Atlantic and Cromarty Environmental Appraisal

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Acronyms

°C	Degree Celsius
A&C	Atlantic and Cromarty
AETs	Apparent Effects Thresholds
AIS	Automatic Information System
ALARP	As Low As Reasonably Practicable
Ba	Barium
BAT	Best Available Technique
BEP	Best Environmental Practice
BEIS	Department for Business, Energy and Industrial Strategy
BG (Group)	British Gas (Group)
BODC	British Oceanographic Data Centre
CA	Comparative Assessment
CCC	Committee on Climate Change
CCS	Carbon Capture and Storage
CCUS	Carbon Capture Utilisation and Storage
Cd	Cadmium
CH_4	Methane
cm	Centimetre
COLREGS	International Regulations for the Prevention of Collisions at Sea
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide Equivalent
CMID	Common Marine Inspection Documents
CNOOC	China National Offshore Oil Corporation
CNS	Central North Sea
C&P	Contracting and Procurement
CRA	Collision Risk Assessment
DECC	Department of Energy and Climate Change
DESNZ	Department for Energy Security and Net Zero
DP	Decommissioning Programme
EA	Environmental Appraisal
EC	European Commission
EEMS	Environmental and Emissions Monitoring System
EHC	Electro-Hydraulic Control
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EMS	Environmental Management System

EMT	Environmental Management Team
ENVID	Environmental Identification
EPS	European Protected Species
ERL	Estimated Range Low
ES	Environmental Statement
ESAS	European Seabirds at Sea
EU	European Union
FEAST	Feature Activity Sensitivity Tool
GHG	Greenhouse Gas
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HSE	Health, Safety and Environment
HSSE-SP	Health, Safety, Security, Environment and Social Performance
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Seas
IMO	International Maritime Organisation
INTOG	Innovation and Targeted Oil & Gas
IoP	Institute of Petroleum
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
J	Juveniles
JNCC	Joint Nature Conservation Committee
km	kilometre
km^2	Square kilometre
LAT	Lowest Astronomical Tide
LSA (materials)	Low Specific Activity (materials)
LWSV	Light Weight Support Vehicle
m	Metre
mg/l	Milligram per litre
m/s	Metre per second
MARPOL	International Convention for the Prevention of Pollution from Ships
MAS	Marine Assurance Standards
MEG	Monoethylene glycol
mm	Millimetre
MMS	Minerals Management Service
MPA	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
MU	Management Unit

N	North
N	Nursery
NCMPA	Nature Conservation Marine Protected Area
nm	Nautical mile
NMP	National Marine Plan
NMPi	NMP interactive
NO_x	Nitrogen oxide
NORM	Naturally Occurring Radioactive Material
NSTA	North Sea Transition Authority
NSTD	North Sea Transition Deal
ODU	Offshore Decommissioning Unit
OESEA	Offshore Energy Strategic Environmental Assessment
OEUK	Offshore Energies UK
OGUK	Oil and Gas UK
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSPAR	Oslo and Paris Conventions
OVID	Offshore Vessel Inspection Database
PAH	Polycyclic Aromatic Hydrocarbon
P&A	Plug and Abandon
PMF	Priority Marine Features
POP	Persistent Organic Pollutants
PPC	Pollution Prevention and Control
ppm	Parts per million
PUQ	Process, Utilities and Quarters
PWA	Pipelines Work Authorisation
RAG	Red-Amber-Green
ROV	Remotely Operate Vehicle
ROVSV	Remotely Operate Vehicle Support Vessel
S	Spawning
S*	Peak Spawning
SAC	Special Area of Conservation
SACFOR	Superabundant, Abundant, Common, Frequent, Occasional and Rare
SAGE	Scottish Area Gas Excavation
SCANS	Small Cetacean Abundance in the North Sea
SEEMP	Ship Energy Efficiency Management Plan
SEMS	Safety and Environmental Management System
SFF	Scottish Fishermen's Federation
SIMOPS	Simultaneous Operations

Sn	Tin
SNH	Scottish Natural Heritage
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protected Areas
SSS	Side Scan Sonar
te	Tonnes
THC	Total Hydrocarbon
UK	United Kingdom
UKCS	UK Continental Shelf
UKOOA	UK Offshore Operators Association
UV	Ultraviolet
$\mu g\ g^{-1}$	Microgram per gram
µm	Micrometre
VOC	Volatile Organic Compounds
W	West
WBM	Water Based Mud
WEEE	Waste Electrical and Electronic Equipment
WMP	Waste Management Plan

Non-Technical Summary

Background Information

The Atlantic and Cromarty (A&C) Fields are located in the outer Moray Firth in United Kingdom Continental Shelf Blocks 14/26a and 13/30, respectively. The Atlantic and Cromarty Fields are both approximately 67 km northeast of the St Fergus Gas Terminal in the northeast Aberdeenshire coast and approximately 144 km and 154 km from the median line with Norway, respectively.

The A&C fields were developed via three production wells (two at Atlantic and one at Cromarty - all now plugged and abandoned). Production at the A&C Fields started in 2006 and stopped in 2009, after several restart attempts. Formal cessation of production was in 2011. In 2012, the pipelines were flushed and isolated and in 2014 the wells were suspended with well plug and abandonment taking place in 2018.

Figure 1 identifies the infrastructure associated with the A&C Infield Pipelines DP, the A&C Pipeline Comparative Assessment (CA) and this supporting Environmental Appraisal (EA).

The A&C Decommissioning Programmes (DPs) were originally submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) in 2016[1]. However, potential repurposing options (e.g. the transport of CO_2 for offshore storage) for the gas export pipeline to the SAGE Terminal resulted in the approval of the DPs being put on hold. An agreement has since been reached between Shell Global LNG Limited (hereinafter referred to as Shell) and OPRED, that Shell will resubmit the DPs (in a single DP submission) that focus on the offshore elements of the A&C fields only. This will allow Shell to continue to plan for decommissioning of the offshore elements, whilst repurposing options for the gas export pipeline are still being considered.

As operator, Shell has prepared this Environmental Appraisal (EA) under the Petroleum Act 1998, in support of the four draft Decommissioning Programmes (DPs) that are being submitted (as a single DP submission) to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to seek approval for the decommissioning of the following infrastructure:

- subsea installations in the Atlantic Field;
- subsea pipelines associated with the Atlantic Field;
- subsea installations in the Cromarty Field; and
- subsea pipelines associated with the Cromarty Field.

Note: The gas export pipeline (PL2029) from the Atlantic manifold to the SAGE terminal (next to the St Fergus Gas Terminal) does not form part of the DP or this EA as it is subject to possible repurposing considerations for carbon capture and storage (CCS) by third parties.

[1] BG Group submitted the initial DP, however Shell acquired the BG Group in 2016 including the A&C Fields.

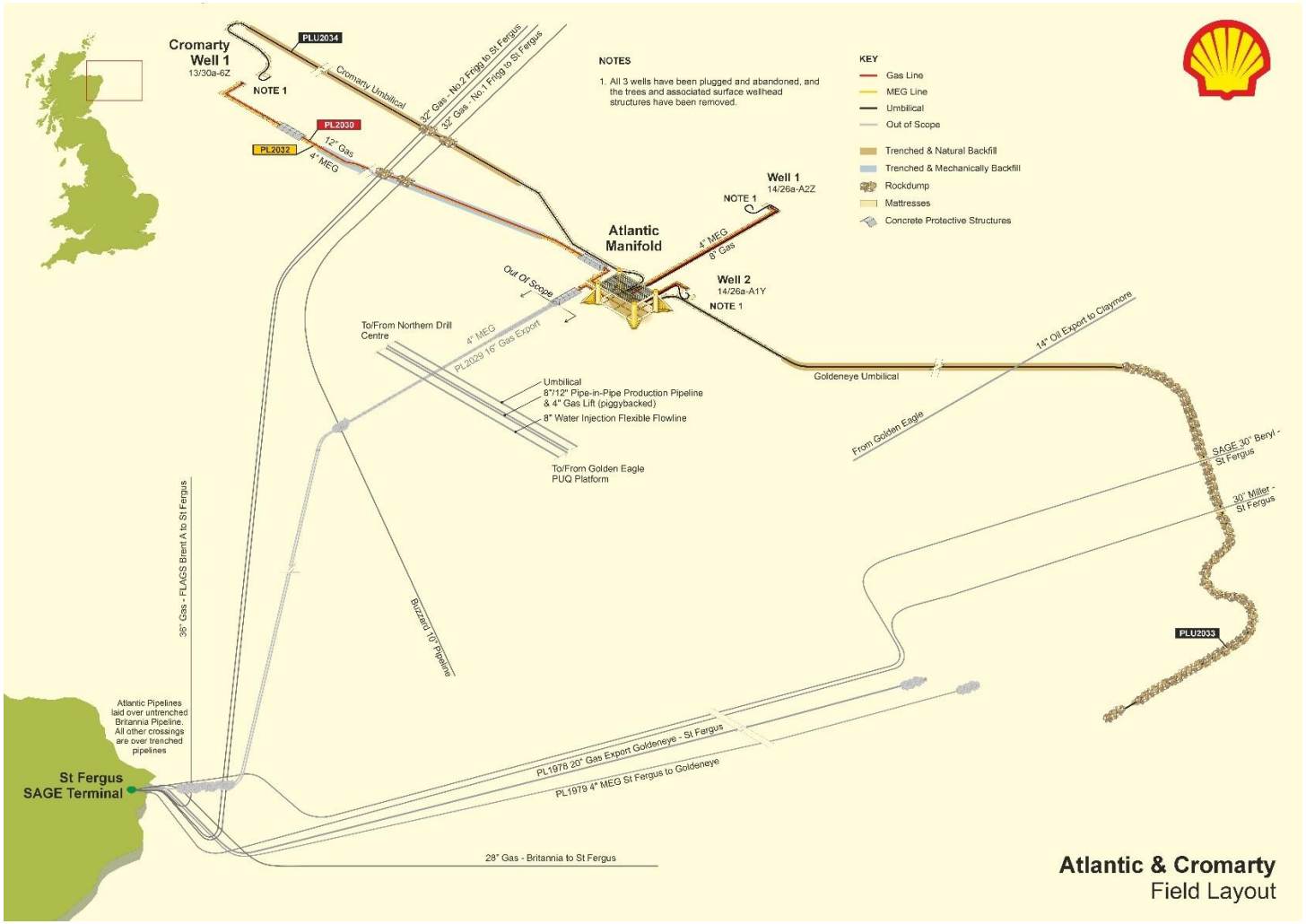

Figure 1: Infrastructure associated with the A&C Development.

