the pipelines exposed on the seabed impacting an area of 5 m either side.

Victoria Field Decommissioning

8.10 The Victoria field lies within both the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC. NEO Energy submitted two decommissioning plans and an associated environmental appraisal in 2020. The field is due to be decommissioned between 2021 and 2025 (NEO Energy 2020a,b).

8.11 The Victoria field comprises of:

- Victoria subsea well with well head protection structure
- Valve skid,
- Pipeline and umbilical from well to valve skid (27 m),
- Pipeline and umbilical from valve skid to main pipeline (126 m),
- Umbilical at Victoria valve skid (150 m),
- Pipeline to Viking BD valve skid (78 m),
- Umbilical to Viking BD valve skid (120 m),
- Production export pipeline and umbilical (3.95 km).

8.12 The estimated area of impact from the decommissioning of the Victoria field is presented in Table 23 and Table 24. The overall extent of seabed disturbance arising from the planned decommissioning of the Victoria field within both SACs is estimated to be 0.0328 km^2 and potential area of seabed habitat that may be lost is estimated to be 0.0006 km^2.

Table 17: Estimated area of seabed impacted by decommissioning the Victoria Field.

Activity	Assumptions	Area of seabed disturbed (km^2)
Anchoring jack-up vessel for well abandonment	No anchors or rig stabilisation material will be required.	0
Location of Jack-up vessel spud cans	4 x 5.2 m diameter spud cans.	0.00009
Pipeline section and umbilical removal	532 m of pipeline to be removed. Pipeline ends will be trenched and naturally buried.	0.0052
Victoria valve skid removal	Presumed same area of seabed disturbed as pile removal	0
Valve skid piles	Cut of four piles	0.0027
Wellhead removal	Cut of well tubing allowing 4 m deep with radius of 3 m.	0.0002
Concrete mattress removal	109 concrete mattress 6 m x 2.4 m. 176.9 m^2 for each mattress.	0.0193
Frond mattress removal	13 frond mattresses 6 m x 2.4 m. 176.9 m^2 for each mattress.	0.0053
Post decommissioning over-trawl surveys	Applicant has stated that over-trawl surveys will be non-intrusive	0
	Total area impacted (km^2)	0.0328

Note: Area of pipeline section and removal is based on seabed disturbance of 10 m corridor and not 5 m as per application.

Area of impact from pile removal 929 m^2 for each pile (see Spirit Energy 2020a).

Area of seabed disturbance around each mattress of 5 m.

Table 18: Estimated are of seabed physically lost due to the decommissioning of the Victoria field.

Infrastructure	Assumptions	Area of seabed lost (km^2)
Decommissioned pipelines left *in situ.*[1]	All remaining pipelines are buried and therefore do not impact on the seabed.	0
Leave *in situ* pipeline crossing	There is one pipeline crossing with 44 mattresses and an unknown number of grout bags. Presumed area of permanent impact based on mattress of 6 m x 2.4 m.	0.0006
	Total area impacted (km^2)	0.0006

Anglia Field Decommissioning

8.13 The Anglia field lies within the North Norfolk Sandbanks and Saturn Reef SAC and is due to be decommissioned between 2023 and 2025 (Ithaca 2019a, b).

8.14 The field comprises of:

- Anglia A normally unmanned installation,
- Anglia West B subsea manifold (outwith the SACs),
- 11 wells, (six in NNSSR SAC),
- Anglia A to Anglia West B 5 km export line (trenched and buried),
- Anglia A to LOGGS 24 km export line (trenched and buried),
- Protective materials, mattresses, grout bags and rock.

8.15 All 24 km of the Anglia A to LOGGS export line and associated piggy-backed methanol line (PL854 and PL855) lie within the North Norfolk Sandbanks and Saturn Reef SAC. A total of 18 km of these lines occur within the Southern North Sea SAC. Surveys undertaken in 2018 confirmed that 519 m of the line was exposed on the seabed and 97 m of it was identified as being free-spans. Consequently, 2.2% of the line was exposed. A further 68 m of free-spans were identified along the 10 km of interfiled pipeline and umbilical (PL954 and PL955) (Ithaca 2019a,b). Total length of free-spans is therefore 165 m. For the purposes of this assessment a precautionary presumption has been made that all free-spans will require rock placement which will impact a 10 m wide corridor.

8.16 The Anglia West B subsea manifold lies outside of the North Norfolk Sandbanks and Saturn Reef SAC and the impacts from its removal will not impact on the features of the site. Neither Anglia A nor Anglia West B lie within the Southern North Sea SAC.

Table 19: Estimated area of seabed physically impacted from the proposed decommissioning activities associated with the Anglia decommissioning.

Activity	Total area of seabed impacted (km^2)	
	NNSSR SAC	SNS SAC
Decommissioning impacts [1]		
Platform removal – Cutting of piles	0.01	0
Platform removal – HLV anchors and chains	0.02	0
Removal/moving of subsea protective material	0.006	0
Removal of 2.5 km of infield umbilical	0.003	0
Well abandonment – spud cans and anchors	0.001	0
Over-trawl survey [2]	5.59	3.60
Total area of physical impact (km^2)	0.040	0
Total area of physical impact including over-trawl survey (km^2)	5.63	3.60

1 – Ithaca 2019a, b

2 - Area of over-trawl survey has been estimated based on a 200 m corridor along the 24 km of export line and one survey in 500 m radius of installation.

Table 20: Estimated area of seabed physically lost from the proposed decommissioning activities associated with the Anglia decommissioning.

Activity	Total area of seabed impacted (km^2)	
	NNSSR SAC	SNS SAC
Decommissioning impacts		
Free-span remediation – rock protection [1]	0.0016	0
Well abandonment – rig stabilisation [2]	0.002	0
Existing impacts		
Leave *in situ* existing exposed pipelines [2]	0.007	0
Total area of habitat loss (km^2)	0.0106	0

1 - Based on rock placement across 165 m of identified free-spans impacting a 10 m wide corridor of seabed.

2 – Ithaca 2019a

8.17 It is estimated that Anglia decommissioning activities could cause physical impact of 0.040 km^2 and loss of habitat covering 0.0106 km^2 within the North Norfolk Sandbanks and Saturn Reef SAC. In the event that an over-trawl survey is undertaken the area of seabed disturbed increases to an estimated 5.63 km^2. Within the Southern North Sea SAC the only potential impact is from a contingent over-trawl survey along the 18 km of pipeline within the site and could cause an estimated area of seabed disturbance of 3.60 km^2.

Hewett Field Decommissioning

8.18 The Hewett field lies partially within Southern North Sea SAC but lies beyond 7 km from the North Norfolk Sandbanks and Saturn Reef SAC. ENI submitted a decommissioning plan for the removal of six platforms: 48/29A-FTP, 48/29A-P, 48/29A-Q, 48/29B, 48/29C, 52/5A. and associated infrastructure in 2020 (ENI 2020). Decommissioning involves the removal of all six installations and the cutting and leaving *in situ* the associated pipelines and umbilicals (PL020, PL021, PL084, PL085, PL086, PL087, PL584 PL1173 and PL1177).

8.19 The proposed removal activities will be undertaken between 2021 and 2028. The estimated area of impact from the decommissioning of the ENI field is presented in Table 21 and Table 22. The overall extent of seabed disturbance arising from the planned decommissioning of the Hewett field within the Southern North Sea SAC is estimated to be 0.6518 km^2 and potential area of seabed habitat that may be lost is 0.076 km^2.

Table 21: Estimated area of seabed impacted by decommissioning Hewett fields (Source: ENI 2020).

Activity	Assumptions	Area of seabed disturbed (km^2)
External cutting of jacket legs	To excavate to 4 metres below the seabed, excavations will extend laterally 7 m from each jacket leg impacting an area of c. 154 m^2. Platform 48/29A-Q has 4 legs and all other platforms have 8 legs.	0.0067
Removal of riser and cut of pipeline ends	The area of seabed disturbance assumes a corridor width of 4 m for the 12 m length from the riser impacting an area of 48 m^2	0.0006
Removal of mattresses and other stabilisation materials	Mattresses and other stabilisation materials will only be removed from areas requiring excavation.	Included in above estimates
Use of an anchor moored HLV to remove topsides and jackets	Each anchor will directly cover an area of 25 m^2. There will be a 600 m length of each anchor line in contact with the seabed and the lines will sweep ca. 3 degrees when the HLV travels 120 m from the standoff to working location. In addition, it is assumed that the anchor lines on the seabed are subject to a lateral movement of ca. 5 m. This equates to an area of seabed of 11,146 m^2 per anchor line being disturbed.	0.7149
Over-trawl survey	No over-trawl survey is within the decommissioning programme.	0
	Total area impacted (km^2)	0.7475
	Total area impacted in SNS SAC [1]	0.6518

1 - Installation 48/29b lies outwith the SNS SAC.

Table 22: Estimated are of seabed physically lost due to the decommissioning of the Hewett fields (Source: ENI 2020).

Infrastructure	Assumptions	Area of seabed lost (km^2)
Use of W2W HLV jack-up vessel	It is assumed that the vessel has 4 spud cans, each of which has a radius of 7 m, impacting an area of 154 m^2, equating to 616 m^2 for all four. However, in the event that pre-lay rock needs to be deposited for stabilisation it is assumed that a radius of 20 m around each spud can would be disturbed, impacting an area of 1,257 m^2. Any rock deposited for scour mitigation would be within this disturbance area	0.025
Decommissioned pipelines left *in situ.*[1]	Area is calculated based on length of lines in Appendix B. 56.31 km of pipeline. Assuming 9.1% of the pipelines are exposed on the seabed and impact 10 m wide corridor.	0.051
	Total area impacted	0.076
	Total area lost in SNS SAC	0.076

1 – No assessment has been made within the decommissioning plan of impacts from leaving *in situ* pipelines.

Cavendish

8.20 The Cavendish field lies within Southern North Sea SAC but 81 km from the North Norfolk Sandbanks and Saturn Reef SAC. INEOS submitted a decommissioning plan for the removal of one platform and one pipeline (PL2284), one umbilical (PL2285) and one fibre optic cable (PL4612); all of which are laid within the same trench (INEOS 2019a,b).

8.21 Decommissioning involves the removal of the Cavendish installation and the cutting and leaving *in situ* the associated pipeline, umbilical and cable.

8.22 The proposed removal activities was undertaken in 2020 and all decommissioning activities will be completed by 2023 (INEOS 2019a,b).

8.23 The estimated area of impact from the decommissioning of the Cavendish field is presented in Table 23 and Table 24. The overall extent of seabed disturbance arising from the planned decommissioning of the Cavendish field within the Southern North Sea SAC is estimated to be 0.0279 km^2 and potential area of seabed habitat that may be lost is 0.0472 km^2.

Table 23: Estimated area of seabed impacted by decommissioning the Cavendish Field.

Activity	Assumptions	Area of seabed disturbed (km^2)
Anchoring HLV	14 anchors each 4x4x4 m. 500 m long chains 90% in contact with seabed, buried to 0.5 m with 4 m lateral movement.	0.0254
Location of Jack-up vessel spud cans	4x18 m diameter spud cans to a depth of 0.5 m	0.0005
Pipeline section and umbilical removal	Est. 275 m	0.0004
Jacket and pile removal	Cut of jacket piles allowing 4m deep with a radius of 3m. 4 No. piles	0.0004
Wellhead removal	Cut of well tubing allowing 4 m deep with radius of 3 m.	0.0002
Mattress removal	139 mattress	0.0010
	Total area impacted (km^2)	0.0279
	Total area impacted in SNS SAC [1]	0.0279

Table 24: Estimated are of seabed physically lost due to the decommissioning of the Cavendish field.

Infrastructure	Assumptions	Area of seabed lost (km^2)
Decommissioned pipelines left *in situ.*[1]	Area of impact within SAC is calculated based on length of lines in Appendix B. 47.17 km of pipeline. Assuming 9.1% of the pipelines are exposed on the seabed and impact 10 m wide corridor.	0.0472
	Total area impacted	0.0472
	Total area lost in SNS SAC	0.0472

1 – No assessment has been made within the decommissioning plan of impacts from leaving *in situ* pipelines.

Leman BH Field

8.24 The Leman BH field lies within the North Norfolk Sandbanks and Saturn Reef SAC. Shell submitted a decommissioning plan for the removal of the Leman BH platform and associated infrastructure in 2015; the installation was removed in 2017.

8.25 The decommissioning involved the removal of the Leman BH installation only. No other infrastructure was decommissioned (Shell 2017).

8.26 The installation was removed by the use of a heavy lift vessel that used anchors to maintain position. The estimated area of impact on the seabed from the worst-case scenario was 0.41 km^2 (Shell 2015).

8.27 No other impacts on qualifying features were identified.

Future Decommissioning Programmes

8.28 It is recognised that future decommissioning activities will be undertaken within the SACs. Currently, the timing of future activities are unknown. However, it is possible that the following installations may be subject to decommissioning plans prior to 2024:

- Indefatigable (Inde) 18A (49/18A),
- Leman 27J (49/27J),
- Leman 27E (49/27E),
- Waveney (48/17c).

8.29 There is no information on how or when decommissioning of these, or other, installations will be undertaken but it is recognised that future plans and projects will be subject to the requirements of the Habitats Regulations once applications have been made.

Other oil and gas activity

8.30 Figure 6 presents the existing oil and gas infrastructure in the North Norfolk Sandbanks and Saturn Reef SAC. This area is extensively developed with numerous existing pipelines, wells and platforms. It is not known what other projects may be planned in the future and so it is not possible to include all future activities within the in-combination assessment. However, any future developments would be required to undertake a Habitats Regulations Assessment that would take into consideration the potential in-combination impacts, including those arising from the proposed decommissioning activities.

8.31 Within the North Norfolk Sandbanks and Saturn Reef SAC there were 77 surface installations, including those relating to the A-fields and Ensign (Appendix C). Since the removal of nine installations in 2019 (Viking GD, HD, DD, CD, ED, LD, and KD, plus Victor JD and Vulcan UR) the number of installation present within the North Norfolk sandbanks and Saturn Reef SAC has been reduced to 68.

8.32 In the Southern North Sea SAC there are 136 surface installations (Appendix D), of which five have been removed: Camelot CA and CB, Horne and Wren, Leman BH and Welland.

8.33 The majority of the installations were installed over ten years ago with only one having been installed within the North Norfolk Sandbanks and Saturn Reef SAC since 2013.

8.34 The Southwark installation and associated export pipeline are part of the wider Blythe field development and lie within the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC (IOG 2019, 2021). Located in Block 49/21 the Southwark installation is a minimal facilities platform with three production wells exporting gas and condensate to the existing Thames to Bacton pipeline (PL370) via a 5.67 km long 24" export pipeline.

8.35 The estimated area of seabed physically lost due to the installation of the platform and export pipeline is 2,168 m^2 (0.002 km^2). This is from the deposit of up to 22 mattresses and rock placement for pipeline stabilisation (IOG 2019).