Stakeholder Engagement

In May 2024, as part of the informal stakeholder engagement process, Shell issued a Scoping Report to a number of stakeholders. The Scoping Report provided an overview of the A&C fields and pipelines, the proposed decommissioning activities and an overview of the impacts to be assessed in this EA. Stakeholders were invited to comment on the Scoping Report with respect to any concerns they may have and comments received have been addressed in this report.

The report also presents details of the relevant stakeholder engagement that was carried out in support of the initial DP submission.

Planned Decommissioning Activities

Infrastructure to be recovered as part of the decommissioning activities includes:

- The Atlantic manifold;
- The surface laid tie-in spools (production and MEG spools) and control jumpers between the Atlantic manifold and the two Atlantic wells;
- A piping assembly at the Cromarty field;
- The surface laid tie-in spools connecting the Cromarty production and MEG pipelines to the Cromarty well at one end and to the Atlantic manifold at the other;
- The surface laid tie-in spools connecting the gas export and MEG pipelines to the Atlantic manifold; and
- Where technically feasible, all exposed grout bags, mattresses and concrete protection structures.

A Comparative Assessment (CA) of the feasible decommissioning options was carried out to determine the preferred approach to decommissioning the pipelines and umbilicals associated with the fields. A screening process was initially carried out to identify which decommissioning options would be suitable. In the CA, the selected options were then assessed against a number of criteria (safety, environment, technical feasibility, societal impacts, and economics) to determine the preferred approach. For each umbilical/pipeline, in addition to identifying a preferred approach, a number of acceptable options were also identified as summarised in Table 1. If the Contracts and Procurement (C&P) tendering phase or the findings from the as found surveys, that will be completed in advance of execution, result in the preferred option not being selected Shell will inform the Department for Energy Security and Net Zero (DESNZ) before a decision is taken on the overall strategy.

Table 1: Results of the CA showing the preferred decommissioning option and acceptable options identified.

Most Preferred Decommissioning Option	Acceptable Options[1]
Group A: PL2030 (11.87 km) and PL2032 (11.87 km) – Rigid piggy-backed pipelines: trenched and mechanically buried	
Option 2a Remediate *in situ* with Exposed Sections Rock Covered	**Option 2b** Remediate *in situ* with Exposed Sections Trenched and Buried **Option 2c** Remediate *in situ* with Exposed Sections Cut & Removed
Group B: PLU2034 (11.97 km) and PLU2033 (18.27 km) – Flexible EHC umbilicals: trenched and natural backfill with Depth of Cover (DoC) >0.6 m	
Option 2c Remediate *in situ* with Exposed Sections Cut & Removed	**Option 2b** Remediate *in situ* with Exposed Sections Trenched and Buried **Option 2a** Remediate *in situ* with Exposed Sections Rock Covered
Group C: PLU2033 (12.97 km) – Flexible EHC umbilical: trenched and natural backfill with DoC <0.6 m	
Option 1a Total Removal by Reverse Reel[2]	No other options considered acceptable.
Notes: [1] Options that had no 'showstoppers' identified against them in the CA and are therefore deemed 'acceptable' alternatives. [2] Screening concluded that Full Removal by Reverse Reel was the preferred option for the 12.97 km section of PLU2033 that does not meet the target >0.6m depth of cover (DoC).	

Environmental and Socio-Economic Baseline

The A&C Fields lie in water depths of between 113.6 m and 115.4 m LAT (Lowest Astronomical Tide) with an average gradient of <1° whilst the Cromarty Field lies in water depths of 105 m to 116.4 m LAT with an average gradient of <1°. Along the Goldeneye to Atlantic umbilical (PLU2033) water depths ranged from 125.2 m LAT at the platform to 98 m LAT at the Atlantic manifold.

The water currents in the area move predominantly in an anticlockwise direction. The maximum tidal current speed is 0.51 m/s. Sea surface temperatures range from 8.5°C in the winter to 15°C in the summer and at the seabed temperatures range between 8°C and 9°C.

Within the immediate area of A&C, the broad habitat 'Sublittoral sediment' . The seabed in the area was also found to have areas of 'Circalittoral fine mud' (A5.36) and 'Circalittoral muddy sand' (A5.26), while areas of muddy sands with shell fragments and bioturbation are also present throughout.

The Southern Trench Nature Conservation Marine Protected Area (NCMPA) is the only protected area within 40 km of the A&C development, located *c.* 39 km southwest of the fields.

Plankton, benthic and fish species in the area are typical of the Central North Sea (CNS). The A&C area is situated within an area which is a nursery and spawning ground for Norway pout, *Nephrops*, lemon sole, herring, sandeel, spotted ray, sprat, whiting, cod and plaice. Of the fish species identified the following are priority marine features (PMFs): blue whiting, spurdog, anglerfish, mackerel, ling, sandeel, herring, cod, Norway pout and whiting.

The Atlas of Cetacean Distribution in Northwest European Waters has indicated that white-beaked dolphin, Atlantic white-sided dolphin, minke whale, and harbour porpoise have been sighted in the vicinity of the A&C Fields. All of the cetaceans recorded in the area are PMFs. Additionally, all cetaceans in UK waters are considered to be European Protected Species such that under the Habitats Regulations, it is an offence to deliberately disturb, capture, injure or kill any of these species. Harbour porpoise and bottlenose dolphin are also protected under Annex II of the Habitats Directive.

Distribution and abundance of bird species vary seasonally and annually. Seabird densities such as black-legged kittiwake are generally higher in the breeding season (April – July), whereas other species such as the Atlantic puffin have higher densities in the winter season (August - February). Of the species expected to occur in the area, Arctic tern (*Sterna paradisaea*) and the European storm petrel (*Hydrobates pelagicus*) are afforded protection by the European Commission (EC) Birds Directive (Annex I).

The A&C infrastructure occurs within ICES rectangles 45E8, 45E9 and borders 44E9. Data provided by the Scottish Government demonstrates that trawls and seine nets were used throughout 44E9, 45E8 and 45E9 in 2023 (Scottish Government, 2024). Species targeted in the area include cod, *Nephrops* and haddock. The data suggests that these ICES rectangles encompass an area that is of relatively moderate importance to the UK fishing industry such that fishing activity in the area can be considered moderate.

The shipping activity throughout the relevant United Kingdom Continental Shelf (UKCS) Blocks is generally low, ranging from 0 to > 89.5 hours per km^2 per month.

Impact Assessment

In order to determine the significance of the impact of the proposed decommissioning activities an ENVironmental Issues IDentification (ENVID) was undertaken. Receptors considered included: air quality, water quality, sediment quality, plankton, benthic species, fish, marine mammals, seabirds, fisheries, shipping, landfill resources and resource use. The impacts associated with emissions to air, discharges to sea, seabed disturbance, underwater noise, waste production, the physical presence of the vessels during operations and the legacy impacts of the items (buried pipelines and umbilical and surface laid rockdump) to be decommissioned *in situ* were considered on each of the receptors.

Applying industry standard mitigation measures (see Table 2), the impact significance of each of the planned activities were considered to be either Slight or Minor. Following scoping of the ENVID results, a further assessment was carried out on:

1) the impacts of the potential seabed disturbance associated with the proposed activities,
2) the legacy impacts associated with decommissioning the buried pipelines and umbilical, and the surface laid rockdump in situ; and
3) Atmospheric emissions from vessels.

For each of the receptors the results of this further assessment aligned with the initial results of the ENVID and concluded that, apart from the over trawl trial, with the application of industry standard mitigation measures, the impact significance is Slight (i.e. not significant) or Minor (detectable but not significant) with respect to seabed disturbance, legacy impacts (both environmental and socio-economic) and climate change.

Environmental Management

The A&C DP will be aligned to Shell's goal to 'minimise the impact to the environment'.

Atmospheric emissions will be managed by inspection of the vessels contracted to carry out the work and by planning vessel schedules to ensure efficient operations.

The inventory of decommissioned items will distinguish equipment that can be reused, materials that can be recycled and waste for appropriate disposal. Naturally Occurring Radioactive Material (NORM) is not expected to be present, but if it is detected, the contaminated waste will be sent for appropriate

treatment. Waste management activities will be conducted in full compliance with all relevant legislation and regulatory controls. Disposal to landfill will be the waste management option of last resort.

Following the decommissioning activities, independent verification of the seabed state will be obtained, and evidence of a safe seabed will be provided to all relevant governmental and non-governmental organisations. A post-decommissioning environmental survey will be carried out following decommissioning activities to establish the condition in which the seabed is left. An ongoing monitoring survey strategy will be agreed with OPRED, the aim of which will be to verify recovery of the seabed and that the pipelines and umbilical decommissioned *in situ* remain buried and do not present a risk of snagging to other users of the sea.

Stringent control measures and operational procedures will be implemented to prevent accidental events involving the release of hydrocarbons or chemicals.

Table 2 lists procedural and technical controls and mitigation measures identified by the project that ain to reduce environmental impacts to a level that is 'as low as reasonably practicable' (ALARP).

Table 2: Decommissioning of A&C: Project specific commitments.

Aspect	Commitment
Physical presence	• Ongoing consultation with Scottish Fishermen's Federation (SFF). • Notice to mariners will be circulated. • Vessel use will be optimised. • A Collision Risk Management Plan will be produced if required. • All vessels engaged in the project operations will have markings and lightings as per the International Regulations for the Prevention of Collisions at Sea (COLREGS) (International Maritime Organisation, 1972). • A safe seabed will be achieved as part of the decommissioning activities. • If used, rock cover will be optimised and carefully managed. A fall pipe will be used to ensure accuracy of the rock dumping. Size of rock cover will be in accordance with industry practice which is also the preferred SFF/industry best practices. • Location of remaining material will be mark on Fishsafe.
Atmospheric emissions and energy use	• As part of the tendering process, proposed vessels will go through a detailed assurance process which will include a review of generator and engine maintenance which leads to better efficiency in line with manufacturer's specifications. • Decommissioning vessel schedules will be planned to minimise vessel use. • Prior to the contract award, Shell will audit the decommissioning yards to ensure suitable permits are in place and that atmospheric emissions are being managed. • Activities will be carried out in line with Shell's environmental policy which includes minimising emissions.
Discharges to sea	• Shell will carry out a detailed assurance process on all vessels prior to contract award. • Work procedures will be in place to minimise offshore campaigns. • Only MARPOL compliant vessels will be used. • Flushing and cleaning of pipelines and umbilicals has been completed in line with Best Available Technique (BAT)/Best Environmental Practice (BEP) requirements.

Aspect	Commitment
	• All contracted vessels will be signed up to the International Maritime Organisation (IMO) and will adhere to their guidelines. • Any associated discharges will be managed, tracked and permitted to minimise impact.
Physical disturbance of the seabed and marine species	• Cutting/jetting/dredging and lifting procedures will be in place. • If rock cover is used, volumes will be minimised, and a fallpipe will be used to lay it on the seabed. • With respect to determining a safe seabed status after decommissioning activities are completed, the use of surveys for example side scan sonar surveys will be prioritised over the use of over trawl trials.
Onshore activities	• Contract award will be to an established yard with appropriate experience, capability, licences, consents and community engagement in place.
Waste generation and resource use	• The A&C DP will have in place a Waste Management Plan (WMP) developed to describe and quantify waste arising from decommissioning activities and identify available disposal options for those wastes. • Waste management options will take account of the waste hierarchy. • As part of Shell's Duty of Care, contract award will be to an established yard with appropriate experience, capability, licences and consents in place.
Accidental events	• Any infrastructure decommissioned *in situ* will be marked on FishSafe and communicated accordingly. • Work procedures in place. • Vessel assurance inspections. • Pre-hire vessel audits. • SOPEPs (shipboard oil pollution emergency plan) in place.
Legacy impacts	The location of the lines to be decommissioned in situ (i.e. buried to >0.6 m) means that the conditions typically required for plastic and steel breakdown are not present. Therefore taking account of: • The buried nature of the lines; • The slow anticipated rate of degradation; • The low mechanical forces predicted to be acting on the lines; and • The fact that much of the eventual plastic contaminants produced will be contained within the sediment and prevented from reaching the water column, the long-term significance of the environmental impact of the plastics associated with the lines decommissioned *in situ* is not considered significant. The post decommissioning clear seabed surveys will be used to confirm that there are no line sections exposed on the seabed.

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Conclusion

This EA has assessed the environmental and socio-economic impacts associated with the proposed A&C offshore decommissioning activities in the context of the environment within which the fields are situated. With implementation of the proposed mitigation measures, the environmental impact of the decommissioning activities is likely to be minimal and the proposed decommissioning activities will leave the area in a condition suitable for re-colonisation by local species and safe for fishermen.

In addition, the EA has considered the objectives and marine planning policies of the Scottish National Marine Plan (NMP) across the range of policy topics including biodiversity, natural heritage, cumulative impacts and oil and gas. Shell considers that the proposed decommissioning activities are in broad alignment with such objectives and policies.

1. Introduction

The Atlantic and Cromarty (A&C) fields are located *c.* 71 km northeast of the Scottish coastline and *c.* 147 km from the UK/Norway median line. The fields lie in *c.* 114 m water depth and the associated infrastructure span across United Kingdom Continental Shelf (UKCS) Blocks 13/30, 14/26, 14/27, 14/28 and 14/29 (Figure 1-1).

The A&C fields were developed as subsea tiebacks with the hydrocarbons from both fields comingling at a manifold located at the Atlantic field prior to transportation directly to the SAGE[1] Terminal (next to the St. Fergus Gas Terminal) via a *c.* 77.6 km production pipeline. A MEG pipeline was piggybacked to the production pipeline whilst control of the fields was via the Goldeneye platform. Further details are provided in Section 2.

Production at the A&C Fields started in 2006 and stopped in 2009, after several restart attempts. Formal cessation of production was in 2011. In 2012, the pipelines were flushed and isolated and in 2014 the wells were suspended with well plug and abandonment taking place in 2018.

The A&C Decommissioning Programmes (DPs)[2] were originally submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) in 2016[3]. However, potential repurposing options (e.g. the transport of CO_2 for offshore storage) for the gas export pipeline to the SAGE Terminal resulted in the approval of the DP being put on hold. An agreement has since been reached between Shell Global LNG Limited (hereinafter referred to as Shell) and OPRED, that Shell will resubmit the DPs that focuses on the offshore elements of the A&C fields only. This will allow Shell to continue to plan for decommissioning of the offshore elements, whilst repurposing options for the gas export pipeline are still being considered.

This Environmental Appraisal (EA) has been completed to support the resubmitted DPs and therefore focuses on the decommissioning of the infield infrastructure (and associated stabilisation features). It does not include the production and MEG pipelines to shore (PL2029 and PL2031 respectively).

Four DPs identified as follows will be submitted in a single DP submission capturing:

- Atlantic Installations;
- Atlantic Pipelines and umbilical;
- Cromarty Installations;
- Cromarty pipelines and umbilicals.

[1] SAGE – Scottish Area Gas Evacuation.

[2] Multiple DPs in a single DP submission.

[3] BG Group submitted the initial DP, however Shell acquired the BG Group in 2016 including the A&C Fields.

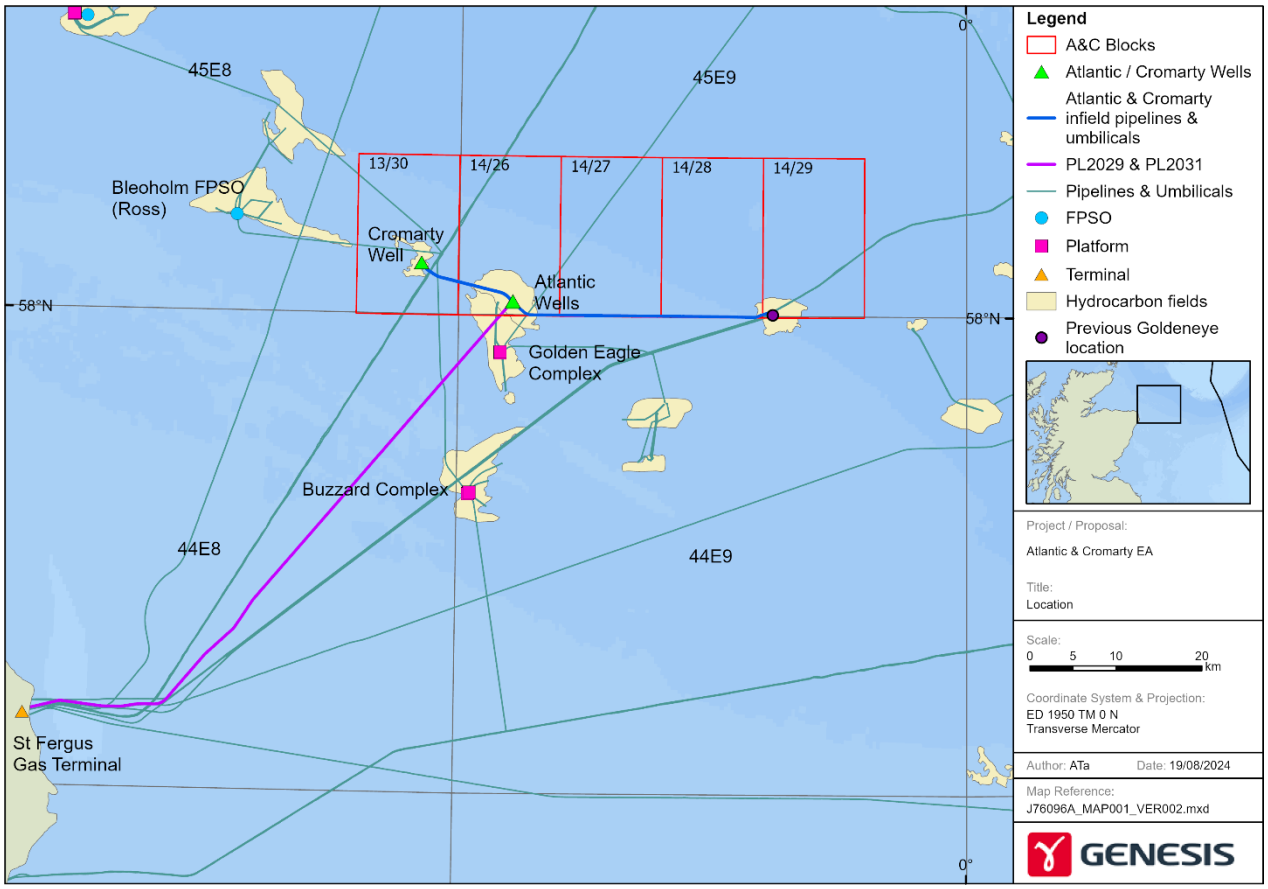

Figure 1-1: Location of A&C fields.