8.36 The estimated area of seabed physically impacted is 5,653 m^2 (0.005 km^2). This is primarily due to the installation of the pipeline which will be trenched and buried (IOG 2019, 2021).

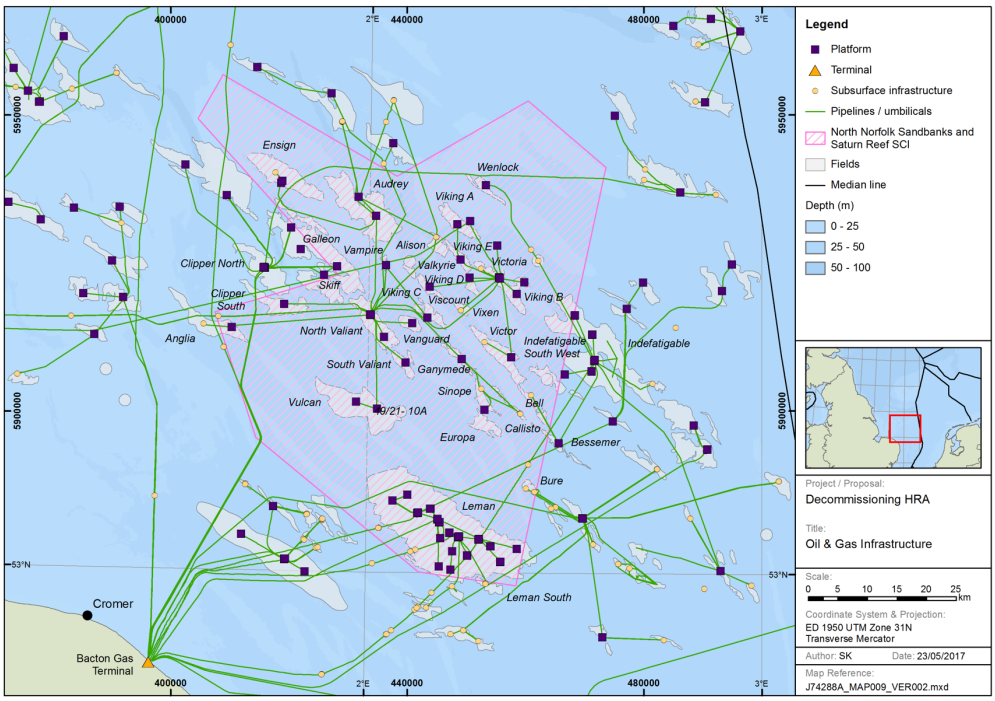


Figure 6: Existing oil and gas infrastructure within the North Norfolk Sandbanks and Saturn Reef SAC.

8.37 The area of physical impact on the seabed from the existing installations is dependent on the size of each installation. Based on the known jacket size of 34 Southern North Sea installations the average installation footprint is 726 m^2 [22]. Consequently, the estimated area of physical impact caused by existing infrastructure within the North Norfolk Sandbanks and Saturn Reef SAC is estimated to be 49,368 m^2 (0.049 km^2). In the Southern North Sea SAC the remaining installations have an estimated total footprint of 95,106 m^2 (0.095 km^2).

8.38 It is recognised that buried pipelines can both resurface and re-bury overtime due to sediment movement. Evidence from pipeline surveys undertaken since 1994 across the

[22] The area of each jacket leg is unknown and therefore the 'footprint' refers to the area within the platform jacket legs and not the physical impact from the actual legs on the seabed. Consequently, this is a very much worse-case estimate.

Viking field indicate that pipelines buried over sandy sediments largely remain buried, whereas those buried across gravelly sand are more at risk of becoming exposed (ConocoPhillips 2016). Along five pipelines within the Viking field a total of 31.1 km of gas pipeline have been surveyed for burial depth and free-spans. A total of 13.9 km of the lines were buried at the time of installation. Of the 13.9 km of line trenched and buried at the time of installation a total of 1.0 km (7.5%) is now on the surface of the seabed. Of the pipelines that were laid on the surface of the seabed at the time of installation (the Viking ED and GD pipelines), 63.7% of the pipeline is currently buried. This indicates that overtime a significant proportion of existing pipelines that are laid on the surface of the seabed may become buried.

8.39 The results of the surveys indicate that the depths at which surface laid pipelines become self-buried varies over the years, with intermittent exposure on the seabed surface occurring in areas of gravelly sand and complete burial across sandbanks where the sediment comprises predominantly of sand. Buried pipelines may become exposed where mega-ripples have moved since the pipelines have been laid. This suggests that buried pipelines do not affect the movement of surface sediments.

8.40 Surveys and monitoring around installations within the SAC indicate that scour can occur around relatively large infrastructure such as installations but not all of them and that following removal any scour pits are in-filled over time. Similarly, rock and mattresses can become buried, although this does vary upon the local conditions and the proximity to installations, with little or no coverage occurring closer to the platforms (Chrysaor 2020b). Buried pipelines will not affect the structure, function or integrity of the site.

8.41 A total of 721.57 km of gas pipeline is present within the North Norfolk Sandbanks SAC (Appendix A). This does not include the smaller diameter methanol, chemical and hydraulic lines that are normally piggy-backed or laid alongside (within the same trench) larger lines. For the purposes of this assessment, unless it is known otherwise, these small diameter lines are presumed to be piggy-backed or alongside the existing gas lines and therefore their presence does not increase the overall area of seabed impacted.

8.42 Based on an estimated 10 m corridor of impact along each pipeline, a total area of 7.2 km^2 of seabed within the SAC is estimated to have been physically disturbed by the installation of existing gas pipelines. However, following burial the seabed is known to recover and only pipelines remaining on the seabed surface cause on-going loss of habitat. Within the SAC, 88.3% of all pipelines are trenched and buried and do not affect the surface of the seabed. Surveys undertaken by Chrysaor along 557 km of pipeline reported 9.1% of the pipeline as being exposed on the seabed (Chrysaor 2020d). However, some of this may include pipelines that were surface laid. Similar surveys along 368.9 km of pipeline and umbilical that were buried when installed have reported 2.5% of the pipeline being exposed on the seabed (Perenco 2014b). On a precautionary

assumption that 9.1% of the 721.57 km of pipeline in the North Norfolk Sandbanks and Saturn Reef SAC is exposed on the seabed, approximately 65.7 km may be exposed and impacting an estimated area of seabed of 0.657 km^2.

8.43 Within the Southern North Sea SAC the total length of pipeline is 2,657 km, of which 89.4% was trenched and buried. If 9.1% of all pipeline line laid within the SAC is exposed then an estimated 241.8 km of pipeline could be exposed on the seabed within the Southern North Sea SAC. This equates to an estimated physical impact of 2.4 km^2.

8.44 Historical deposits of rock for rig stabilisation have been made over the years. The exact extent of seabed impacted by historical deposits is unknown. However, known deposits made within the North Norfolk Sandbanks and Saturn reefs SAC since 2011 cover an area of 0.0714 km^2 (Table 25) The area of rock deposited within the Southern North Sea SAC by the oil and gas industry since 2011 is 0.2185 km^2 (Table 26). These totals are recognised to be a minimum. It is possible that a larger area of the SACs may have been impacted by historical rock dump over the years. Furthermore, applications for contingency rock dumping for rig stabilisation are made but it is not always reported as to whether it is ultimately required and deposited. This is particularly the case with regards to activities undertaken prior to the sites being designated.

Table 25: Known area of rock deposits in the North Norfolk Sandbanks and Saturn Reef SAC.

Location	Year	Area (km^2)
Vanguard QD [1]	2013	0.0024
South Valiant TD [1]	2014	0.0052
North Valiant 1 PD [1]	2014/15	0.0033
Block 48/20 – pipeline [1]	2018	0.0019
Block 53/1 [1]	2018	0.0007
Ann/Alison [2]	n/a	0.0096
NNSSR SAC [3]	2011 - 2016	0.0483
	Total	0.0714

Note – the total includes both the total deposits made between 2011-2016 as well as the individual deposits listed above including those made between 2013 and 2015. Consequently some deposits may have been accounted for twice.

1 – Chrysaor 2020a; 2 – Centrica 2017a; 3 - Genesis 2020.

Table 26: Known rock deposits in the Southern North Sea SAC.

Location	Year	Area (km^2)
Vanguard QD [1]	2013	0.0024
South Valiant TD [1]	2014	0.0052
North Valiant 1 PD [1]	2014/15	0.0033
Block 48/20 – pipeline [1]	2018	0.0019
Block 53/1 [1]	2018	0.0007
Ann/Alison [2]	n/a	0.0096
SNS SAC [3]	2011 - 2016	0.1954
	Total	0.2185

Note – the total includes both the total deposits made between 2011-2016 as well as the individual deposits listed above including those made between 2013 and 2015. Consequently some deposits may have been accounted for twice.

1 – Chrysaor 2020a; 2 – Centrica 2017a; 3 - Genesis 2020.

8.45 A significant majority of existing oil and gas infrastructure has been present prior to the site becoming designated and therefore the impacts on the qualifying features of the site are part of the baseline environment.

Fishing

8.46 Fishing occurs widely across the southern North Sea and has been on-going for many hundreds of years. The predominant fishing activity within the North Norfolk and Saturn Reef SAC is beam trawling, mainly by Dutch and UK registered vessels targeting demersal species such Dover sole, plaice and lemon sole (MMO 2011, ConocoPhillips 2015a). Bottom fishing causes a physical impact on the seabed and the intensity of bottom fishing across the SAC is presented in Figure 7. The figures show the swept

area ratio[23] in each block from surface and subsurface fishing within the SAC during 2017 [24] (ICES 2019).

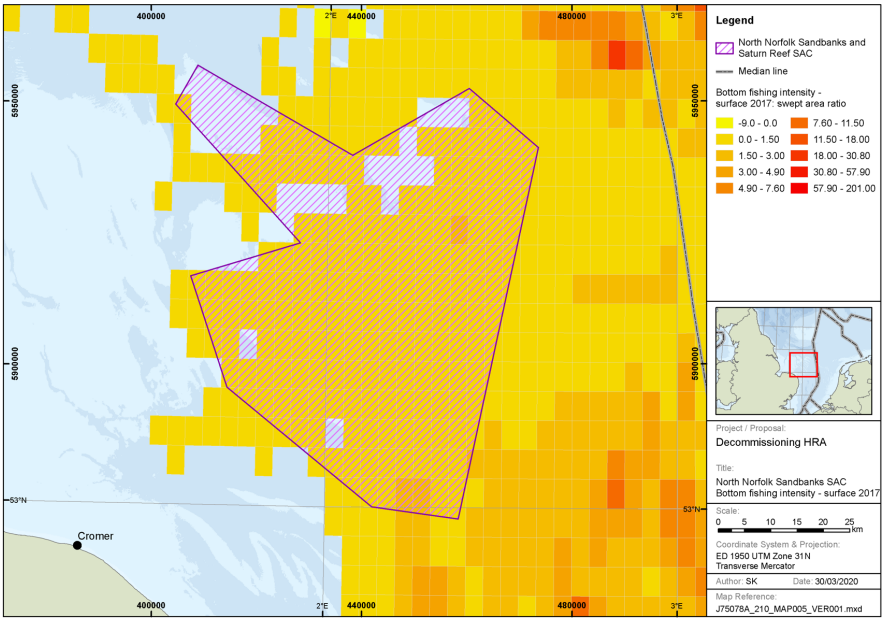
8.47 Based on studies undertaken on the impacts of beam trawling on the seabed, the potential extent of seabed disturbance on average per year within the North Norfolk Sandbanks and Saturn Reef SAC has been estimated to be 1,312 km^2 per year (36.4% of the SAC) (ABPMer and Ichthys Marine 2015). Over a period of five years an estimated 39% of the SAC is physically impacted by beam trawling.

8.48 Within the Southern North Sea SAC the majority of current fish landings are obtained from areas adjacent to the SAC but there is widespread fishing activity in the southern half and north-eastern edge of the SAC and relatively moderate to high level of fishing activity along the western edge of the central part of the SAC (Figure 8) (MMO 2017a). Note however, this does not include the activities of non-UK registered vessels that will occur within the site or vessels less than 10 m in length.

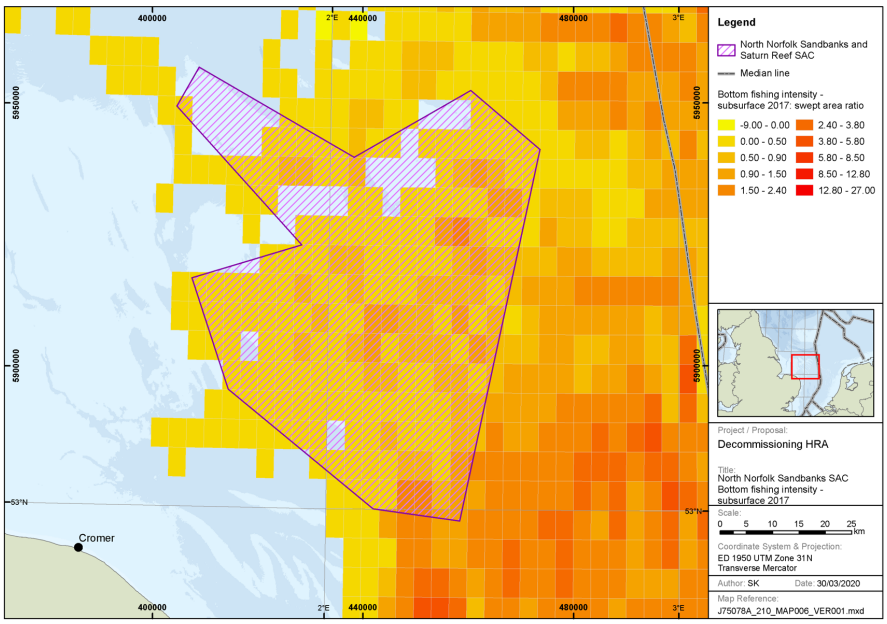
8.49 The predominant fishing activity within the SAC is beam trawling, mainly by Belgian and Dutch vessels targeting Dover sole, plaice and lemon sole (MMO 2017b). Otter trawling and seine netting also occur for flat fish and sandeel fishing is also undertaken by trawling primarily around the western edge of Dogger Bank. The significant majority of fish taken and landed in the UK are plaice, sole, skates and rays caught by demersal and beam trawlers.

8.50 There have been no studies undertaken to estimate the level of seabed impact within the Southern North Sea SAC and therefore it is not possible to quantify the extent of seabed disturbance caused by fishing activities within the site.

[23] The swept area ratio is the annual area of seabed impacted per year divided by the surface area of each cell.
[24] Surface fishing is where fishing gear does not penetrate more than 2 cm below the seabed surface. Sub-surface fishing is where fishing gear impacts greater than 2 cm below the seabed surface.



a) Surface fishing intensity in North Norfolk Sandbanks and Saturn Reef SAC



b) Sub-surface fishing intensity in North Norfolk Sandbanks and Saturn Reef SAC.