1.1. Overview of A&C Infrastructure to be Decommissioned

The A&C fields were developed via three production wells (two at Atlantic and one at Cromarty - all of which were plugged and abandoned in 2018. The two Atlantic wells were tied back to the Atlantic subsea manifold via surface laid tie-in spools, whilst the Cromarty well was connected to the Atlantic manifold via a 12 km in-field production flowline and piggy-backed MEG line. Production control was via a 32 km electro-hydraulic control (EHC) umbilical from the now decommissioned Shell Goldeneye platform to the Atlantic manifold with EHC umbilical jumpers installed between the Atlantic manifold and each Atlantic well. Production control was extended to the Cromarty well via a 12 km EHC umbilical from the Atlantic manifold. The 32 km and 12 km EHC umbilicals are predominantly trenched and buried. Note a section of the EHC umbilical in the vicinity of the previous Goldeneye location has previously been removed to facilitate decommissioning of the Goldeneye platform (Figure 1-2).

In accordance with the Petroleum Act 1998, the Section 29 Notice holders of the A&C fields are applying to OPRED to obtain approval for the decommissioning of the:

- subsea installations associated with the Atlantic Field;
- subsea pipelines associated with the Atlantic Field;
- subsea installations associated with the Cromarty Field; and
- subsea pipelines associated with the Cromarty Field.

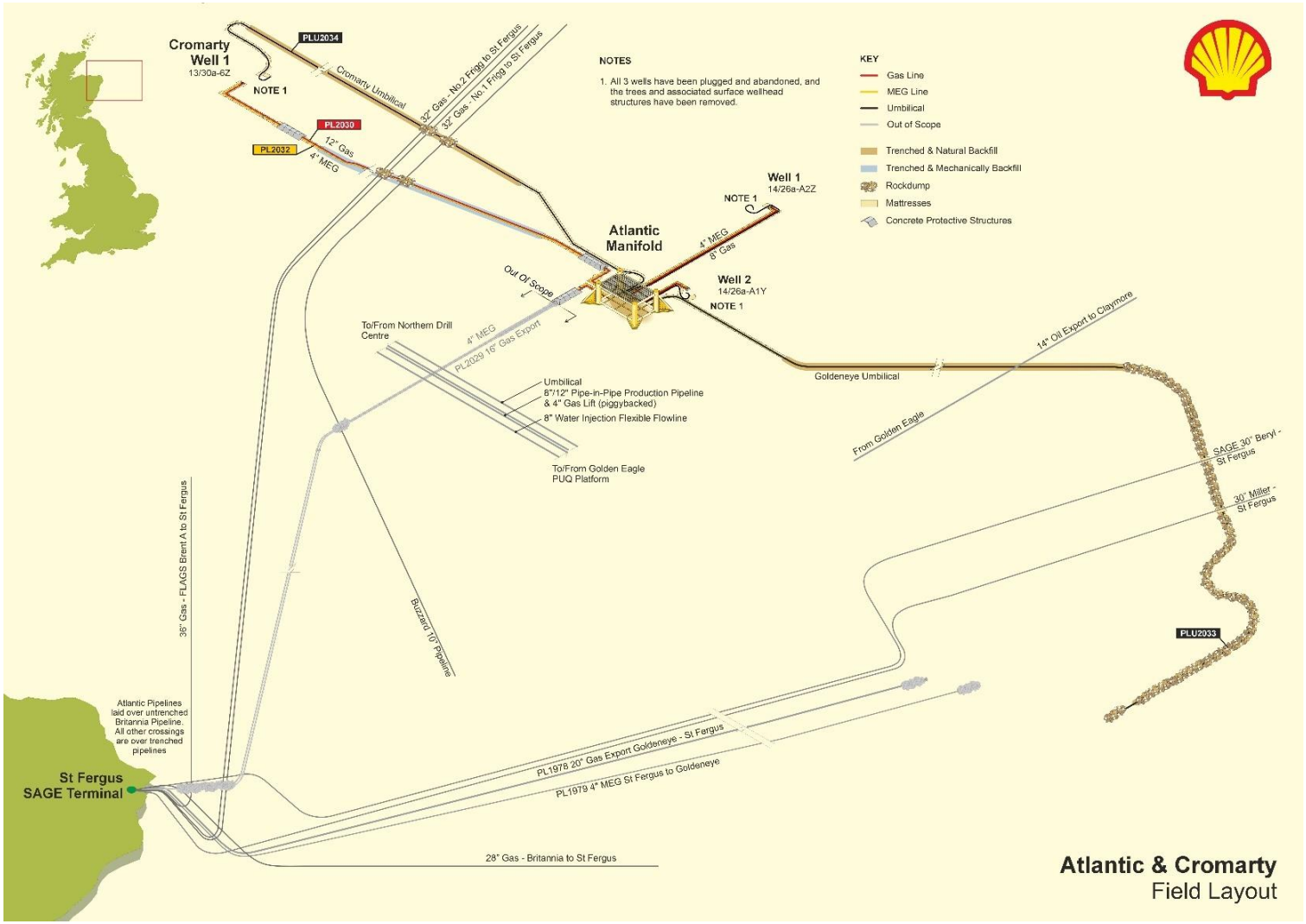

Figure 1-2: Infield infrastructure associated with the A&C fields.

1.2. Purpose of this Document

The purpose of the EA is to assess and describe, in a proportionate manner, the potential environmental and socio-economic impacts associated with the proposed decommissioning activities, and to identify mitigation measures to reduce the level of these impacts to 'as low as reasonable practicable' (ALARP).

1.3. Regulatory Context

The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (Oslo and Paris (OSPAR) Convention). OSPAR Decision 98/3 require that all installations should be completely removed and recovered to shore for re-use, recycling or final disposal unless a derogation is granted. Pipelines and cables are not included within the Decision, however OPRED's decommissioning guidance notes (BEIS, 2018) require that operators aim to achieve a safe seabed and robustly assess decommissioning options, based on evidence and data, using a Comparative Assessment (CA) process.

The decommissioning of offshore oil and gas infrastructure (including pipelines) in the UKCS is principally governed by the Petroleum Act 1998 (as amended by the Energy Act 2008). This Act sets out the requirements for a formal DP, which must be approved by OPRED before the owners of an offshore installation or pipeline may proceed with decommissioning.

There is no statutory requirement to undertake an Environmental Impact Assessment (EIA), but OPRED's decommissioning guidance notes (BEIS, 2018) advise that any DP is supported by an assessment of the environmental impacts of undertaking the decommissioning activities described. This EA has been prepared to meet this requirement.

1.4. Document Layout

Table 1-1 details the structure of the EA Report.

Table 1-1: Structure of the EA Report.

Chapter No	Title	Contents
	Non-Technical Summary	A summary of the EA Report.
1	Introduction	Introduction to the project and scope of the EA. This chapter also includes a summary of applicable legislation.
2	Stakeholder Engagement	Details of the consultation process to date.
3	Project Description	A description of the infrastructure to be decommissioned, the proposed decommissioning activities and an indicative schedule of activities.
4	Comparative Assessment	Summary of the results of the CA carried out for the pipelines and EHC umbilicals.
5	Environmental Baseline	A description of the environmental and socio-economic receptors in the project area.
6	Scoping of Potential Environmental Impacts	Overview of the methodology used to determine the environmental and socio-economic impact significance of the proposed decommissioning activities. Results of the ENVID Workshop and justification for selecting those aspects not requiring further assessment in the EA. Justification is also provided for those aspects that are assessed further.
7	Seabed Disturbance	Assessment of seabed disturbance during decommissioning.
8	Legacy Impacts	Assessment of legacy impacts on other sea users and on the environment.
9	Atmospheric Emissions	Assessment of the impacts from atmospheric emissions from vessels used during the decommissioning.
10	Environmental Management	A description of Shell's Environmental Management Procedures and how they apply to the A&C Infield Pipelines Decommissioning Project.
11	Conclusions	Key findings including a register of commitments.
12	References	Data sources used to support the EA.
Appendix A		Impact Assessment Methodology.
Appendix B		Assessment against Scotland's National Marine Plan

2. Stakeholder Engagement

Consulting with stakeholders is an important part of the decommissioning EIA process. It allows any concerns or issues which stakeholders may have, to be communicated and addressed.

2.1. Stakeholder Engagement in Support of the Revised Decommissioning Programme

As part of the informal stakeholder engagement process Shell issued a Scoping Report, in May 2024, to a number of stakeholders.

The Scoping Report provided an overview of the A&C fields, the proposed decommissioning activities and an overview of the impacts to be assessed in the EA. Recipients of the Scoping Report were invited to comment on the content with respect to any concerns they may have. Comments received on the Scoping Report are summarised in Table 2-1.

The formal statutory and public consultation process will be triggered by the submission of the consultation draft of the DPs and supporting documents (including this EA report) to OPRED. As the project progresses, further consultation will be undertaken in line with Shell's stakeholder engagement processes.

Table 2-1 summarises the main concerns that the stakeholders have identified to date.

Table 2-1: Summary of stakeholder comments.