Figure 7: Surface and sub-surface fishing intensity in North Norfolk Sandbanks and Saturn Reef SAC.

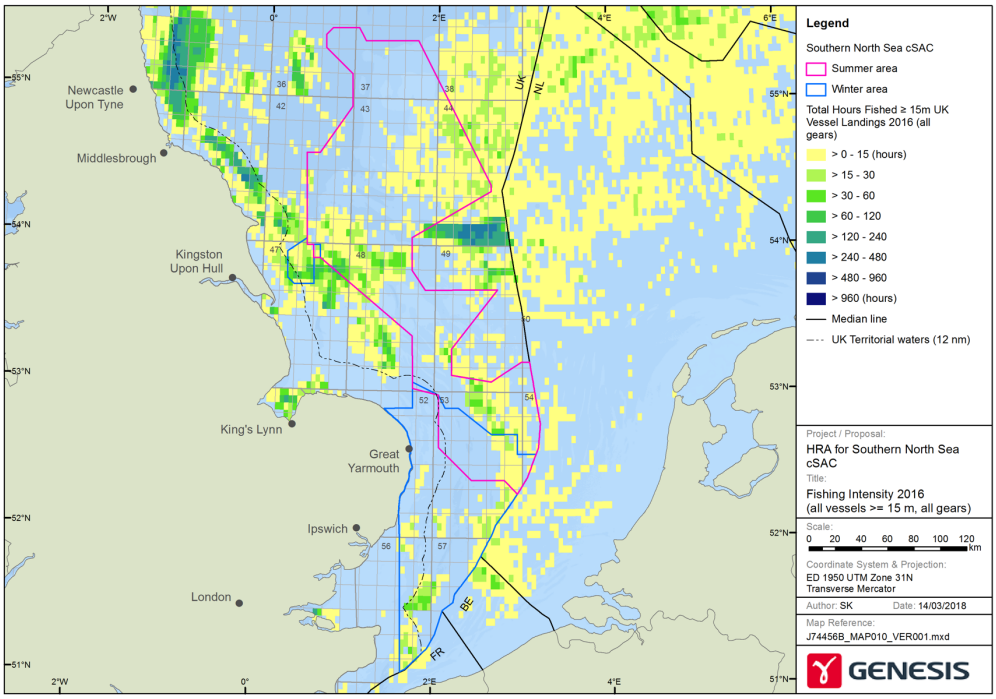


Figure 8: Fishing intensity across the SAC during 2016 by UK registered vessels.

Renewable energy

8.51 No wind farm licensed areas occur within the boundaries of the North Norfolk Sandbanks and Saturn Reef SAC and no direct or indirect physical impacts on the SAC are predicted to occur from offshore wind turbines. However, up to six export cables from the proposed Hornsea 3 offshore wind farm are currently planned to cross the SAC from the Hornsea 3 offshore wind farm to the north Norfolk Coast (Figure 9).

8.52 The total length of the export cable route associated with the proposed Hornsea 3 development is 145 km long and 1.5 km wide. The cables will be predominantly buried to a depth of 1 to 2 m, although up to 6% of the total cable route may require additional rock dumping to ensure burial (Ørsted 2020). In addition, where cables cross existing infrastructure, e.g. pipelines, rock will be required at each of the crossings. In total, within the SAC, an estimated 4,086,405 m^2 (4.1 km^2) of seabed may be physically disturbed by the trenching and burying of the cables and 418,440 m^2 (0.4 km^2) of seabed will be physically impacted by rock placed along the cable route for protection and crossings (Ørsted 2020).

8.53 Surveys undertaken to support the wind farm application did not identify any reef habitats along the proposed cable routes (Ørsted 2018a).

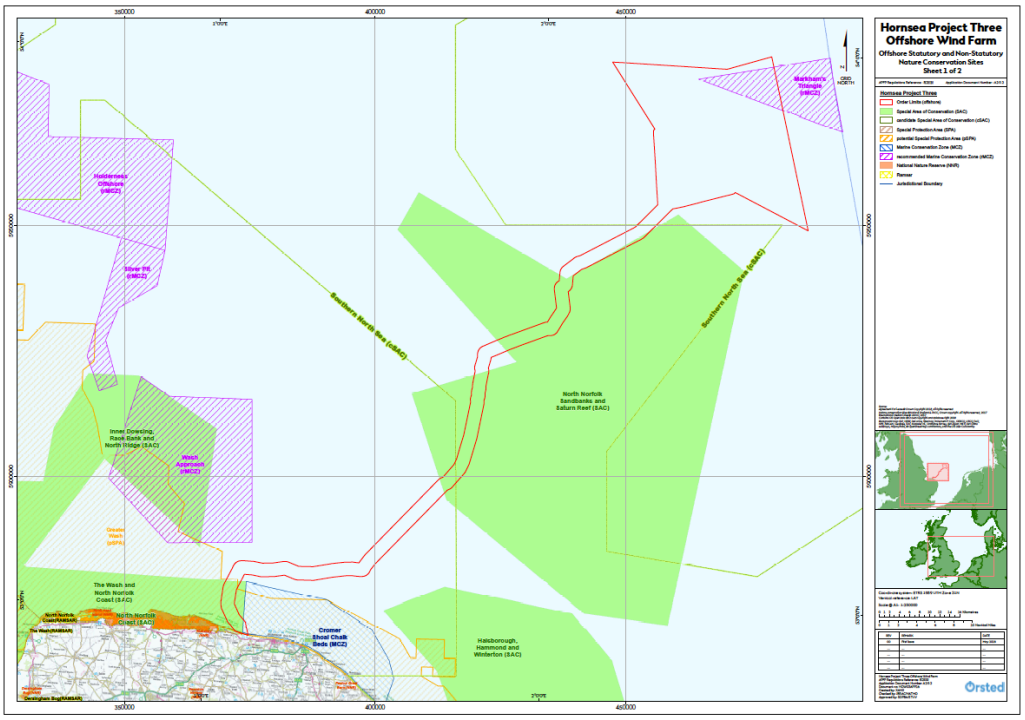


Figure 9: Proposed Hornsea 3 project and offshore nature conservation sites (Source Ørsted 2018b).

8.54 In total an estimated 0.1% of the seabed within the SAC may be physically disturbed and 0.01% may be physically lost by the laying of export cables across the SAC.

8.55 The estimated area of impact arising from offshore wind farms within the Southern North Sea SAC are presented in Table 27. The potential area of seabed within the SAC estimated to be permanently impacted by the physical presence of the turbines, associated infrastructure and scour protection is 8.52 km^2. A total of 98.76 km^2 of seabed may be temporarily impacted by cable trenching (BEIS 2020a).

Table 27: Estimated area of impact from consented offshore wind farms within the Southern North Sea SAC (Source BEIS 2020a, Ørsted 2020).

Wind farm	Estimated area of physical impact (km²)				
	Turbines and scour	Infrastructure	Cable protection	Total permanent impact	Cable trenching
Galloper	0.98	0.00	0.20	0.29	3.90
Greater Gabbard	0.11	0.005	0.15	0.27	2.99
Dogger Bank A (planned)	0.45	0.02	0.74	1.33	14.73
Dogger Bank B (planned)	0.45	0.02	0.73	1.32	14.64
Dogger Bank C (consented)	0.00	0.00	0.08	0.08	1.53
Sophia (planned)	0.68	0.11	0.72	1.51	14.37
Hornsea One (planned)	0.25	0.05	0.27	0.57	7.10
Hornsea Two (planned)	0.32	0.06	0.63	1.02	12.62
Hornsea Three (consented)	0.00	0.00	0.40	0.40	4.10
East Anglia One (planned)	0.13	0.03	0.37	0.52	7.32
East Anglia Three (consented)	0.33	0.11	0.77	1.21	15.46
Total	3.70	0.41	5.06	8.52	98.76

Aggregate extraction and dredging activity

8.56 Aggregate extraction areas 483 and 484 lie within the boundary of the North Norfolk Sandbanks and Saturn Reef SAC (Figure 10). Applications to undertake extraction at both sites were made in 2014 and consent given for area 484 in March 2015 and varied in June 2017 (currently discharging conditions from 2017 variation approval. Extraction area 483 obtained consent in December 2017 (MMO 2015b, MMO 2017c).

8.57 The area of each site within which extraction could be undertaken is 28.24 km^2 for site 483 and 17.2 km^2 for site 484; a combined total area of 45.4 km^2. Assuming the worst-case scenario is that the whole area of the two sites will be impacted, then 1.2% of the SAC could be physically impacted by aggregate extraction.

8.58 Consent was granted for both Areas to each extract up to a maximum of nine million tonnes of material over the licence term of 15 years (i.e. an average of 600,000 tonnes/area/year) (Fugro Emu 2014).

8.59 Dredged material will be extracted using a trailer suction hopper dredger. Material will be screened and estimated 50 – 55% of the material may be returned back to the seabed

due to being unsuitable for market requirements. The dredging of the material will cause a physical impact on the seabed and habitats.

8.60 An assessment undertaken by the applicant in support of their license application concluded that dredging activities at either site would not cause an adverse effect on the integrity of the SAC. Following an agreement to avoid an area of Sabellaria reef habitat, both the MMO and JNCC agreed with these conclusions for area 484, (Fugro Emu 2014, MMO 2015b).

8.61 Within the Southern North Sea SAC existing localised aggregate dredging occurs primarily in the southern half of the SAC, along the east coast (Figure 11). In 2017 there were 29 aggregate production areas and five Exploration and Option sites covering an area of 579.3 km^2 (Table 28). Five of the aggregate sites occur in the 'summer' area of SAC and the rest occur in the 'winter' area of the SAC, with some sites occurring in both the 'winter' and 'summer' areas (TCE 2019a).

8.62 The three-year average annual offtake of construction aggregate across the Humber, East Coast and Thames Estuary regions was 8.13 million tonnes (TCE 2019b).

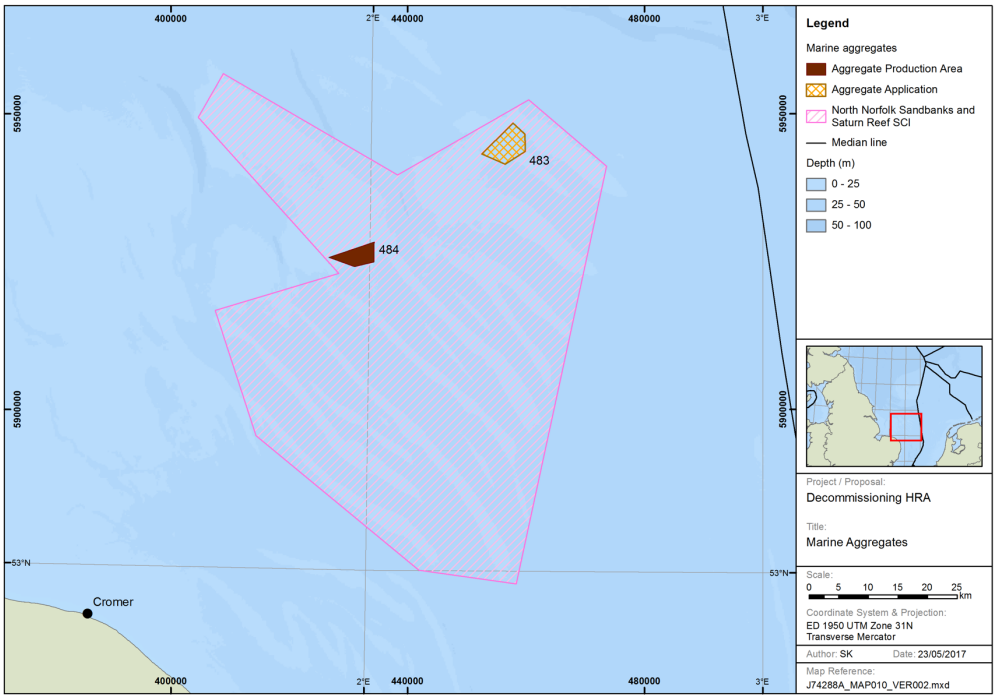


Figure 10: Aggregate extraction sites within the North Norfolk Sandbanks and Saturn Reef SAC.

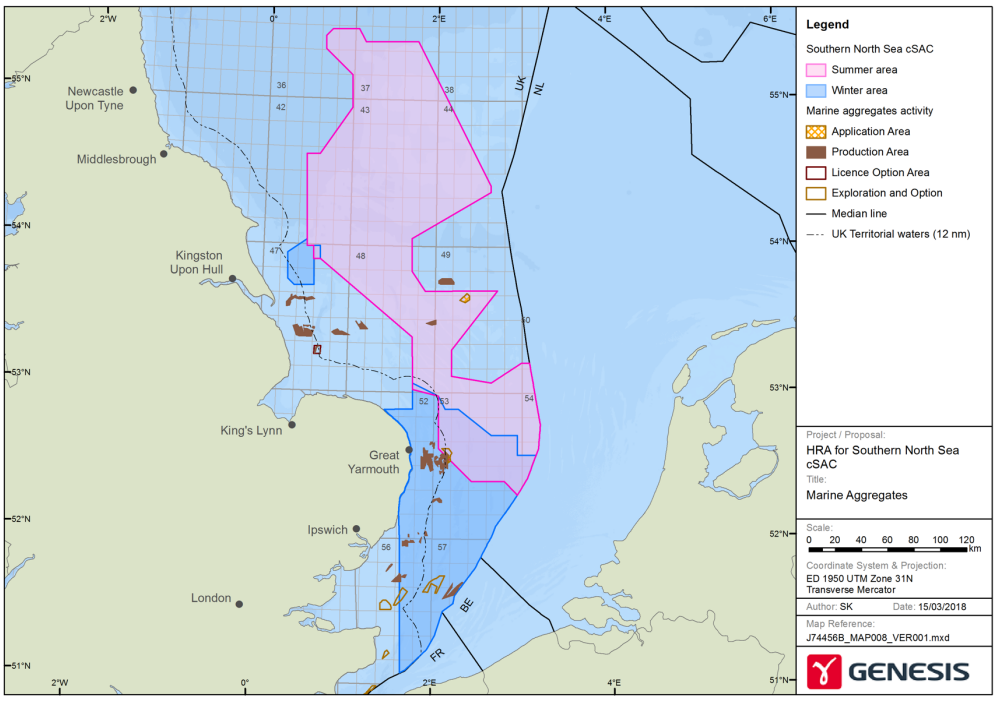


Figure 11: Existing marine aggregate activities in the Southern North Sea SAC.

Table 28: Aggregate extraction sites within the Southern North Sea SAC.

Aggregate Site	Area number	Area (km^2)
Humber 5	483	28.24
Humber 3	484	17.20
Longsand	510/2	6.21
Longsand	509/3	6.65
Shipwash	507/5	0.82
Shipwash	507/6	4.25
Shipwash	507/2	2.13
Shipwash	507/4	6.80
Shipwash	507/3	0.68
Shipwash	507/1	17.78
North Cross Sands	494	6.15
North Inner Gabbard	498	6.56
Southwold East	430	15.32
Off Great Yarmouth	254	11.71
TBC	511	26.63
Off Great Yarmouth	228	13.11
Off Great Yarmouth Extension	240	31.54
Yarmouth	401/2A	48.23
Yarmouth	401/2B	2.89
TBC	512	21.76
Norfolk	212	3.12
North Inner Gabbard	498	6.56
Southwold East	430	15.32
Longsand	510/1	6.65
TBC	513/2	8.61
TBC	513/1	5.91
Longsand	508	6.65
New 495	525	28.13
Thames D	524	77.45
North Falls East	501	52.25
Outer OTE	528/2	31.81
Cross Sands	242/361	9.32
Lowestoft Extension	1804	13.97
East Orford Ness	1809	38.86

9 LIKELY SIGNIFICANT EFFECTS TEST

9.1 Regulation 5 of the 2001 Regulations requires the Competent Authority to consider whether a development will have a likely significant effect on a national site, either alone or in combination with other plans or projects. A likely significant effect is, in this context, any effect that may be reasonably 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 (English Nature 1999). An Appropriate Assessment is required if a plan or project is likely to have a significant effect on a national site, either alone or in combination with other plans or projects. A judgement of likely significant effect in no way pre-supposes a judgement of adverse effect on site integrity.

9.2 This section addresses this first step of the HRA, for which BEIS has considered the potential impacts of decommissioning activities alone and in combination with other plans and projects on each of the interest features of the relevant national site to determine whether there will be a likely significant effect.

North Norfolk Sandbanks and Saturn Reef SAC Likely Significant Effect

Sandbanks

9.3 Results from the assessment of potential impacts presented in Section 7 indicates that there is a risk of physical impacts or loss of habitat occurring that could cause a likely significant effect on sandbank features

9.4 BEIS considers that the proposed decommissioning, when considered alone and in-combination may have a likely significant effect on the North Norfolk Sandbanks and Saturn Reef SAC because:

a. Physical impacts may occur to sandbank habitats through the use of heavy lift vessel/ drill rig anchors/chains, drill rig spud cans, cutting of jacket and subsea asset piles and pipelines and the removal of well conductors and infrastructure.

b. Physical loss of habitat may occur due to the placement of rock for the protection of the pipeline ends.

c. Physical loss of habitat from existing infrastructure that will remain *in situ*, e.g. exposed pipelines.

Reefs

9.5 BEIS considers that there is potential for a likely significant effect on *Sabellaria* reef habitats from the proposed decommissioning activities. This is based on results from surveys undertaken that have reported *Sabellaria* reef habitat within the area predicted

to be impacted. Specifically at well 48/14a-7 where surveys indicated low reef habitat at this location.

Southern North Sea SAC Likely Significant Effect

Harbour porpoise

9.6 Results from the assessment of potential impacts presented in Section 7 indicates that there is a risk of physical injury or disturbance that could cause a likely significant effect on harbour porpoise arising from:

- Noise arising from vessel activity,
- Noise arising from cutting jacket piles and pipelines.

9.7 There is potential for a physical impact on the supporting habitats and processes. It is estimated that the total area of habitat within the that could be disturbed from decommissioning is 0.884 km^2 if all over-trawl surveys use non-intrusive means. This increases to up to 26.535 km^2 if over-trawl surveys are undertaken that impacts on the seabed (Table 11). The impacts from seabed disturbance will be temporary with the habitat predicted to recover over a relatively short period of time.

9.8 There is potential for loss of habitat due to planned decommissioning activities. An estimated 0.08 km^2 could be permanently affected (Para. 7.69). This permanent impact arises from deposits made on the seabed at the time of the field development or during the operating period, much of which was in place prior to the site being designated as a cSAC in 2017.

9.9 The habitat that is impacted is widespread across the SAC and the area impacted is equivalent to 0.0002% of the SAC. The loss of 0.0002% of habitat is considered to be trivial and the effects, if any, will be inconsequential. Although there is potential for an in-combination impact arising from existing and future activities, the extent of any impact on habitat is so small that it will not contribute in any meaningful way to the potential in-combination impacts.

9.10 Consequently, it is concluded that the physical impacts and potential loss of habitat arising from the decommissioning A-fields and Ensign field will not cause a likely significant effect on the Conservation Objectives of the Southern North Sea SAC.

9.11 BEIS considers that the proposed decommissioning, when considered alone and in-combination may have a likely significant effect on the Southern North Sea SAC because:

a) Sound arising from the proposed activities may cause injury or disturbance to harbour porpoise or their prey.

10 APPROPRIATE ASSESSMENT

10.1 An Appropriate Assessment is triggered when the competent authority, in this case the Secretary of State, determines that a plan or project is likely to have a significant effect on a national site. Guidance issued by the European Commission states that the purpose of an Appropriate Assessment is to determine whether adverse effects on the integrity of the site can be ruled out as a result of the plan or project, either alone or in-combination with other plans and projects, in view of the site's conservation objectives (EC 2019).

North Norfolk Sandbanks and Saturn Reef SAC

Sandbanks which are slightly covered by seawater all the time: Physical impact

10.2 A physical impact on the sandbanks may arise from decommissioning activities. The total estimated area of seabed disturbance, excluding over-trawl surveys, within the SAC is 0.880 km^2 (Table 11). Within the Ensign decommissioning plan it is stated that the over-trawl surveys undertaken following decommissioning will be undertaken using non-intrusive means. Consequently, there will be no physical disturbance to the seabed from this survey. However, earlier applications for the approved decommissioning plans for the A-fields do have contingency to undertake over-trawl surveys that could cause physical disturbance to the seabed. On this basis, this assessment is precautionary in that it includes the area of physical disturbance of the seabed from over-trawl surveys within the North Norfolk Sandbanks and Saturn reef SAC. Consequently, the estimated area of physical impact is 20.05 km^2 (Table 11).

10.3 Sediment disturbance will occur during decommissioning. Seabed sediments in the Southern North Sea are subject to physical impacts from winter storms and strong tidal currents and are therefore in a dynamic environment where up to 30 cm of the surface sandy sediments occurring in less than 40 m of water are regularly impacted (ICES 2001). Studies undertaken at the Sean gas field, in water depths of about 20 m and in moderately sorted medium sand sediments demonstrated that resuspension of seabed material and the rate of erosion was closely correlated with seabed shear stresses and that at the Sean field wave induced resuspension of material occurred throughout the year and for over 50% of the time between January and March (Thompson *et al*. 2011). This dynamic environment may cause continual exposure and reburial of pipelines.

10.4 Localised sediment plumes will occur during decommissioning. Although there is little information on the extent sediment plumes may occur from decommissioning activities, studies undertaken for cable and aggregate industries indicate that sediment plumes remain relatively localised with elevated sediment levels occurring largely within a few kilometres of the activities (e.g. Hill *et al.* 2011, BERR 2008). Once decommissioning

activities have ceased, sediment levels will return to background levels within a few weeks (Hill *et al.* 2011).

10.5 Impacts will persist for varying times depending on the rate of local sediment movement. Measurements suggest this may be as short as only a few days in high energy environments such as the Bristol Channel and North Norfolk Banks but can be as long as several years for more stable deposits (Cooper *et al*. 2005*,* Hitchcock and Bell 2004, Kenny and Rees 1996). However, in larger areas of disturbance, e.g. areas of aggregate extraction, evidence from monitoring studies indicates that depressions in the seabed do not inhibit the movement of sediments, as they move into, through and out of the depressions and therefore there is no significant interruption to sediment movements (ICES 2016).

10.6 Studies undertaken along the Munro-Hawksley pipeline in the southern North Sea reported that at ten anchor locations there were no anchor mounds within one month of the anchors having been removed, although there was some evidence of seabed disturbance (ConocoPhillips 2006 cited in Centrica 2010). Similarly, within three years of anchors being used during the installation of a pipeline there was no evidence of any anchor scars on the seabed (Witteveen and Boss 2010).

10.7 Monitoring of trenched and buried cables across the Race Bank indicate that sandwaves up to 4 m in height that were pre-sweeped at the time of the cable installation had, within two years, recovered to their preconstruction levels (DeepBV 2018).

10.8 Consequently, it is predicted that sandbanks will progressively recover following decommissioning and any physical impacts will be localised and temporary.

10.9 Subtidal sandbanks are considered to be highly tolerant to physical disturbance with a high capability of recovery. Consequently, they are not considered to be highly sensitive to physical disturbance.

10.10 Following cessation of activities benthic communities within the sandbank features will rapidly recolonise due to their mobile nature. Studies have shown that meiofaunal communities have partially recovered from sediment disturbance within a few tidal cycles and the ability of subtidal sandbank benthic communities to recover from sediment disturbance is high (Elliot *et al.*1998). However, the time taken for recovery to occur does vary depending on the level of disturbance, the type of community and seabed (Pidduck *et al*. 2017).

10.11 Studies along trenched and buried offshore wind farm export cables, e.g. Lynn and Inner Dowsing offshore wind farm, have shown that benthic communities, including *Sabellaria* re-colonised the disturbed seabed within a year of cable laying and that there were no differences in species composition from areas that had been impacted and those that had not (RPS 2019).

10.12 The area of physical impact on sandbank habitat arising from sediment disturbance will be localised and occur in an area recognised as already having existing historical seabed disturbance. Any impacts on both the sandbank features or their communities will cease shortly after decommissioning activities have been completed. The impact will be temporary with evidence indicating that recovery of the sandbank habitat will occur.

10.13 The total area of Annex I sandbank habitat within the SAC is 3,603 km^2 and the total area impacted by the proposed decommissioning is approximately 20.924 km^2 (Table 11). The potential physical impact to the feature is 0.6% of the total habitat within the site, with the impacts predominantly from over-trawl surveys undertaken at the A-fields over a number of years.

Sandbanks which are slightly covered by seawater all the time: Physical loss of habitat

10.14 Sandbanks are highly mobile, so the presence of solid structures in this environment can create an artificial habitat, localised scouring and sediment deposits and consequently a physical loss of habitat. Removal of the sandbank features may result in some localised loss of its ecological communities. The structure and diversity of sandbank communities are determined by environmental characteristics such as sediment particle size distribution, seabed slope and water depth. Any change in these environmental parameters (e.g. by removing or smothering part of the feature) could result in a loss of habitat and a possible shift in community organisation.

10.15 Physical loss of sandbank habitat will arise from the placement of rock used for burying the ends of the pipelines at the Ensign field. It is recognised that there is potential for future remediation of free-spans along exposed pipelines, although, it is not possible to determine the extent that this may occur. However, based on historical levels of rock dump along the existing pipelines it is unlikely that that there will be any requirement for future deposits and if there is such a requirement the area impacted will be relatively localised. Any future remediation requiring rock dumping or other deposits will require an assessment to be undertaken under the Habitats Regulations.

10.16 The estimated area of seabed that could be permanently impacted by rock deposited during the decommissioning of the Ensign field is 0.002 km^2 (Para. 7.68). The total area of sandbank habitat within the North Norfolk Sandbanks and Saturn Reef SAC is 3,603 km^2. Consequently, approximately, 0.00005% of the qualifying sandbank habitat within the SAC may be impacted by the additional rock deposits at the end of the pipelines

10.17 The leaving *in situ* of pipelines will cause an estimated area of 0.08 km^2 of seabed to be lost (Para. 7.69), impacting 0.002% of the sandbank habitat. Much of the rock associated with the pipeline crossings was placed prior to the site becoming designated.

10.18 Rock placed onto a sandbank feature will change the habitat from a mobile sand feature to an immobile rock habitat. Overtime some of the rock may potentially bury or be partially buried by sand deposition although the extent that this occurs will depend on the local currents at each location and there is potential for re-exposure.

10.19 The physical presence of rock or infrastructure within the SAC may cause an obstruction to the sandbanks and inhibit their natural mobility. The rate at which sandbanks are reported to move varies depending on their location. It has been estimated that at the rate that the Norfolk sandbanks move it could take in excess of 100 years for the sandbanks to move 100 m (Cooper *et al*. 2008). Although, movements of between 11 m and 15 m/year may occur (ABPmer 2005, Cooper *et al*. 2008). At these rates of movement, it is unlikely that any possible effect the physical presence of rock may potentially have on the mobility of the sandbank feature will be able to be detected.

10.20 Studies undertaken at Scroby Sands offshore wind farm, which is located on a shallow sandbank, indicated that although the physical presence of the turbines did cause an affect within 100 m of the turbines due to extensive scouring, there was no effect from the physical presence of the turbines on the sediment transport of the sandbank and therefore the overall morphology of the sandbank was being maintained (CEFAS 2006).

10.21 The movement of sandbanks within the SAC is caused by the re-deposition of sand in a north-easterly direction predominantly as bedload, although also by suspension (Colins *et al.* 1995, Cooper *et al.* 2008*)*. The movement is caused by large scale hydrographic features such as Coriolis forces and tidal currents (Collins *et al*. 1995, ABPmer 2005). Additional material deposited from onshore erosion and residual currents around the banks maintain them. An estimated 400,000 m^3 of additional sand per year is deposited from cliff erosion along the Norfolk coast. Overtime this material is transported offshore onto the sandbanks (Cooper *et al.* 2008). North Sea mean current speeds are predominantly below 0.5 ms^{-1} but can be over 1 ms^{-1} during tidal flood (Collins *et al*. 1995). In order to cause the physical loss of a sandbank that would affect the maintenance of the sandbank feature, an impact would need to affect the transportation of sand; the movement of which is primarily caused by tidal currents and Coriolis forces.

10.22 Data from ten years of surveys undertaken along two gas pipelines demonstrate the variability in the rate of burial. At the NW Bell ZX to Callisto ZM pipeline, the pipeline and associated rock and mattresses were completely buried over a ten year period, whereas along the Callisto ZM to Ganymede ZD pipeline the pipeline and associated rock and mattresses were only partially buried over this time (Chrysaor 2020d).

10.23 The Ensign to Audrey A (WD) pipelines (PL2838 and PL2839) were trenched and buried in 2010 with the seabed pre-swept prior to their installation. Surveys undertaken in 2018 indicate that sandwaves have re-established along the pipeline since they were laid, with

some sandwave movement in a north-westerly direction over the eight year period (Figure 12) (Spirit Energy 2020a).