Date	Stakeholder	Comments raised on Scoping Report issued in May 2024
Comments received on the Scoping Report		
22/05/2024	Global Marine Systems	Global Marine Systems confirmed that no telecommunication cables will be impacted by the proposed activities.
28/10/2024	Marine Directorate	Marine Directorate advised that given the scope of the A&C Decommissioning Project, the activities are covered by OPRED such that they have no comments on the Scoping Report.
12/12/2024	JNCC	1. JNCC advised that the results of the surveys are placed in the context of the proposed operations and their specific locations. ***Response**: Chapter 5 summarises the results of the surveys whilst Chapter 7 discusses the impact of the proposed activities on the habitats and benthic species identified in the surveys.* 2. JNCC recommended that the addition of protective material is kept to a minimum, though if used the DPs should assess the worst-case option to enumerate the protection/stabilisation material that will be used, and the area of seabed impacted. JNCC advised that the details of protection material should include: location of rock protection sites; size / grade of rock to be used; tonnage / volume to be used; contingency tonnage / volume to be used; method of delivery to the seabed; footprint of rock. ***Response:** A number of decommissioning options were considered for the pipelines and umbilicals. Following the comparative assessment process, for the pipelines, the acceptable options did include the potential of rock cover. The quantities of additional rock that would*

Date	Stakeholder	Comments raised on Scoping Report issued in May 2024
		be required are provided in Table 3-2. Paragraph of text after Table 3-2 describes the rock profile, size, volumes (with and without contingency). The impact of this rock placement is described in Chapter 7. 3. JNCC requested that cumulative impacts of the proposed activities along side approved developments under construction, approved developments that have not yet commenced construction, developments submitted for approval but not yet approved, as well as any other significant development for which some realistic figures are available. ***Response**: Taking account of the proposed activities, proportionate consideration has been taken of the potential cumulative impacts in the impact assessment sections.* 4. JNCC have requested that when considering the environmental impacts a realistic worst-case scenario is assessed. ***Response**: The EA considers a worst-case realistic scenario in each of the impact assessment sections. .*
The Scoping Report was issued to the Joint Nature Conservation Committee (JNCC), OPRED, Scottish Fishermen's Federation (SFF) Global Marine Systems and the Marine Directorate.		
Additional engagement		
01/09/2024	NSTA	Engagement with NSTA regarding re-purposing of export pipeline and progression to decommissioning. No further repurposing options identified.

2.2. Stakeholder Engagement Prior to Issue of 2024 Scoping Report

In support of the earlier DPs which included the pipelines laid between the SAGE Terminal and the Atlantic manifold, extensive stakeholder engagement was carried out either by emails, meetings and site visits. A summary of some of this correspondence is provided in Table 2-2. Correspondence shared focuses on demonstrating engagements with SFF, engagement on the environmental surveys, engagement related to the repurposing of the gas export pipeline and engagement associated with preparing a revised DP submission capturing the infield infrastructure only.

Table 2-2: Stakeholder engagement highlights prior to issue of 2024 Scoping Report.

Date	Stakeholder	Comments/Issues/Concerns raised on Scoping Report issued in May 2024
May 2015	OPRED EMT, Marine Scotland, JNCC, Scottish Natural Heritage (SNH) (now NatureScot).	Meeting to discuss the scope of work for the Pre-Decommissioning Environmental Baseline Survey. *Outcome: The scope of work for the survey was modified to include additional sampling points in accordance with the requirements of the regulatory agencies expressed at and after the meeting.*
June 2015	Scottish Fishermen's Federation (SFF)	First meeting held with SFF, a statutory consultee) to initiate project and seek early-stage input to characterise the nearshore area in terms of fishing activity. *Outcome: It was agreed that a 'one-size-fits-all' approach to pipeline decommissioning for A&C was not appropriate and that a section-by-section treatment, particularly in the nearshore area, was required given the varying pipeline characteristics and potential interactions with other users of the sea. SFF advice was taken account of in relation to the CA process and survey activities.* Note: further meetings were held with SFF to discuss decommissioning options for the nearshore section of the pipelines (August 2015); to share results of an ROV survey (October 2015); to discuss comparison of ROV footage on pipelines taken in 2011 and 2015 and whether or not change in cover over time (February 2016). In addition SFF attended the initial CA workshop.
March 2016	DECC EMT, Marine Scotland, JNCC, and SNH (now NatureScot)	Pre-Decommissioning Environmental Baseline Survey Report provided to DECC EMT, Marine Scotland, JNCC, and SNH with offer of presentation and/or discussion if required. *Outcome: Responses from three parties acknowledged that they were content with the results. OPRED EMT did not comment.*
March 2017	SFF	Engagement with fishing industry regarding potential re-purposing of the pipeline and protection for the offshore end once surface-laid infrastructure removed
November 2017	Summit Power; Pale Blue Dot	Stakeholder engagement meeting with CCUS community regarding potential repurposing of Atlantic Export pipeline
January 2018	Pale Blue Dot	Correspondence with Pale Blue Dot regarding re-purposing potential of Atlantic Export pipeline
February 2018	OPRED ODU	Face-to-face meeting regarding CCUS re-purposing of the export line and impact on progression of the DPs.
January 2024	OPRED ODU; OPRED EMT	Engagement with OPRED to confirm proposals for splitting DPs and to submit DP Part 1 covering the offshore infrastructure only (four DPs as detailed in Section 1).

3. Project Description

This section describes the A&C infield subsea infrastructure to be decommissioned and outlines the proposed decommissioning activities. As mentioned previously the decommissioning of the gas export line and the piggy-backed MEG line are not covered by this EA.

3.1. A&C Subsea Overview

As described in Section 1.1, the A&C fields were developed via three production wells: two at the Atlantic field and one at the Cromarty field (Figure 1-2)[1]. The three wells were tied back to a manifold at the Atlantic field (referred to as the Atlantic manifold).

The wells were controlled via a *c.* 32 km EHC umbilical from the Goldeneye platform to the Atlantic manifold. EHC umbilical jumpers connected the Atlantic wells to the Atlantic manifold whilst a 12 km EHC umbilical was laid between the Atlantic manifold and the Cromarty well.

A 12 km production pipeline transported hydrocarbons from the Cromarty well to the Atlantic manifold whilst 8" production jumper spools connect the two Atlantic wells to the manifold. A&C production from the three wells was co-mingled at the Atlantic manifold before being transported directly to the SAGE terminal via an 80 km production pipeline.

Hydrate formation control was achieved using MEG. MEG was transported to the fields via an 80 km pipeline from shore directly to the Atlantic manifold and then onwards through a 12 km MEG pipeline to the Cromarty well and via 4" jumper spools to the Atlantic wells. The 80 km and 12 km MEG pipelines are piggy-backed on the production pipelines.

Further details of the lines, including burial status and use of stabilisation materials are provided in Table 3-1.

During drilling of the A&C wells only the cuttings generated using Water Based Mud (WBM) drilling fluids were discharged. Limited quantities of WBM contaminated cuttings were discharged, estimated at 398 te in total for all three wells. These deposits are well-dispersed and do not constitute cuttings piles within the definition in OSPAR Recommendation 2006/5.

As mentioned previously, the export pipeline and associated MEG line from the Atlantic manifold to the SAGE Terminal are excluded from the scope of this EA. The boundary for both lines is the tie-in flanges on each line, which are connected by surface laid tie-in spools approximately 45 m from the Atlantic manifold. These 45 m tie-in spools are captured within the infield DPs being supported by this EA.

The three A&C wells have been plugged and abandoned while a section of the umbilical at the now removed Goldeneye platform was recovered in 2022, with the cut end made safe i.e. over trawlable.

A summary of the pipelines and infrastructure included in the scope of this DP submission is shown in Table 3-1 and Figure 1-2.

[1] Atlantic wells were 14/26-A1Y and 14/26-A2Z and the Cromarty well was 13/30a-6Z.

3.2. Proposed Activities

3.2.1. Schedule

Shell proposes to progress A&C decommissioning activities in line with the indicative schedule shown in Figure 3-1.

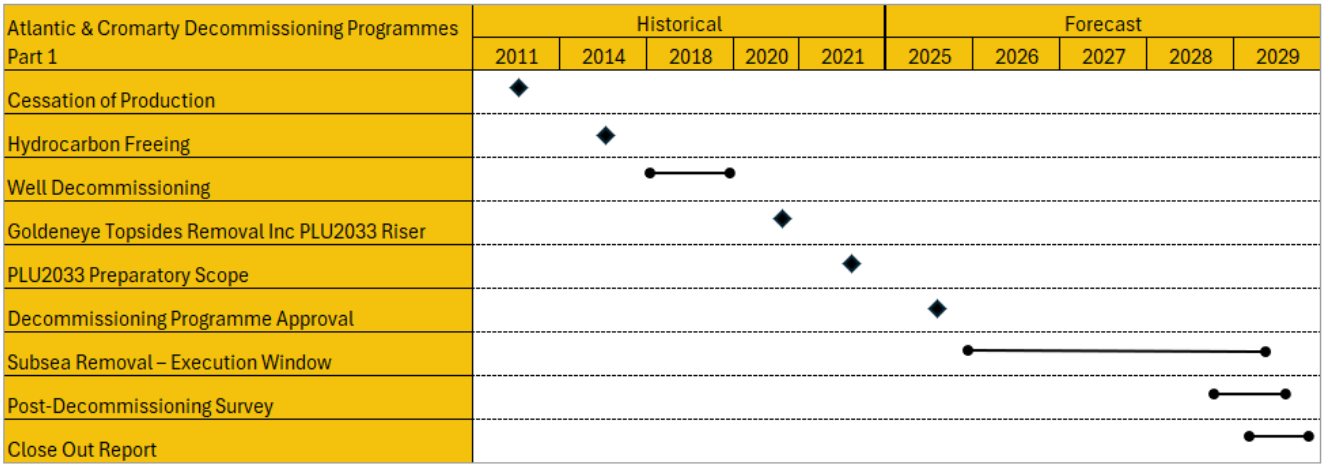

Figure 3-1: Indicative schedule.