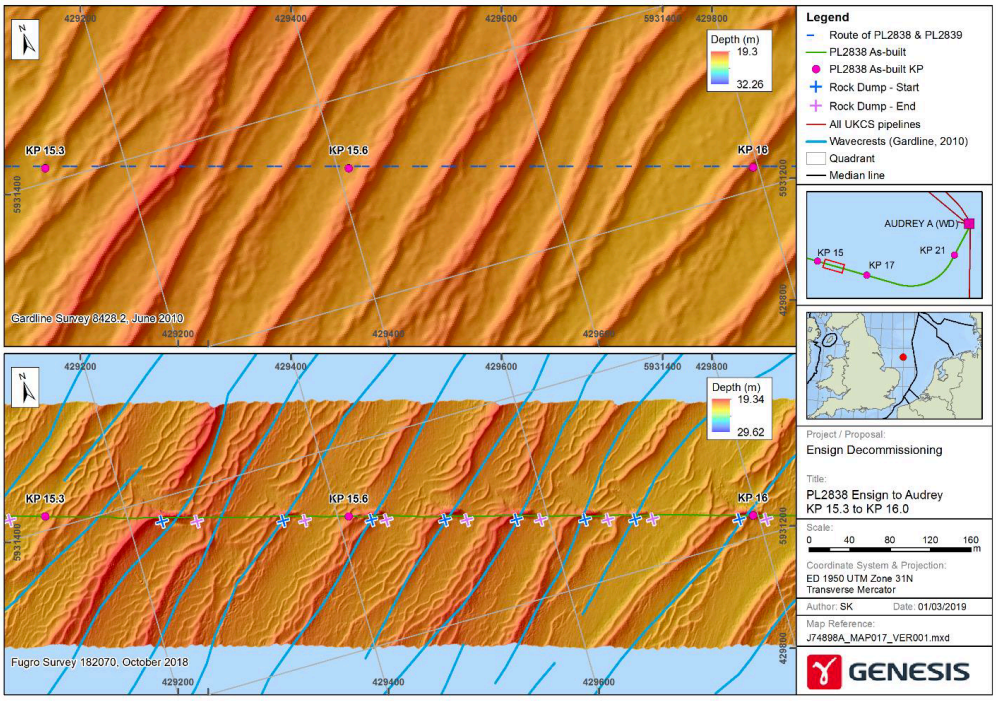


Figure 12: Sandwaves along PL2838 and PL2839 in 2010 and 2018 (Source Spirit Energy 2020a).

10.24 A further study undertaken by Centrica, compared the changes in the positions of sandwaves within the North Norfolk Sandbanks and Saturn Reef SAC from the time a 4" umbilical was trenched and buried in 1993 and 2017. The results indicated that there had been no noticeable difference in the position of the sandwaves from the time the umbilical had been laid and 2017 (Figure 13) (Centrica 2017b).

10.25 Surveys undertaken since 1994 along 31 km of Viking VDP1 pipelines indicate that pipelines located on sandy sediments bury or remain buried if trenched and buried at installation over such sediment type. Pipelines which were trenched without burial or were surface laid appear to remain stable when located on gravelly sands (covered by deposits and subject to sand ripple migration) unless they were buried at the installation (ConocoPhillips 2016). Pipeline surveys showed the migration of sand mega-ripples over pipelines, regardless of pipeline orientation. Figure 14 shows the progressive movement of a sand mega ripple, moving right to left, over a buried pipeline over three survey periods undertaken between 2000 and 2012.

10.26 Pipeline route inspections undertaken along four pipelines crossing the Swarte Bank have indicated that the physical presence of pipelines do not cause any discernible effects on the sandbanks features, with surface features, such as mega-ripples, being

visually identical along the pipeline corridors as those away from the pipelines. (ConocoPhillips 2015a).

10.27 The results from the studies indicate that pipelines and umbilicals that are situated on the seabed or mostly buried but with some exposure to the seabed (for example only top of pipeline exposed) are subject to constant burial and re-exposure as sandwaves or sand ripples move over the pipelines and across the protected site.

10.28 There is likely to be some variability in this natural process as a result of a range of factors including changes in wind and weather, wave, tides, surges and sediments which are likely to influence sand migration. This appears to be reflected in a natural variability in exposure between survey periods which means the percentage of pipelines buried or exposed is subject to change between survey periods. Sand mega-ripples continue to migrate across the site and over time regardless of the presence of pipelines. Pipelines do not appear to impede this sand migration and it means that pipelines which are exposed at one point in time can be buried at another point in time in a continuously process of sand movement. This feature also migrates at the surface over buried pipelines, resulting in variability in burial depth profiles, though pipelines which are substantially buried, remain buried.

10.29 Sand migration as a result of mega-ripples appears to be impeded at a small scale in the immediate vicinity of gas platforms / pipeline risers. Scour and accretion is evident at some platform / pipeline riser base locations. (ConocoPhillips 2015c). However mega-ripples appear to quickly reform away from platforms and platform risers, re-establishing the continuity of the feature. As the Ensign platform and pipeline risers are to be removed and pipelines cut in proximity to the platform it is likely that the sand features will progressively re-establish over former platform locations.

10.30 Studies undertaken at the Viking A complex (Viking AC, AD, AP, AR and FD) have found no evidence of scour at any of the historical platform locations, with only minor depressions at the Platform AD and AF locations (Chrysaor 2020d). Mega-ripples are smaller scale features compared to sandbanks and the presence of oil and gas assets which were mostly installed in the 1970s appears to have had no impact on the sandbanks over that period and gas platforms have a very minor impact on the migration of sand mega-ripples.

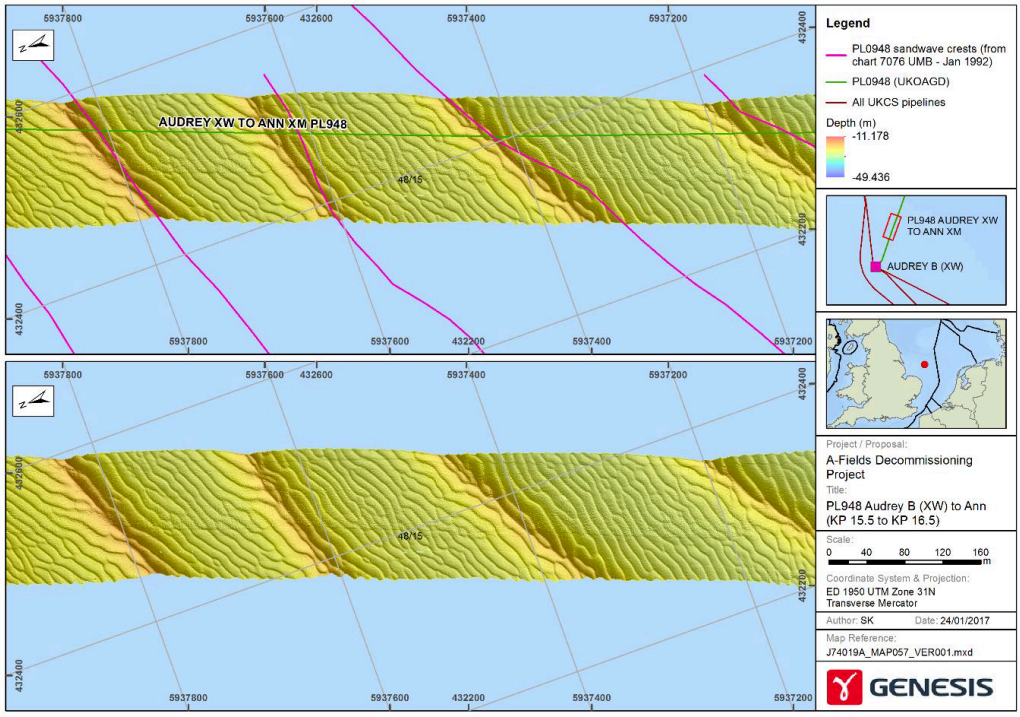


Figure 13: Location of sandwaves over a buried umbilical (Audrey to Ann) in 1993 and 2017.

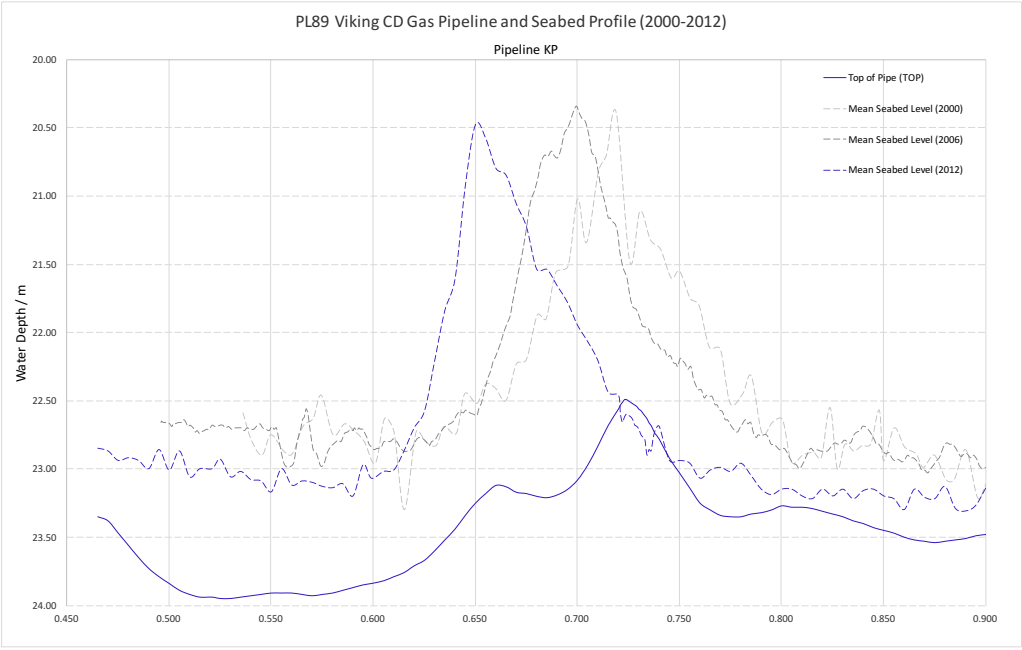


Figure 14: Viking CD gas pipeline burial depths and mean seabed profile between 2000 and 2012.

10.31 The relatively very small scale of obstruction caused by oil and gas infrastructure is not predicted to affect the larger scale tidal currents or Coriolis forces that maintain the sandbank feature. Therefore, the sandbank features will maintain their morphological equilibrium which is determined by environmental factors whilst it is evident that they are migrating over time.

10.32 There is already a physical loss of habitat from the existing infrastructure, much of which has been in place prior to the site being designated the impacts from which are therefore part of the baseline environment. Following the removal of infrastructure there will be depressions in the seabed where piles, conductors and pipeline ends are cut. However, overtime the habitat will recover and will reduce the area of habitat currently lost by the physical presence of the existing installations.

10.33 Although, no additional equipment is being placed on the seabed, the rock that may be used for burying the pipeline ends at Ensign may also cause localised scour. The extent of scour is dependent on the local conditions but is reported to be typically ten times the diameter of the obstacle (OSPAR 2006). Studies undertaken at offshore wind farms indicate scour depths vary both across locations and within the same locations, with deeper scouring typically occurring in areas of shallower waters and stronger currents. However, the extent and depth of scour at each location can change overtime depending on the prevailing tidal and wave conditions (HR Wallingford 2008, ABPmer 2010). Studies undertaken at Scroby Sands indicated no significant effects on sandbanks from scour beyond 100 m (CEFAS 2006). It is therefore predicted that, if it occurs, the impacts from scour will be relatively localised at each location and not affect natural processes beyond a microscale.

Reefs: Physical loss of habitat

10.34 The applicant has identified five aggregations of *S. spinulosa* during Ensign surveys. Four of these areas occur along the Ensign export lines PL2838 and PL2839 and are defined as being of 'medium reef', although within these areas patches of 'high' reef also occur. One area of 'low' reef occurs at the well 48/14-a7. The extent of reef at each of the four locations is not defined in the application (Spirit Energy 2020a).

10.35 There will be no over-trawlability surveys undertaken at the Ensign field and the location of the aggregations recorded along the pipelines are in areas where it is thought that no decommissioning activities will occur that will impact on the reef present. Physical damage to the biogenic reef *S. spinulosa* qualifying feature could occur during the abandonment of Well 48/14-a7, the removal of *c*.20 mattresses along PLU2840 and the cutting and removal of approximately 120 m of umbilical (PLU2840) at the well head. Physical damage may arise from the use of anchors and associated wires by the rig

used for well abandonment and seabed disturbance caused by the removal of mattresses and umbilical.

10.36 The total area of *S. spinulosa* reef habitat present and therefore could be impacted is not known. For the purposes of this assessment a worse-case scenario has been used based on an assumption that all impacts associated with activities at well 48/14-a7 impact on *Sabellaria* habitat. On this precautionary basis an estimated 0.003 km^2 of Annex I reef habitat could be impacted by the abandonment of well 48/14-a7 (Para. 7.56). The removal of the umbilical will impact an estimated area of 1,200 m^2 (0.001 km^2) [25]. The removal of mattresses will not affect any area that is not already impacted by the removal of the umbilical and therefore will not cause an additive impact. In total an area of reef habitat of 0.004 km^2 could be impacted.

10.37 Elsewhere, within the SAC, a total of 8.08 km^2 of *S. spinulosa* reef habitat has been identified. Therefore, an impact of 0.004 km^2 of low quality *S. spinulosa* reef habitat is 0.05% of the total *S. spinulosa* habitat identified within the SAC.

10.38 *Sabellaria spinulosa* can re-establish colonies in areas of disturbed habitat within 12 months or less and although reefs may take longer to reform they may recover if the physical conditions required to do so remain unchanged (Pearce *et al.* 2007). Following the installation the completion of the well abandonment and the removal the exiting mattresses and umbilical it is predicted that the area impacted will recover, with the removal of the existing infrastructure potentially improving the habitat in the medium to long-term and allowing colonisation of Sabellaria into areas which previously may have been unsuitable for it to grow. Based on evidence from monitoring studies, it is predicted that *S. spinulosa* may recolonise areas of disturbed seabed following cessation of activities.

10.39 Although there is uncertainty in the exact extent of Annex I reef habitat and consequently, the scale of any impact. There is recognition that following the short-term impact arising from the decommissioning activities there is good potential for the habitat to recover.

Conclusion

10.40 The potential impacts from the proposed decommissioning associated the Ensign field and the remaining activities associated with the decommissioning of the A-fields located within the North Norfolk Sandbanks and Saturn Reef SAC will cause a localised area of physical impact to the SAC. The area at potential risk of being impacted is relatively small compared to the extent of Annex I habitats within the SAC.

[25] Based on approximately 120 m of umbilical being removed impacting a corridor of 5 m either side of the umbilical.

10.41 The sandbank features at risk of being impacted are widespread and not sensitive to physical disturbance. Evidence from existing studies indicate that any physical impact is temporary, with the both the habitat and benthic communities, including biogenic reefs, recovering once decommissioning activities are completed.

10.42 The potential impacts from the proposed decommissioning activities will cause a loss of habitat within the SAC. However, the extent of potential habitat loss is estimated to be relatively small compared to the extent of habitat within the SAC and it is predicted that less than 0.0005% of the site may be impacted by the deposit of additional rock and 0.002% of the habitat may be impacted the leaving *in situ* pipeline crossings. Over time it is predicted that a proportion of the rock placed on the seabed at the pipeline ends will be buried and not cause an ongoing long-term loss of habitat.

10.43 The physical presence of existing structures on sandbanks have been shown to not cause morphological impacts on sandbanks over anything but a localised area. Existing pipelines are not predicted to effect sandbank features, with surface features being uninterrupted by their presence and leaving them *in situ* is not predicted to increase the current extent of possible habitat loss or physical impact to the site. The communities and typical species across the SAC are predicted to remain the same with recovery occurring in areas of disturbance shortly after activities cease. There will be a reduction in the area impacted by the existing infrastructure when it is removed during decommissioning.

10.44 Based on the best available information BEIS is satisfied that the planned decommissioning activities relating to the Ensign field and the remaining activities at the A-fields will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC.

Southern North Sea SAC

Harbour porpoise

10.45 The primary source of noise predicted to impact on harbour porpoise arises from vessels associated with the proposed decommissioning activities.

10.46 There are no published studies indicating that there is potential for either permanent threshold shift (PTS) or temporary threshold shift (TTS) from vessel noise in harbour porpoise. The level of sound arising from vessels is relatively low (<190 dB re 1 µPa @ 1 m) and is a continuous sound source (i.e. non-pulsed) and the risk of PTS or TTS occurring is considered to be very low. The main frequencies produced by vessels are below the main hearing frequencies for harbour porpoise. However, vessel noise is audible to harbour porpoise and has the potential to cause behavioural impacts, with localised displacement, a reduction in vocalisation and masking effects (Nowacek *et al.* 2007, Pirotta *et al.* 2015).

10.47 If, based on the current estimates, there is an avoidance or a behavioural response out to 0.4 km from a vessel, then an area of 0.5 km^2 may be impacted around each vessel. Should this occur, the area of habitat temporarily unavailable to harbour porpoise, or within which they will be disturbed, will be 0.001% of the SAC as a whole or 0.002% of the 'summer' area. In the event that eight vessels are operating simultaneously, the worst-case scenario is that an area of 4 km^2 may be affected, equivalent to 0.01% of the SAC as a whole or 0.01% of the 'summer' area (see Para. 7.80).

10.48 Recorded densities of harbour porpoise across the SAC vary from between 0.19 ind./km^2 at East Anglia One offshore wind farm and 2.87 ind./km^2 at Hornsea Zone 3 (BEIS 2020a). Peak densities, based on modelling, of harbour porpoise within the SAC are 3 ind./km^2 (Heinänen and Skov 2015). Therefore, based on the peak densities, up to 12 harbour porpoise may be disturbed or displaced from the areas used by vessels during decommissioning. This is 0.003% of the North Sea Management Unit harbour porpoise population.

10.49 Although there is potential for relatively localised behavioural response arising from vessel noise which could cause an increase in energetic costs to individual harbour porpoise, the duration of any behavioural effects arising from decommissioning vessels are predicted to be relatively short (Dyndo *et al.* 2015). Studies undertaken on bottlenose dolphins indicate that although there is a reduction in vocalisation due to the presence of vessels, the dolphins remain in the area and resume activities as the vessels move away (Pirotta *et al.* 2015). Similar behaviour is predicted to occur with harbour porpoise within the SAC and any behavioural impact caused by vessel activities will be localised and temporary.

10.50 Fish are not known to be particularly sensitive to vessel noise and although there is potential for a very localised area of displacement away from vessel within the SAC, the extent of any impact is predicted to be very localised and will not affect the ability of harbour porpoise to feed within the designated site.

10.51 In the event that fish do relocate away from the decommissioning activities, they will return once the sound has stopped. Harbour porpoise will be able to find prey elsewhere within the SAC during the relatively short period of time that the activities are occurring within any one area. They will return once activities stop.

10.52 There is potential for a localised, temporary effect on the supporting habitats and their prey from the removal of installations and associated infrastructure. The physically impacted seabed is predicted to recover over a period of time depending on the local environment. Any disturbance to the seabed habitat that could affect either harbour porpoise or their prey within the SAC will be temporary. Within the SAC harbour porpoise occur widely and therefore any individuals displaced by the relatively localised

short-term impacts from decommissioning activities will be able to relocate to suitable habitats elsewhere within the SAC.

Conclusion

10.53 The potential impacts from the proposed decommissioning activities within the Southern North Sea SAC may cause localised temporary disturbance to harbour porpoise. The extent of potential area of disturbance is estimated to be relatively small compared to the overall area of the SAC and it is predicted that less than 0.03% of the site may be temporarily affected by noise arising from decommissioning activities. The number of individuals estimated to be impacted is 0.03% of the North Sea Management Unit population. Any impacts will be temporary and localised.

10.54 The disturbance to habitats and their prey species will be equally localised and temporary and impacted porpoises will locate to other suitable sites areas within the SAC.

10.55 Based on the best available information BEIS is satisfied that the planned decommissioning activities will not have an adverse effect upon the integrity of the Southern North Sea SAC alone or in-combination.

11 In-combination impacts

11.1 BEIS recognises that there is extensive existing oil and gas related infrastructure within the southern North Sea, the majority of which has been present prior to sites being designated as SACs. Impacts on qualifying features from existing infrastructure that have been present prior to the sites being designated are considered part of the baseline environment.

11.2 Decommissioning of existing oil and gas infrastructure has occurred in the past and will occur in the future. All planned decommissioning projects require the submission of a decommissioning programme and an environmental appraisal. Each programme will also require an assessment to be made under the Habitats Regulations if there is potential for a likely significant effect on a designated site.

11.3 Where no decommissioning programmes have been submitted, the assessment of potential scale of impacts arising from decommissioning is based on assumptions derived from existing decommissioning activities undertaken within the area. It is important to note that the scale of the potential impacts are estimates based on the currently best available information and assumptions based on previous decommissioning experience; they are however, estimated impacts. Further assessment will be required at the time of each decommissioning project. Presuming that future decommissioning will be undertaken using similar methods as those used in this assessment, then similar scales of impact for each activity are predicted to occur.

In-combination impacts on North Norfolk Sandbanks and Saturn Reef SAC

Sabellaria spinulosa reef

11.4 No *Sabellaria spinulosa* reef has been identified along the proposed Hornsea Three export cable route and there will be no in-combination impact with renewable energy projects.

11.5 Mitigation measures in place ensure that no dredging occurs in areas where *Sabellaria spinulosa* reef has been identified (MMO 2015b). Consequently, there is no known in-combination impact with dredging activities.

11.6 An estimated 1,312 km^2 of seabed within the SAC is impacted each year by beam trawling. The extent of any impact on *Sabellaria spinulosa* reef within the SAC from beam trawling is unknown. There is potential for an in-combination impact with the proposed decommissioning activities and beam trawling. However, the predicted worse-case scenario of 0.004 km^2 area of impact on potential *Sabellaria* reef will not cause anything more than a *de minimus* in-combination impact compared with potential impact from beam trawling.

11.7 The lack of site specific information at many of the fields located within the SAC and the ephemeral nature of *Sabellaria spinulosa* makes it not possible to assess the extent of future impacts on this qualifying feature. However, site surveys undertaken at the time of decommissioning will, if present, identify areas of *Sabellaria* reef that could be impacted by specific decommissioning projects and these will be subject to assessment under the Habitats regulations at the time decommissioning programmes are submitted.

Sandbanks

11.8 The estimated extent of physical disturbance that could arise from past, current and future decommissioning within the North Norfolk Sandbanks and Saturn Reef SAC is presented in Table 29. The estimated loss of habitat from existing infrastructure and decommissioning is presented in Table 30.

11.9 There will be a physical impact on the sandbank features and their communities from decommissioning activities. It is estimated that the total area physically impacted, excluding over-trawl surveys, will be 1.68 km^2 (Table 29). Evidence from existing studies indicate that any physical impacts will be temporary with both the sandbank features and associated communities recovering within a relatively short period of time.

11.10 The policy position on over-trawlability surveys in sites protected for seabed features has evolved and undertaking them in sensitive areas may be inappropriate (BEIS 2018). Previously submitted environmental appraisals included over-trawl surveys which may impact a total area of 110.18 km^2 (Table 29). These have been, or will be, undertaken over a number of years and contribute a relatively small area of impact compared with the 1,312 km^2 of beam trawling estimated to occur within the SAC each year. Following any survey, the impacts will cease and the seabed and the biological communities will recover. The impacts from the over-trawlability surveys are therefore temporary. It is also likely that over-trawlability surveys that would impact on the seabed will not be required for all future decommissioning activities with none, for example, being undertaken at the Ensign field or for the LOGGS LDP2 to LDP5 decommissioning programme.

11.11 There is potential for a physical loss of habitat of up to 0.2556 km^2 due to rock placement (Table 30). The significant majority of this relates to impacts from contingency stabilisation of accommodation vessels and drill rigs. In the event that they are not used then the estimated area of impact from rock-placement is significantly reduced.

11.12 Existing pipeline infrastructure is largely buried and will not cause a physical impact on the seabed. However, exposed sections of pipeline could have a localised effect estimated to cover 1.0657 km^2. Existing rock and other known deposits impact over an area of 0.1284 km^2. In total an estimated area of habitat that could be lost from existing infrastructure, deposits and decommissioning is 1.4497 km^2.

11.13 The leaving *in situ* of existing lines is not considered to impact on the integrity of the site as they are predicted to remain largely buried by sandbanks or mobile sediments and will require minimal additional remediation. The extent of existing rock dump along all the pipelines within the SAC is currently unknown. Site specific surveys at the time of decommissioning pipelines will determine the extent of any existing or additional rock dump that may be required to ensure the pipelines remain safe for other sea users. In the event that remediation is required in the future, then this will be subject to further assessment.

11.14 The physical loss of habitat will be localised and not predicted to affect the tidal currents or Coriolis effects that maintain the structure of the sandbanks. There will be localised changes in the biological communities in areas where the substrate has changed but these will not affect the overall community structure within the SAC.

11.15 The physical loss of habitat due to decommissioning across the SAC will not affect the integrity of the site.

11.16 The physical presence of buried pipelines will not affect the structure and function of the Annex I sandbank habitat and not impact on the integrity of the site.

Table 29: Estimated in-combination physical impact from decommissioning all existing oil and gas infrastructure within the NNSSR SAC.

Activity	A-Fields	Ensign	VDP1 and LDP1	VDP2 and VDP3	LOGGS LDP2 to 5	Anglia	Victoria	Leman BH	41 Remaining fields	Total
Area of physical seabed disturbance										
Accommodation works vessel – spud cans [-1]	0	0	0.063	0.0394	0.0013	*0*	0	0	*0.0049*	0.1086
Platform removal – Cutting of piles [2]	0.023	0.004	0.0087	0.0096	0.0096	*0.01*	0.0027	<0.0001	*0.0379*	0.1056
Heavy lift vessel anchors [3]	0.24	0.161	0.012	0.018	0	0.02	0	0.4	*0.057*	0.9080
Removal of subsea infrastructure (excluding pipelines) [4]	0.001	0	-	0.0037	0.0037	0.006	0.0248	0	*unknown*	0.0392
Cutting and removal of pipeline ends [5]	0.105	0.007			0.0013	0.003	0.0052	0	*0.0064*	0.1279
Well abandonment – spud cans [6]	0.001	0.0006	0.047	0.0029	0.0538	0.001	0.0001	0	*0.0483*	0.1547
Well abandonment – anchors and chains [7]	0.004	0.002	0.0192	0.012	-	*0.0048*	0	0	*0.1968*	0.2388
Removal of conductors [8]	0.0001	0.0001	0.0001	0.0001	0.0002	-	0	0	*unknown*	0.0006
Over-trawlability surveys [9]	25.65	0	17.2	18.9	0	5.59	0	0	*42.84*	110.18
Estimated area of seabed disturbance from oil and gas decommissioning = 111.86 km^2										

1- Assumes area of impact from spud cans of 120 m^2 at each installation (Chrysaor 2020a).

2 - Assumes area of impact from cutting piles of 154 m^2 and an average of six piles at each installation (ConocoPhillips 2018a, BEIS 2019, Chrysaor 2020a).

3 - Assumes 8 anchors and chains impacting 750 m of seabed and worst-case scenario of two movements at each installation, i.e. 1,500 m^2 (ConocoPhillips 2018a).

4 – The number of subsea structures are unknown.

5 – Assumed to be same area as rock placement across pipeline ends of 22 m^2 (Chrysaor 2020a). 29 pipelines not accounted for in decommissioning plans all presumed to be wholly within SAC, i.e. two cut ends for each pipelines.

6 – Assumes drill rig spud can for well abandonment of 589 m^2 (Chrysaor 2020a).

7 – Assumes anchor and chain impacts of 2,400 m^2 at each installation (Chrysaor 2020a).

8 – The number of wells to be decommissioned and therefore the number of conductors to be removed is unknown.

9 – Assumes over-trawlability surveys will occur along a 200 m corridor for the entire length of pipelines and a 500 m radius around each installation.

Table 30: Estimated in-combination habitat loss from existing infrastructure and decommissioning all existing oil and gas infrastructure within the NNSSR SAC.

Activity	A-fields	Ensign	VDP1 and LDP1	VDP2 and VDP3	LOGGS LDP2 to 5	Anglia	Victoria	Leman BH	41 Remaining fields	Total
Area of habitat loss										
Accommodation works vessel – rock stabilisation [1]	0	0	0.051	0.0432	0.0138	0.002	0	0	*0.0902*	*0.2002*
Rock at pipeline ends [2]	0	0	0.0002	0.0004	0.0002	*0.0001*	0	0	*0.0079*	*0.0088*
Jack-up well abandonment rock stabilisation [3]	0	0	0.0032	0.002	0.0072	0.002	0	0	*0.0302*	*0.0446*
Free-spans [4]	0	-	0.0002	0.0004	0.0005	0.0009	0	0	*unknown*	*0.002*
Exposed existing pipelines [5]	0	0	0.0498	0.2001	0.1504	*0.0218*	0.0006	0	*0.643*	*1.0657*
Existing rock [6]	0.007	0.001	-	-	-	-	0	-	0.0714	*0.0794*
Existing installations [7]	-	-	-	-	-	-	-	-	0.049	*0.0490*
Estimated area of habitat loss from oil and gas decommissioning = 1.45 km^2										

Italics represent figures that have been calculated based on the assumptions listed below. Other, non-italic, figures have been obtained from the relevant decommissioning plans.

1 - Assumes area of impact from rock placement required for AWV stabilisation of 1,100 m^2 at each installation (Chrysaor 2020a) and includes re-distribution of rock for rig stabilisation

2 - Assumed to be 22 m^2 at each end of pipeline (Chrysaor 2020a).