3.2.2. Preparatory Activities

All the A&C hydrocarbon and MEG pipelines have been flushed and cleaned. The production pipelines (including jumper spools) are considered hydrocarbon free having been flushed to reach an oil in water content of <30 mg/l. Following flushing the production and MEG pipelines (including jumper spools) were filled with inhibited freshwater containing RX-5227 (corrosion inhibitor, oxygen scavenger and biocide) dosed at 1,000 ppm.

The umbilical cores were filled either with the hydraulic fluid Oceanic HW430 R or a 50:50 MEG/water mix. Note when umbilical PLU2033 was cut in 2018 during the P&A activities the umbilical was left open and therefore the cores are now filled with seawater. This was carried out under approved permits.

Prior to disconnection / recovery activities chemical permit applications will be submitted to OPRED for those discharges which have not already been fully permitted during the preparatory scopes.

3.2.3. Plug and Abandonment

The wells associated with the A&C fields were plugged in compliance with the requirements of the Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 and abandoned in accordance with the latest version of the Oil & Gas UK Guidelines (OGUK, 2018) in 2018.

Any surface infrastructure associated with these wells (Xmas trees, wellheads and protection structures) has already been recovered from the seabed and are therefore excluded from this scope.

3.2.4. Decommissioning of Subsea Installations

The subsea installations detailed in this EA include the Atlantic manifold structure and associated piles, and a piping assembly at the Cromarty well referred to as the Cromarty piping assembly. These structures will be recovered as part of the proposed activities. The following subsections provide a summary description of the structures and the proposed recovery method.

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3.2.4.1. *Atlantic Manifold Structure and Associated Piles*

The manifold structure is piled, weighs *c.* 163.6 te and measures *c.* 17.8 m (L) x 13.7 m (W) x 5.46 m (H). The piles are *c.* 10 te each (four in total) and will be severed from the structure which will be recovered as a single lift. Each of the piles will be cut internally with best endeavours to achieve 3 m below the seabed. Shell are not aware of any evidence that this depth of cut may not be achievable, however any change in this depth will be discussed with OPRED at the time of execution. The piles will subsequently be recovered using separate lifts.

3.2.4.2. *Cromarty Piping Assembly*

The Cromarty piping assembly weighs *c.* 8 te and measures *c.* 7.7 m (L) x 1.5 m (W) x 1.5 m (H). The structure is currently wet stored in close proximity to the abandoned Cromarty well location and it is expected it will be recovered with a single lift.

3.2.5. Decommissioning of Pipelines and Umbilicals

3.2.5.1. *Pipelines and Umbilicals*

Table 3-1 summarises the pipelines, umbilicals and jumpers associated with the A&C fields.

The surface laid jumper spools and control umbilical jumpers will all be recovered to shore for management in line with the waste hierarchy.

A CA was carried out to determine the optimal approach to decommissioning the pipelines (PL2030 and PL2032) and umbilicals (PLU2033 and PLU2034). The CA approach and results are detailed in the CA Report (Genesis, 2025) and summarised in Section 4 of this EA.

Table 3-2 summarises the status of the pipelines and umbilicals in terms of depth of burial and existing rock cover. The table also provides a summary of the CA results showing that multiple options were considered acceptable for each group whilst highlighting the preferred option.

For each group all acceptable options could be carried forward to C&P tendering, with Shell free to select any of the three options based on feedback from the market and potential synergies with other scopes. DESNZ will be informed by Shell on the overall strategy.

Table 3-1: Pipelines and umbilicals associated with the A&C fields.

Pipeline Number (as per PWA)	Description	Length (km)	Product Conveyed	From – To End Points	Burial Status	Current Content
PL2029	16" jumper spool	0.045	Gas /gas condensate	Tie-in flange on Atlantic manifold to pipeline tie-in flange	Surface laid and protected by mattresses and concrete tunnels	Inhibited freshwater
PL2029JAW1	8" jumper spool	0.14		Atlantic well 1 to Atlantic manifold	Surface laid and mattress covered	
PL2029JAW2	8" jumper spool	0.04		Atlantic well 2 to Atlantic manifold		
PL2031	4" jumper spool	0.045	MEG	Tie-in flange on Atlantic manifold to pipeline tie-in flange	Surface laid and protected by mattresses and concrete tunnels	Inhibited freshwater
PL2031JAW1	4" jumper spool	0.14		Atlantic manifold to Atlantic well 1	Surface laid and mattress covered	
PL2031JAW2	4" jumper spool	0.04		Atlantic manifold to Atlantic well 2		
PLU2033	EHC umbilical	31.2*	Power /signal / hydraulics	Goldeneye to Atlantic Manifold	Trenched and buried	Seawater (note the umbilical was initially filled hydraulic fluid Oceanic HW430 R or a 50:50 MEG/water mix (see Section 3.2.2)
PLU2033JAW1	EHC umbilical jumper	0.15		Atlantic Manifold to Atlantic Well 1	Surface laid and mattress covered	
PLU2033JAW2	EHC umbilical jumper	0.04		Atlantic Manifold to Atlantic Well 2	Surface laid and mattress covered	

Pipeline Number (as per PWA)	Description	Length (km)	Product Conveyed	From – To End Points	Burial Status	Current Content
PL2030	12" Infield production pipeline	11.87	Gas	Cromarty well to Atlantic manifold	Trenched and buried with surface laid transitions to structures protected with mattresses and tunnels. Also rock cover in open water section.	Inhibited freshwater
PL2032	4" Infield MEG pipeline	11.87	MEG	Atlantic manifold to Cromarty well	Trenched and buried with surface laid transitions to structures protected with mattresses and tunnels.	Inhibited freshwater
PLU2034	Infield EHC umbilical	11.96	Power /signal / hydraulics	Atlantic Manifold to Cromarty Well		Cores filled with hydraulic fluid Oceanic HW430 R or a 50:50 MEG/water mix
Notes: *In the PWA the full length of PLU2033 is 31.4 km. However, 167 m has previously been recovered at the Goldeneye end.						

Table 3-2: Proposed decommissioning methods for the A&C pipelines and umbilicals.

Pipeline/Umbilical	Proposed Decommissioning Method
Group A PL2030 (11.87 km) and PL2032 (11.87 km)	These rigid piggybacked pipelines are laid between the Atlantic manifold and the Cromarty well and were trenched and mechanically backfilled. They have an average burial depth of 1.32 m depth of cover (DoC). Along the route there is also 4.3 km of rock cover. The existing mattresses and concrete tunnels associated with the lines will be recovered whilst the existing rock cover will be decommissioned *in situ* (detailed in Section 3.2.5.2). Once the mattresses and concrete tunnels are recovered *c.* 760 m of the piggybacked pipelines will remain exposed on the seabed (this includes *c.* 100 m at each end of the lines and *c.* 560 m mid-line that is currently protected with mattresses). The CA identified a number of acceptable decommissioning options for these pipelines: • Option 2a: Decommissioned *in situ* with rock cover added to the exposed end and mid-line sections (most preferred option); • Option 2b: Decommissioned *in situ* with exposed end and mid-line sections trenched and buried; and • Option 2c: Decommissioned *in situ* with exposed end and mid-line sections cut and removed. If following the C&P process, the addition of rock cover (Option 2a) is selected *c.* 2,253 te of rock (includes 10% contingency) would be required to remediate the exposed sections.
Group B PLU2034 (11.97 km) and 18.27 km of buried PLU2033 (DoC >0.6 m)	The PLU2034 EHC umbilical is laid between the Atlantic manifold and Cromarty well, and was trenched and left to naturally backfilled. The umbilical has an average DoC of 0.81 m. Approximately 3.6 km of the line has a DoC of 0.48 m, however the depth of lowering (DoL) is 0.6 m. Along the route there is also *c.* 3,300 te of rock cover. The existing mattresses associated with the EHC umbilical will be recovered whilst the existing rock cover will be decommissioned *in situ* (detailed in Section 3.2.5.2). The adequately buried (DoC >0.6 m) sections of PLU2033 comprises a section from KP0.00 to KP4.527, which is trenched and naturally backfilled (0.89 m average DoC) and which has *c.* 3,115 te of rock cover along the section. The other section is from KP17.5 to KP31.247 and is also trenched and naturally backfilled (0.76 m average DoC). Along this section there is also *c.* 1,582 te of rock cover. The CA identified a number of acceptable decommissioning options for these umbilicals: • Option 2c: Decommissioned *in situ* with exposed sections cut and removed (most preferred option); • Option 2b: Decommissioned *in situ* with exposed sections trenched and buried; • Option 2a: Decommissioned *in situ* with rock cover added to the exposed sections. If following the C&P process, the addition of rock cover (Option 2a) is selected as the remediate *in situ* option, *c.* 921 te of rock (includes 10% contingency) would be required to remediate the exposed sections.

Pipeline/Umbilical	Proposed Decommissioning Method
Group C 12.97 km of exposed PLU2033 (DoC <0.6 m)	This EHC umbilical is laid between the previous Goldeneye platform location and the Atlantic manifold and was trenched and naturally backfilled. The umbilical has an average DoC of 0.44 m. DoC is <0.6 m for the entire 12.97 km section, while DoL ranges between 0.2-0.5 m. Along the route there is also *c.* 1,904 te of rock cover. The existing mattresses associated with the EHC umbilical will be recovered whilst the existing rock cover will be decommissioned *in situ* (detailed in Section 3.2.5.2). The CA concluded that Full Removal by Reverse Reel was the preferred option for the 12.97 km section of PLU2033 that does not meet the target >0.6 m DoC/DoL. Whilst other removal options are technically achievable, the associated durations (with linked implications on safety and the environment) as well as cost increases ruled them out.