3 - Assumed to be 400 m^2 (ConocoPhillips 2017) and two rig movements at each location (BEIS 2019).

4 - The requirement of future rock dump along existing pipelines is unknown.

5 - Estimated based on 9.1% of pipelines being exposed and impacting 10 m corridor (Chrysaor 2020b).

6 – Blank cells are either because the existing rock is already accounted for in exposed pipeline assessment or the amount is unknown.

7 – Figure is an estimate based on jacket size of existing installations and not footprint from installation legs and therefore an over-estimate of the potential impact (See Para. 8.37).

11.17 There is potential for an in-combination impact with current aggregate extraction in areas 483 and 484 (Figure 10). Assuming that aggregate extraction occurs across the whole of each site, a total of 45.4 km^2 of the SAC will be physically impacted and habitat lost. Subject to conditions the extraction of aggregates at 483 and 484 will not cause an adverse effect on the integrity of the site (MMO 2015b).

11.18 There is potential for an in-combination impact with the proposed export cable for the Hornsea 3 offshore wind farm. It is estimated that a total area of 4.1 km^2 of sandbank habitat within the SAC will be physically impacted by activities associated with the trenching and burying of the cables. An additional 0.4 km^2 of sandbank features will be physically lost due to the placement of cable protection along the surface of the seabed.

11.19 Other activities being undertaken within the SAC that could cause an in-combination impact include fishing. Fishing intensity within the SAC is estimated to impact on 1,312 km^2 of seabed each year. This annual impact on the seabed is significantly greater than that predicted to be caused by all the oil and gas decommissioning over-trawl surveys that may be undertaken within the SAC (based on previously submitted environmental assessments supporting decommissioning programmes). The predicted level of over-trawl surveys is likely to be within the annual range of current fishing activity within the SAC and are not predicted to contribute to an in-combination impact that would cause a likely significant or adverse effect.

11.20 The overall area of seabed estimated to be physically disturbed within the SAC from existing or planned activities is 1,428 km^2, of which the estimated area of seabed disturbance of 26.20 km^2 by proposed decommissioning activities at the remaining A-field and Ensign field, contributing 1.8% of the total area of seabed disturbed (Table 31).

11.21 The overall area of seabed estimated to be physically lost within the SAC from existing or planned activities is 47.26 km^2, of which the proposed decommissioning activities at the remaining A-field and Ensign contribute 0.008 km^2; 0.02% of the in-combination total (Table 31).

Table 31: Total estimated in-combination impacts within North Norfolk Sandbanks and Saturn Reef SAC

Activity	Total area of physical impact (km^2)	Total area of seabed physically lost (km^2)
A-Fields and Ensign	26.20	0.008
Past, current and future decommissioning	85.66	0.2556
Existing gas pipelines and umbilicals	-	1.0657
Existing rock and other deposits (2011 to 2016)	-	0.0794
Existing installations	-	0.0490
Aggregate Extraction	-	45.4
Beam Trawling (annual)	1,312	-
Renewables	4.1	0.4
Total	1,428	47.26
% of NNSSR SAC	38.91	1.31

11.22 The physical impact to the seabed is a temporary impact and it is predicted that the seabed will recover following cessation of activities that cause the physical impacts to the seabed. The proportion of the in-combination impact that is attributable to the proposed decommissioning activities at the A-field and Ensign field is relatively very small and once decommissioning is completed, no further on-going impacts are likely to occur. Consequently, there will not be an on-going in-combination adverse effect from physical impacts arising from the proposed decommissioning.

11.23 All oil and gas related activities within the SAC may cause the loss of 0.04% of the SAC. However, this is largely due to the exposed existing pipelines being left *in situ*. The majority of which were present prior to the site becoming designated. Potential impacts from renewables will be compensated for and there should be no net loss of habitat arising from renewable developments within the SAC (BEIS 2020b). The largest are of impact causing physical loss of habitat within the SAC arises from existing aggregate extraction.

11.24 The loss of habitat is predicted to be permanent but the physical presence of existing installations will not cause significant changes to the hydrodynamic regime that maintains the sandbank features as these are influenced by large scale Coriolis forces and tidal currents (Collins *et al*. 1995, ABPmer 2005) and these will not be significantly affected by the relatively small scale physical loss of habitat from existing oil and gas infrastructure and future decommissioning activities.

In-combination Conclusion

11.25 The potential impacts from the proposed decommissioning activities within the North Norfolk Sandbanks and Saturn Reef SAC in-combination with other plans or projects, including existing infrastructure, will cause physical impacts and a loss of habitat within the SAC. Evidence from surveys shows that any physical impacts to the sandbank features and their communities will be temporary and the habitat will recover once the impact has ceased. Permanent impacts will cause a loss of habitat but the impacts will be localised and not affect the hydrography such that it will affect the maintenance of the sandbank features.

11.26 Based on the best available information BEIS is satisfied that the planned decommissioning activities will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC in-combination with other plans or projects.

In-combination impacts on Southern North Sea SAC

Impacts from noise on harbour porpoise

11.27 Shipping has been on-going in the southern North Sea for many hundreds of years and the area is important for shipping, with relatively high numbers of vessels occurring within it. Based on vessel track lines, in 2013 a total of 93,291 vessels were recorded transiting across the SAC; an average of 256 vessels per day (MMO 2016).

11.28 The oil and gas industry has used, and will continue to use, vessels in support of the vast majority of offshore activity, from initial exploration through to final decommissioning. Vessels are extensively used during construction and maintenance, with supply vessels supporting operating platforms and safety vessels permanently present in development areas. A total of 19,976 vessels associated with oil and gas industry were recorded crossing the SAC in 2013 (MMO 2016); an average of 55 vessels per day. Oil and gas related vessel traffic accounted for 21.4% of all vessel traffic within the site.

11.29 Vessel movements are the largest contributor to anthropogenic ocean noise and in deeper water are the dominant noise source in the lower frequencies, between 50-300 Hz (Ulrick 1967). Measurements undertaken in the Southern North Sea indicate that shipping noise is the dominant anthropogenic noise in the region predominantly in the frequency range of between 40 and 200 Hz (de Haan *et al.* 2007). In general, vessels that use dynamic positioning thrusters tend to generate higher levels of underwater sound. The individual noise output produced by a vessel is dependent upon a number of factors including the speed of the vessel, age, load, maintenance and oceanographic conditions.

11.30 The additional use of up to eight vessels during decommissioning contributes a very small proportion of the total vessel activity within the SAC. The extensive vessel activity, including that associated with the oil and gas industry, within and adjacent to the SAC over many years has not had a measurable negative effect on the current conservation status of harbour porpoise within the site.

11.31 BEIS recognises that there are other activities within the Southern North Sea SAC that could cause an in-combination impact, e.g. offshore renewable, fishing, dredging and geophysical surveys. Impacts from these activities include noise from pile-driving, the clearance of unexploded ordnance and seismic airguns. The relatively very small area of potential impact arising from the eight vessels proposed during decommissioning activities will not contribute substantially to the overall impacts within the SAC and will not cause an in-combination impact that will have an adverse effect on site integrity.

Conclusion

11.32 Levels of oil and gas vessel activity within the SAC associated with decommissioning activities are not predicted to be significantly greater than current levels of shipping within the SAC and therefore levels of potential disturbance are also not predicted to significantly increase. As decommissioning progresses in future years, the number of vessels associated with the oil and gas industry will reduce. It is therefore concluded that the in-combination impacts from vessel noise or seabed disturbance will not have an adverse effect upon the integrity of the Southern North Sea SAC alone or in-combination.

12 APPROPRIATE ASSESSMENT - CONCLUSIONS

12.1 BEIS has undertaken a Habitats Regulations Assessment in respect of the Conservation Objectives of relevant national sites to determine whether the proposed Decommissioning programmes for the remaining A-Field decommissioning programmes and the Ensign Field decommissioning programme, either alone or in combination with other plans and projects, will have an adverse effect upon the integrity of the relevant sites. In this case the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC.

12.2 Having concluded that there will be no likely significant effect and no adverse effect on the integrity of any site no further assessment is required.

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14 Appendix A – Gas Pipelines in NNSSR SAC.

Source: UKoilandgas 2018.

Pipeline No.	Name	Trenched	Length in NNSSR SAC (km)
PL22	Indefatigable Joint 49/23 AT to 49/27 BT 30” gas line	Y	21.541
PL23	Leman 49/27 AP to Bacton A1 30” gas line	Y	10.842
PL24	Leman BT to Bacton A2 30” gas line	Y	8.25
PL25	Leman AP to Bacton 30” gas line	Y	9.129
PL27	Viking AR to Theddlethorpe 28” gas line	Y	24.516
PL29	Leman 49/26-BT to Bacton 30” gas line	Y	9.999
PL88	Viking AR to Viking BP 24” gas line	Y	10.964
PL89	Viking BD to Viking CD 12” gas line	Y	3.899
PL90	Viking BD to Viking DD 12” gas line	Y	4.108
PL91	Viking BD to Viking ED 12” gas line	Y	11.895
PL92	Viking BD to Viking GD 12” gas line	Y	5.139
PL93	Viking BD to Viking HD 12” gas line	Y	5.549
PL97	Leman BT to Leman AP 30” gas line	Y	3.501
PL98	Leman BP to Leman BT 24” gas line	Y	0.623
PL99	Leman CP to Leman BT 24” gas line	Y	2.091
PL100	Leman D to Leman BT 24” gas line	Y	8.011
PL101	Leman BT (Perenco) to Leman BT (Shell) 30” gas line	Y	7.771
PL102	Leman E to Leman BP 20” gas line	Y	3.019
PL106	Leman 49/27 BP to 49/27 AP 20” gas internal field line	Y	3.141
PL107	Leman 49/27 CP TP 49/27 AP 20” gas internal field line	Y	3.411
PL108	Leman 49/27 EP TP 49/27 AP 20” gas internal field line	Y	1.671
PL109	Leman 49/27 BT to 49/27 DP 30” gas internal field line	Y	4.847
PL110	Leman 49/27 FP 49/27 BT 20” gas internal field line	Y	2.05
PL206	Leman 49/27 H to 49/27 AC 20” gas internal field line	Y	5.929
PL211	Victor JD to Viking BD 16” gas line	Y	13.451
PL251	Leman 49/27 G to 49/27 BT 24” gas internal field line	Y	6.257
PL253	Esmond to Bacton 24” gas export Line	N	24.431
PL311	Sean PP to Bacton 30” gas line	Y	5.544
PL363	Leman F to Leman AK 20” gas line	Y	4.776
PL364	Leman G to Leman F 14” gas line	Y	2.708
PL370	Bacton to Thames 24” gas export	Y	33.982
PL371	Bure O Wellhead to Thames 8” gas line	Y	0.253
PL454	LOGGS PP to Theddlethorpe 36” gas line	Y	26.546
PL456/PL457	Vanguard QD to LOGGS PP 10” gas line	Y	7.496

Pipeline No.	Name	Trenched	Length in NNSSR SAC (km)
PL458/PL459	Vulcan RD to LOGGS PP 18” gas line	Y	16.055
PL460/PL461	South Valiant TD to LOGGS PP 10” gas line	Y	10.625
PL462/PL463	Vulcan UR to Vulcan RD 12” gas line	Y	3.679
PL470/PL471	North Valiant SP to LOGGS PP 10” gas line	Y	4.304
PL496	Audrey A (WD) to LOGGS PP 20” gas line	N	16.521
PL575	Audrey WM to Audrey A (WD) 8” gas line	Y	0.43
PL624	Former Camelot gas export line	Y	7.123
PL632	Clipper PT to Bacton 24” gas line	Y	24.817
PL723	Audrey B (XW) to Audrey A (WD) 14” gas line	Y	4.317
PL854	LOGGS PP to Anglia YD 12” gas line	Y	23.523
PL947	Ann XM to LOGGS PR 12” gas line	Y	30.181
PL948	Ann to Audrey B	Y	6.400
PL954	Anglia YD to Anglia YM 8” gas line	Y	2.104
PL994	Galleon PN to Clipper PM 12/14” gas line	N	1.051
PL1091	Callisto ZM to Ganymede ZD 12” gas line	Y	14.132
PL1093	Ganymede ZD to LOGGS PR 18” gas line	N	19.129
PL1095	Victor JM to Victor JD 12” gas line	Y	5.151
PL1571	Viking KD to Viking BD 16” gas line	Y	13.436
PL1572	Viking LD to PL1571 TEE 16” gas line	Y	0.047
PL1610	Corvette A to Leman A 20” gas line	N	23.668
PL1635	Bure West to Thames 8” gas line	Y	1.928
PL1690	NW Bell ZX to Callisto ZM 8” gas line	N	0.078
PL1692	Vampire OD to LOGGS PR 12” gas line	Y	9.191
PL1694	Europa EZ to PL1091 TEE 12” gas line	Y	4.539
PL1705	NW Bell to Bess E 6” Gas Production Pipeline	Y	6.399
PL1767	Vixen VM to Viking BD 12” gas line	Y	8.474
PL1962	Viscount VO to Vampire OD 12” gas line	Y	11.307
PL2066	Annabel to Audrey A 10” gas export	Y	13.247
PL2067	Annabel to Audrey A 4.5” umbilical	Y	8.7
PL2107	Saturn 14” gas export line	Y	26.661
PL2355	Wenlock gas export Spool Piece	N	0.06
PL2355	Wenlock Gas pipeline	U	28.621
PL2526	Viking Bravo to Victoria subsea well	Y	3.371
PL2643	Viking to LOGGS gas export pipeline	Y	27.29
PL2810	12” Gas Pipeline from Clipper South Victor to LOGGS	Y	15.156
PL2838	Ensign NPAI to Audrey A (WD) gas export	Y	21.91
PL2841	Ensign Subsea Well 48/14-ED to Ensign NPAI	Y	1.837
PL3027	8” Gas Leman 53/02-14A to Leman 27A	Y	8.771

15 Appendix B – Gas Pipelines in Southern North Sea SAC.

Source: UKoilandgas 2018.

Pipeline No.	Name	Trenched	Length in SNS SAC
-	Cutter to Carrack	Y	5.35
-	Annabel Wells 1 & 2 to Annabel Manifold	Y	0.13
PL020	Hewett Southern Export A-Line to Bacton	Y	4.78
PL021	Hewett Northern Export B-Line to Bacton	Y	5.04
PL083	52/5a to 48/29ftp gas export	Y	4.01
PL084	48/29b to 48/29ftp gas export	Y	3.40
PL085	48/29c to 48/29ftp gas export	Y	10.42
PL086	48/30-8 and 10 to 48/29c gas export	Y	5.84
PL087	48/30-9 to 48/29ftp gas export	Y	6.20
PL100	Leman D to Leman BT	Y	8.01
PL101	Leman BT (Perenco) to Leman BT (Shell)	Y	7.77
PL102	Leman E to Leman BP	Y	3.03
PL1053/PL1054	Davy to Inde-AT	Y	15.68
PL106	Leman 49/27 BP to 49/27 AP	Y	3.14
PL107	Leman 49/27 CP TP 49/27 AP	Y	3.41
PL108	Leman 49/27 EP TP 49/27 AP	Y	1.67
PL109	Leman 49/27 BT to 49/27 DP	Y	4.87
PL1093	Ganymede ZD to LOGGS PR gas line	Y	18.91
PL110	Leman 49/27 FP 49/27 BT	Y	2.06
PL1169	Barque PL to Clipper PM	Y	15.43
PL1171	Newsham to West Sole	Y	5.76
PL1173	48/29-9 to 48/29c gas export	Y	1.59
PL1177	48/30-14 to 48/29c gas export	Y	5.85
PL1220/PL1221	Tyne to Trent	Y	55.80
PL1220X	Tyne to Trent	Y	0.02
PL1222	Schooner to Murdoch gas line	Y	0.34
PL1339	Bacton to Zeebruge	Y	156.07
PL1436	Murdoch MD to Boulton BM gas line	Y	11.36
PL145	West Sole to Easington 24in gas line	N	11.55
PL150	Rough 47/3b Import/Export	N	13.02
PL151	Rough 47/8a Export	N	2.19
PL1561	Galleon PG to Clipper PM Gas	Y	8.77
PL1570	Shearwater to Bacton (SEAL)	N	209.93
PL1571	Viking KD to Viking BD gas line	Y	13.43

Pipeline No.	Name	Trenched	Length in SNS SAC
PL1572	Viking LD to PL1571 Tee	Y	0.05
PL1610	Corvette A to Leman A	Y	5.69
PL1612	Ketch to Murdoch gas line	Y	0.28
PL1630	48/30-16 to Della PLEM gas export	Y	0.24
PL1637	Thurne to Thames RA gas export	Y	0.29
PL1684	Neptune to Cleeton pipeline	Y	6.91
PL1692	Vampire OD to LOGGS PR gas line	N	9.23
PL1707	Mercury to Neptune	Y	13.08
PL1708	Neptune to Mercury	Y	13.13
PL1724	Skiff to Clipper PM	Y	10.51
PL1767	Vixen VM to Viking BD gas line	Y	8.47
PL1871	North Davy to Davy	Y	10.28
PL1875	Hoton Pipeline	Y	11.82
PL1922	Hawksley EM to Murdoch MD gas line	Y	21.55
PL1923	Murdoch K KM to Murdoch MD gas line	Y	0.24
PL1924	Boulton H HM to Murdoch MD gas line	Y	0.15
PL1928	Whittle to Cleeton	Y	14.87
PL1929	Wollaston to Whittle	Y	3.24
PL1932	M5 to Minerva	Y	4.65
PL1933	M1 to Minerva	Y	3.54
PL1934	Minerva to Cleeton gas export	Y	13.27
PL1937	Apollo to Minerva	Y	6.34
PL1962	Viscount VO to Vampire OD gas line	Y	11.31
PL2047	Arthur to Thames	Y	28.61
PL2047JP1	Arthur P1 to Arthur Manifold	Y	0.05
PL2047JP2	Arthur Well 2 to Arthur Manifold	Y	3.21
PL2047JP3	Arthur Well 3 to Arthur Manifold	Y	0.05
PL206	Leman 49/27 H to 49/27 AC	Y	5.97
PL2066	Annabel to Audrey A 10” export	Y	17.82
PL2067	Annabel to Audrey A 4.5” umbilical	Y	13.40
PL2071	Langeled Pipeline	Y	58.21
PL2080	Horne And Wren Export Pipeline	Y	19.86
PL2105	JFE Production	Y	6.73
PL2107	Saturn ND to LOGGS PR	Y	39.33
PL2109	Murno MH to Hawksley EM	Y	4.94
PL211	Victor JD to Viking BD gas line	Y	3.95
PL2137	Hunter Export to Murdoch K	Y	1.16

Pipeline No.	Name	Trenched	Length in SNS SAC
PL2160	Garrow to Kilmar export spool	Y	22.20
PL2160	Garrow export spool	Y	0.04
PL2162	Kilmar to Kilmar gas export spool	Y	0.05
PL2162	Kilmar to Trent gas export spool	Y	0.05
PL2162	Kilmar gas export	Y	21.14
PL22	Indefatigable Joint 49/23 At to 49/27 BT	Y	6.32
PL2225	BBL Balgzand to Bacton	Y	122.03
PL2234	Tethys to Saturn Tee	Y	3.76
PL2236	Mimas to Saturn	Y	9.82
PL2284	Cavendish export pipeline	Y	47.17
PL23	Leman 49/27 AP to Bacton A1	Y	35.78
PL2344	Davy Host to Davy East Gas	Y	5.71
PL2355	Wenlock gas pipeline	Y	16.33
PL2355	Wenlock gas export spool piece	Y	0.06
PL24	Leman BT to Bacton A2	Y	64.87
PL2430	12in Prod. Kelvin to Murdoch	Y	12.43
PL2441	Davy A to Tristan NW	Y	14.89
PL2491	53/4d-11 to Thames AR gas export	Y	10.45
PL2491	Wissey Gas Production	Y	10.45
PL25	Leman AP to Bacton	Y	29.35
PL2501	Johnston J5 Export	Y	0.03
PL251	Leman 49/27 G to 49/27 BT	Y	6.27
PL2526	Lx1 Well to Viking Bravo	Y	3.79
PL2528	Rita to Hunter Export	Y	14.09
PL253	Esmond to Bacton	Y	134.31
PL255	Esmond to Forbes	Y	11.37
PL258	Esmond to Gordon	Y	34.74
PL2595	Ceres to Mercury Export	Y	3.26
PL2597	Eris to Mercury Export	Y	3.26
PL26	Easington to Rough 47/3b	Y	14.16
PL261	Esmond to Forbes	Y	11.37
PL2612	Babbage Export	Y	27.88
PL264	Esmond to Gordon BHP	Y	34.74
PL2641	Seven Seas - Newsham gas export	Y	7.99
PL2643	Viking to LOGGS gas export	Y	27.36
PL27	Viking AR to Theddlethorpe gas line	Y	41.61
PL28	West Sole to Easington 16in gas line	N	15.03

Pipeline No.	Name	Trenched	Length in SNS SAC
PL2810	Clipper South to LOGGS Gas Pipeline	Y	15.15
PL2838	Ensign NPAI to Audrey A (WD) gas export	Y	21.91
PL2841	Ensign Production Pipeline	Y	1.84
PL2894	Katy to Kelvin gas export pipeline	Y	11.94
PL29	Leman 49/26-BT to Bacton	Y	33.99
PL2917	York production pipeline	Y	15.02
PL3005	Hunter to Murdoch K Export Pl3005	Y	1.08
PL3027	8in Gas Leman 53/02-14a to Leman 27a	Y	9.18
PL3027A	Leman SW Spoolpiece	Y	0.09
PL3086	Cygnus A to Cygnus B Gas Pipeline	Y	7.28
PL3088	Cygnus to ETS Gas Pipeline	Y	50.11
PL311	Sean PP to Bacton	Y	82.50
PL363	Leman F to Leman AK	Y	4.82
PL364	Leman G to Leman F	Y	2.74
PL370	Bacton to Thames	Y	33.02
PL372	Yare to Thames	Y	4.12
PL446	48/30-10 to 48/30-8 gas export	Y	0.01
PL447	Cleeton CP to Dimlington	Y	40.22
PL448	Cleeton CP to Ravenspurn A	Y	20.68
PL450	Ravenspurn B Spur	Y	0.07
PL451	Ravenspurn C Spur	Y	0.07
PL454	LOGGS PP to Theddlethorpe gas line	Y	19.15
PL456/PL457	Vanguard QD to LOGGS PP gas line	Y	7.49
PL458/PL459	Vulcan RD to LOGGS PP gas line	Y	16.05
PL460/PL461	South Valiant TD to LOGGS PP gas line	Y	10.62
PL462/PL463	Vulcan UR to Vulcan RD gas line	Y	3.68
PL470/PL471	North Valiant SP to LOGGS	Y	4.30
PL496	Audrey A (WD) to LOGGS PP gas line	Y	16.52
PL575	Audrey WM to Audrey A (WD)	Y	0.43
PL584	48/30-11 to 48/29a-P gas export	Y	9.18
PL624	Camelot CA gas export to Leman 27a	Y	14.70
PL632	Clipper PT to Bacton	Y	9.58
PL633	Barque PB to Clipper PT	Y	24.43
PL669	Ravenspurn North Export Line	Y	25.51
PL670	Ravenspurn North St-2 Infield	Y	5.94
PL674	Welland to Thames	Y	15.20
PL676	Welland 3 to Welland	Y	7.69

Pipeline No.	Name	Trenched	Length in SNS SAC
PL677	Welland 4 to Welland	Y	5.52
PL678	Welland 2 to Welland	Y	3.91
PL723	Audrey B (XW) to Audrey A (WD) gas line	Y	4.32
PL729/PL730	Ravenspurn North ST3 to RNCP	Y	13.70
PL854	LOGGS PP to Anglia YD gas line	N	17.60
PL876	Lancelot to Bacton	N	1.53
PL878	53/2-B to Pl-624 Tee	Y	1.25
PL88	Viking AR to Viking BP gas line	Y	10.96
PL89	Viking BD to Viking CD gas line	Y	3.00
PL90	Viking BD to Viking DD gas line	Y	3.41
PL91	Viking BD to Viking ED gas line	Y	11.89
PL92	Viking BD to Viking GD gas line	Y	5.14
PL93	Viking BD to Viking HD gas line	Y	5.55
PL94	West Sole WB to West Sole WC	Y	4.52
PL95	West Sole E to West Sole B	Y	1.50
PL98	Leman BP to Leman BT	Y	0.62
PL99	Leman CP to Leman BT	Y	2.09
PL929	Theddlethorpe to Murdoch Md	Y	78.21
PL931	Orwell to Thames RA	Y	23.82
PL935	Murdoch MD to Caister CM gas line	Y	0.23
PL937	Hyde to West Sole Bravo	Y	11.50
PL947	Ann XM to LOGGS PR	Y	39.56
PL948	Ann to Audrey B	Y	15.10
PL97	Leman BT to Leman AP	Y	3.50
PL989	Johnston Export	Y	9.34
PL994	Galleon PN to Clipper PM	Y	12.28

16 Appendix C – Surface Installations in NNSSR SAC.

Source: UKoilandgas 2018.

Installation		
Andrea 48/15B – Lighted Buoy	Leman BD (Perenco)	LOGGS Riser
Anglia A	Leman BH	North Valiant 1
Anglia YD	Leman BP (Perenco)	North Valiant 2
Audrey A (WD)	Leman BP (Shell)	South Valiant
Audrey B (XW)	Leman BT (Perenco)	Southwark
Audrey 1 WD	Leman BT (Shell)	Vampire
Audrey XW 2	Leman CD (Perenco)	Vanguard
Buoy H: KFB 07/2002	Leman CD (Shell)	Victor Juliet Drilling
Clipper South	Leman CP (Perenco)	Viking A Riser
Ensign	Leman CP (Shell)	Viking B Accommodation
Ensign Victor	Leman D	Viking B Compression
EUROPA	Leman DD	Viking B Drilling
Galleon PN	Leman DP	Viking B Production
Ganymede ZD	Leman E	Viking C Drilling
Indefatigable Banks: KFB	Leman ED	Viking D Drilling
Jupiter	Leman EP	Viking E Drilling
Leman AC	Leman F	Viking ED
Leman AD	Leman FD	Viking G Drilling
Leman AD1	Leman FP	Viking H Drilling
Leman AD2	Leman G (Perenco)	Viking K Drilling
Leman AK	Leman G (Shell)	Viking L Drilling
Leman AP (Perenco)	Leman H	Viscount
Leman AP (Shell)	Leman J	Vulcan 1
Leman AQ	LOGGS Accommodation	Vulcan 2
Leman AX	LOGGS Compression	Wenlock NUI
Leman BD (Shell)	LOGGS Production	

17 Appendix D – Surface Installations in Southern North Sea SAC

Source: UKoilandgas 2018.

Installation		
Audrey 1 WD	Leman AD	North Valiant 2
Audrey A (WD)	Leman AD1	Ravenspurn North CC
Audrey B (XW)	Leman AD2	Ravenspurn North CCW
Audrey XW 2	Leman AK	Ravenspurn North ST2
Babbage	Leman AP (Perenco)	Ravenspurn North ST3
Barque PB	Leman AP (Shell)	Ravenspurn South A
Barque PL	Leman AQ	Ravenspurn South B
Boulton	Leman AX	Ravenspurn South C
Camelot CA	Leman BD (Perenco)	Rough AD
Camelot CB	Leman BD (Shell)	Rough AP
Cavendish	Leman BH	Rough BD
Cleeton CC	Leman BP (Perenco)	Rough BP
Cleeton PQ	Leman BP (Shell)	Rough CD
Cleeton WLTR	Leman BT (Perenco)	Skiff
Clipper PC	Leman BT (Shell)	South Valiant
Clipper PH	Leman CD (Perenco)	Southwark
Clipper PM	Leman CD (Shell)	Tethys 49/11b
Clipper PR	Leman CP (Perenco)	Trent
Clipper PT	Leman CP (Shell)	Tyne
Clipper PW	Leman D	Vampire
Clipper South	Leman DD	Vanguard
Cutter	Leman DP	Viking Alpha Riser
Cygnus A (APU)	Leman E	Viking B Accommodation
Cygnus A (AQU)	Leman ED	Viking B Compression
Cygnus A (AWHP)	Leman Ep	Viking B Drilling
Cygnus B (BWHP)	Leman F	Viking B Production
Davy A	Leman FD	Viking E Drilling
Ensign	Leman FP	Viking ED
Ensign Platform	Leman G (Perenco)	Viking G Drilling
Frigate Extension	Leman G (Shell)	Viking H Drilling
Galleon PG	Leman H	Viking K Drilling
Galleon PN	Leman J	Viking L Drilling
Garrow NUI	LOGGS Accommodation	Viscount
Hewett 48/29a-FTP	LOGGS Compression	Vulcan 1
Hewett 48/29a-P	LOGGS Production	Vulcan 2
Hewett48/29a-Q	LOGGS Riser	Welland
Hewett 48/29c	Mimas MN	Wenlock NUI
Hewett 52/5a	Mimas 48/9a	West Sole A
Horne And Wren Platform	Minerva	West Sole A
Hoton	Munro MH	West Sole B
Hyde	Murdoch Accommodation	West Sole C
Kelvin TM 44/23a	Murdoch Compression	West Sole PP
Kilmar NUI	Murdoch Drilling	West Sole SP
Leman AC	Neptune	York
Leman AC (Shell)	North Valiant 1	