Notes:

Should cut and removal of exposed ends be selected, if available preference will be given to backfilling/reprofiling previously excavated material to remediate the exposed cut ends as opposed to adding spot rock cover.

For Group A, the CA ratings across all the remediate *in-situ* options were not significantly different with the trench and bury and the rock cover remediation options both ranking 1st equal (1st =). Both lines were trenched and buried on installation with adequate depth-of-cover not being achieved along some short lengths of the lines, hence the requirement to install mattresses to mitigate upheaval buckling. This highlights the risk to the decommissioning project that re-attempting trench and burial will result in a similar failure to achieve depth-of-cover. The cut and lift remediation option will also require rock placement to ensure the cut ends are adequately buried. The SFF have previously advised that, for safety reasons, it would be advisable to create a "link" between rock berms which are in series along the same pipeline where rock berms were close to one another. Due to the exposures' proximity to one another, the total rock applied for cut and lift remediation is very similar to the rock cover remediation option.

Though not the preferred option Table 3-2 notes that for Groups A and B the CA concluded that the addition of rock to mitigate the exposed sections is acceptable. Should both options involving rock cover be selected during the C&P process it is estimated that *c.* 2,885 te of rock would be laid (*c.* 2,048 te of rock for Group A and *c.* 837 te of rock for Group B). Allowing for a 10% contingency the EA assumes a total of 3,174 te of rock would be required (*c.* 2,253 te of rock for Group A and *c.* 921 te of rock for Group B). A vessel with a specialised chute would be used to position the rock on the seabed. The specific size of the rock/gravel to be laid is not yet know but is likely to range between 1.1 cm and 20 cm. Note this range is taken from a JNCC report that considered rock cover at a number of locations across the North Sea (JNCC, 2017a). Rock will be laid in a 1:3 profile in accordance with industry practice.

3.2.5.2. *Stabilisation Features*

Stabilisation features associated with the A&C fields are summarised in Table 3-3. Shell aim to recover all mattresses, concrete tunnels and 25 kg grout bags and the concrete deflector. At the time of execution should it be found to not be technically feasible to recover any of these items Shell will consult with OPRED before an alternative option is executed.

Table 3-3: Summary of stabilisation features associated with the A&C fields.

Stabilisation Feature	**Quantity of features at each location**			
	Atlantic	**Cromarty**	**Approach to Goldeneye**	**Outwith 500 m zone on the Cromarty production line**
Concrete Tunnel (3 m x 6.31 m x 1.9 m)	9*	3**	-	-
Concrete Tunnel (4.3 m x 6.31 m x 1.9 m)	4*	2**	-	-
Concrete mattresses (6 m x 3 m x 0.3 m)	110*	32**	8*	49** associated with upheaval buckling mitigation (to be recovered) 10** associated with crossings (to be left *in situ*)
25 kg grout bags	600*	645**	40* (covered in rock and to be decommissioned *in situ*)	-
Concrete deflector block (2.4 m (L) x 2.1 m (W) x 2 m (H)	1	-	-	-
Rock cover	11,500 te			

Notes:

*Captured in Table 2.4 of the DP.

**Captured in Table 2.10 of the DP.

Concrete Mattresses, Concrete Tunnels and Concrete Deflector Block

The concrete mattresses, tunnels and deflector block will be recovered to a vessel either using a grab or will be lifted onto recovery frames (steel cargo nets or speed loaders) while subsea, and then lifted to the surface via vessel crane. Should the deflector block or any exposed individual concrete mattresses or tunnels be found to be severely degraded and at risk of disintegrating on removal, baskets may be deployed on the seabed for filling by Remotely Operate Vehicles (ROVs) or divers. If during the offshore campaign it is found that any of the mattresses cannot be recovered, Shell will consult with OPRED before any alternative option is executed. Note that the Scope of Work issued to contractors will highlight the risks associated with mattress removal and will request that appropriate mitigation measures are available.

Grout Bags (25 kg)

The 25 kg grout bags comprise sacks filled with cement grout. Where technically feasible to do so, Shell plan to recover all the grout bags. It is likely these will be placed into baskets for removal to the surface. If during the offshore campaign it is found that any of these 25 kg grout bags cannot be recovered, Shell will consult with OPRED before any alternative option is executed.

Rockcover

All existing rock cover will be decommissioned *in situ*. Surveys to monitor the burial status of the pipelines and umbilical and associated protection materials are discussed in Section 3.3.

3.2.5.3. Third Party Crossings

The third-party crossings associated with the A&C infrastructure are summarised in Table 3-4 and illustrated Figure 3-2. Apart from the Miller to St. Fergus gas pipeline, all crossed third party lines are still active.

Table 3-4: Third party crossings.

Map Reference	A&C line	Third party infrastructure and status	Location (ED50 TM 0 N)	Over/Under	Third party Operator
5	PLU2034	PL2072: 10" Buzzard to Captain Tee gas export pipeline (Active)	58.0402362°N 1.0408721°W	O	CNOOC
7		PL6S: 32" Frigg to St. Fergus 1 South (Active)	58.0447870°N 1.0553918°W	O	North Sea Midstream Partners
6		PL7S: 32" Frigg to St. Fergus 2 South (Active)	58.0451449°N 1.0565142°W	O	GASSCO AS
1	PLU2033	PL720: 30" Miller to St Fergus gas line (Not in use)	58.0054319°N 0.3821197°W	O	bp
2		PL762: 30" Beryl Alpha to St. Fergus SAGE gas export pipeline (Active)	58.0059693°N 0.3827523°W	O	Ancala Midstream
3		PL3036: 14" Golden Eagle to Claymore oil export pipeline (Active)	58.0017527°N 0.8628633°W	U	CNOOC
4	PL2030/ PL2032	PL2072: 10" Buzzard to Captain Tee gas export pipeline (Active)	58.0398728°N 1.0408464°W	O	CNOOC
9		PL6S: 32" Frigg to St. Fergus 1 South (Active)	58.0445077°N 1.0556956°W	O	North Sea Midstream Partners Operations Limited
8		PL7S: 32" Frigg to St. Fergus 2 South (Active)	58.0449018°N 1.0567909°W	O	GASSCO AS

Notes:

O = A&C line passes over the third party.

U = A&C line passes under the third-party line.

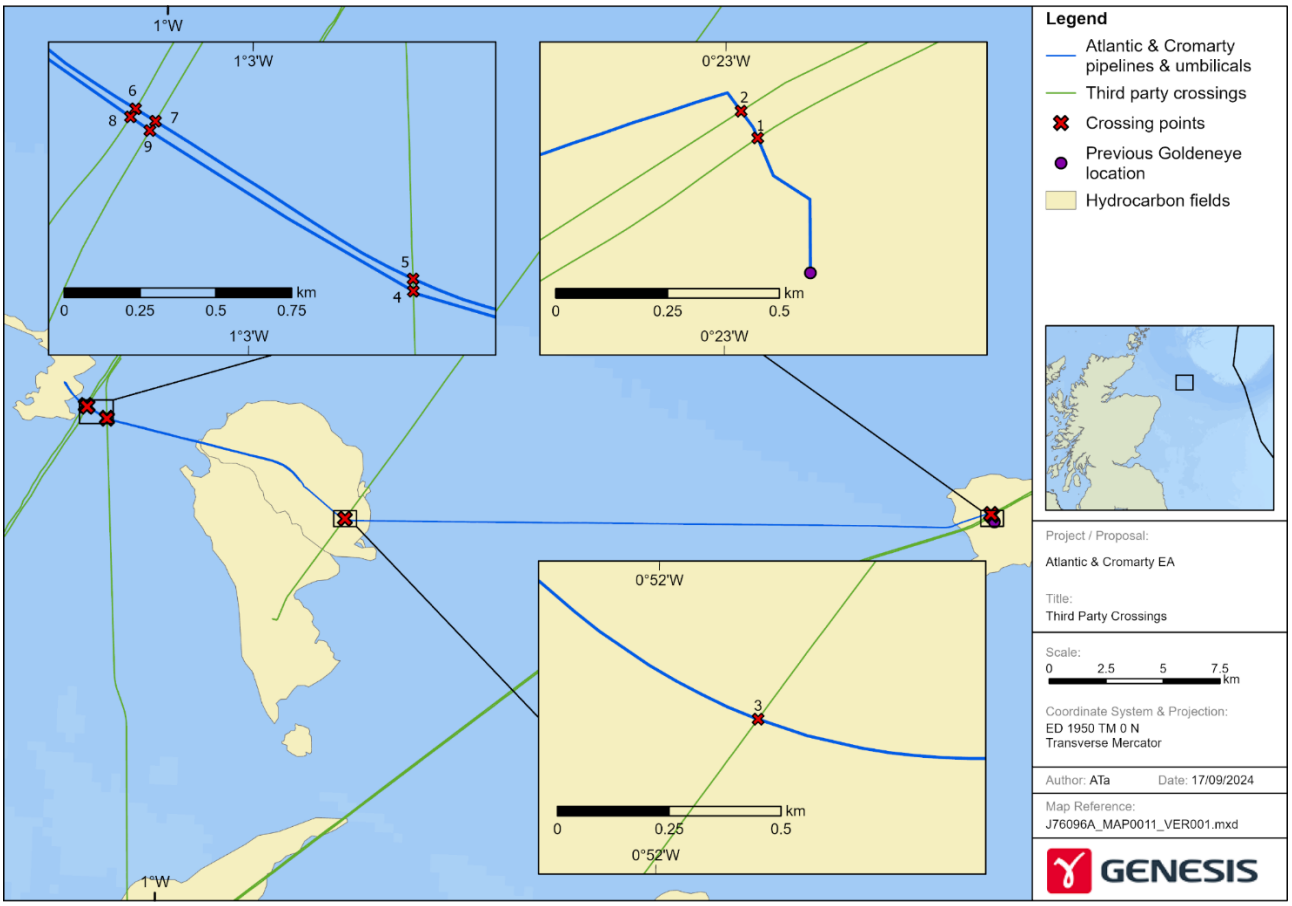

Figure 3-2: Third party crossings.

3.2.6. Cuttings Piles Management

As described in Section 3.1, only limited quantities of WBM contaminated cuttings were discharged, estimated at 398 te in total for all three wells. These deposits are well-dispersed and do not constitute cuttings piles within the definition in OSPAR Recommendation 2006/5. Therefore no specific management measures are required for the dispersed WBM contaminated cuttings.

3.2.7. Vessel Use

A range of specialist and support vessels (Table 3-5) will be required to complete the decommissioning activities. At the time of writing, specific vessels have not yet been identified, however, the types of vessel required are well known and standard performance characteristics for typical vessels have been used for the purposes of estimating energy consumption and emissions to air. By applying the fuel use based on generic vessel types (Institute of Petroleum (IoP) Guidelines, 2000 and industry experience) and the likely duration of the work programme for each vessel, estimates of fuel consumption can be made (Table 3-5).Total fuel use has been provided for the full decommission campaign. The first estimate assumes the preferred option identified in the CA for the decommissioning of the pipelines and umbilicals is used. The second estimate assumes that of the acceptable pipeline and umbilical decommissioning options identified in the CA, the acceptable option with the longest campaign is selected following the P&C process.

Table 3-5: Total anticipated vessel requirements and fuel usage.

Vessel Type	Duration (days)	Fuel Consumption Rate (te/day)	Fuel usage (te)
Vessel use associated with all proposed activities assuming the pipeline and umbilical option identified in the CA as the preferred option is applied			
Survey vessel (mobilisation/demobilisation)	7	1	7
Survey vessel (transit)	5	10	50
Survey vessel (working)	7	5	35
ROVSV (mobilisation/demobilisation)	2	4	8
ROVSV (transit)	1	22	22
ROVSV (working)	1	18	18
Rock dump vessel (mobilisation/demobilisation)	6	2	12
Rock dump vessel (transit)	1.5	10	15
Rock dump vessel (working)	2	15	30
Excavator (mob and demob)	2	4	8
Excavator (transit)	1	26	26
Excavator (working)	6.5	18	117
Reel lay vessels (mob and demob)	2	4	8
Reel lay vessels (transit)	1	26	26
Reel lay vessels (working)	3	18	54
Light Weight Construction Vessel (LWCV) (mob demob)	2	4	8
LWCV (transit)	1	22	22
LWCV (working)	50.5	18	909
		Total fuel use	**1,375**
IoP guidelines do not always have exact equivalent vessel: e.g. for the excavator vessel and reel lay vessel – figures for a multipurpose support vessel were used.			

3.3. Survey and Monitoring Programme

A post decommissioning site survey, along the pipeline and EHC umbilical routes, will be carried out on final completion of all decommissioning works to ensure a safe seabed. In addition a survey will be carried out at the A&C drill centres before surrendering of the 500 m zones. Preference will be given to an approach not impacting on the seabed for example using side scan sonar data to show a safe seabed. However, if deemed necessary by any of the stakeholders, an over trawl trial may be carried out.

A post decommissioning monitoring regime of the pipelines and umbilicals decommissioned *in situ* will be agreed with OPRED. The aim of this survey regime will be to confirm that no further exposures develop and that existing rock berms have maintained their position. The timeline for inspections will be agreed with OPRED.

If deemed necessary, a post decommissioning environmental seabed survey (centred on the sites of the subsea structures and those sections of pipelines and umbilicals where remedial activities are required) will be carried out. The objective of the survey will be to identify any chemical or physical disturbances to the seabed following decommissioning. The survey reports will be submitted to OPRED.

4. Comparative Assessment Summary

4.1. Introduction

OPRED's Guidance Notes on the decommissioning of offshore installations and pipelines (OPRED, 2018) provide for a case-by-case consideration of pipeline decommissioning alternatives on the basis of a CA.

A CA was carried out in line with the Oil & Gas UK (now Offshore Energies UK (OEUK)) Guidelines for CA (OGUK, 2015). The CA Report (Genesis, 2025), submitted in support of the consultation draft DP submission, provides full details of the assessment carried out for the decommissioning of the A&C infield pipelines and EHC umbilicals. This chapter summarises the process followed and the results of the CA.

4.2. Decommissioning Options

In order to facilitate the CA, and as per standard CA method, the A&C pipelines and EHC umbilicals were split into three groups. A number of decommissioning options for each of the groups were considered in the CA. The Groups used in the CA are summarised in Table 4-1.

Table 4-1: Flowline and umbilical groupings used for the CA.

Group ID	Component Type/As-laid Condition	Flowline/Umbilical
A	Rigid piggy-backed pipelines: trenched and mechanically buried.	PL2030/PL2032
B	Flexible EHC umbilicals: trenched and natural backfill with DoC > 0.6 m over full length	PLU2033 & PLU2034
C	Flexible EHC umbilical: trenched and natural backfill with DoC not > 0.6 m over full length	PLU2033

Prior to the CA each of the groupings were assessed against the decommissioning options listed in Table 4-2. The notes associated with the table describe why particular total removal options were selected to be carried through to the CA.

Table 4-2: Decommissioning options to be considered in the CA.

Group ID	1. Total Removal by:			2. Remediate in-situ with Exposed Sections:[3]		
	a) Reverse Reeling	b) Reverse S-lay	c) Cut and Lift	a) Rock Covered	b) Trench and Buried	c) Cut and Removed
A	✗ Screened Out[1]	✗ Screened Out[1]	✓	✓	✓	✓
B	✓	✗ Screened Out[1]	✗ Screened Out[1]	✓	✓	✓
C	✓[2]	✗ Screened Out[1]	✗ Screened Out[1]	✗ Screened Out	✗ Screened Out	N/A

Notes:

[1] Only the best/most compelling full removal option was carried through from screening to the CA. For Group A - with rigid buried piggybacked pipelines, the technical uncertainty ruled out options 1a and 1b. For Groups B and C, whilst all options are technically achievable, the associated durations (with linked implications on safety and the environment) as well as cost increases ruled out options 1b and 1c.

[2] Screening concluded that Full Removal by Reverse Reel was the preferred option for the 12.97 km section of PLU2033 that does not meet the target >0.6 m DoC.

3 Options 2a, 2b and 2c refer to mitigation of exposed ends and mid-line sections.

4.3. Comparative Assessment Approach and Results

Within each Group, scoring of the decommissioning options in the CA was carried out against safety, environment, technical feasibility, societal impacts, and economics. Within each of these criteria a number of sub-criteria were considered.

The CA identified a preferred decommissioning option for each grouping whilst also identifying a number of acceptable options. Results of the CA are provided in Table 4-3. Justification for the results is provided in the CA Report (Genesis, 2025).

If the C&P tendering phase or findings from the as found survey results in the preferred option not being selected Shell will inform DESNZ before a decision is taken on the overall strategy.

Table 4-3: Results of the CA showing preferred decommissioning option and acceptable options identified.

Most Preferred Decommissioning Option	Acceptable Options[1]
Group A: PL2030 and PL2032– Rigid piggy-backed pipelines: trenched and mechanically buried	
Option 2a Remediate *in situ* with Exposed Sections Rock Covered	**Option 2b** Remediate *in situ* with Exposed Sections Trenched and Buried **Option 2c** Remediate *in situ* with Exposed Sections Cut & Removed
Group B: PLU2034 and PLU2033– Flexible EHC umbilicals: trenched and natural backfill with DoC ≥ 0.6 m	
Option 2c Remediate *in situ* with Exposed Sections Cut & Removed	**Option 2b** Remediate *in situ* with Exposed Sections Trenched and Buried **Option 2a** Remediate *in situ* with Exposed Sections Rock Covered
Group C: PLU2033– Flexible EHC umbilical: trenched and natural backfill with DoC <0.6 m	
Option 1a Total Removal by Reverse Reel[2]	No other options are considered acceptable.

Notes:
[1] Options that had no 'showstoppers' identified against them in the CA and are therefore deemed 'acceptable' alternatives.
[2] Screening concluded that Full Removal by Reverse Reel was the preferred option for the 12.97 km section of PLU2033 that does not meet the target >0.6m depth of cover (DoC).

5. Environmental Baseline

5.1. Introduction

This section describes the environment and the environmental receptors in the vicinity of the A&C fields and has been prepared with reference to available literature and the results from environmental surveys carried out across the fields between 2009 and 2022 (Table 5-1).

5.2. Environmental Surveys

The surveys carried, out in the A&C area, involved collection and analysis of a combination of geophysical and acoustic datasets, physical seabed samples and high-definition seabed imagery. Samples were collected to assess the existing environmental conditions by establishing the physical, biological and chemical parameters and identifying and quantifying any species or habitats of conservation importance.

Additionally, Shell commissioned a gap analysis of the existing survey data in the vicinity of the A&C fields (Genesis, 2024). The gap analysis assessed surveys from 2009-2022 (Table 5-1; Figure 5-1) and concluded that the sediment and faunal characteristics in the A&C area were stable and comparable across the surveys. The gap analysis was presented to OPRED, and it was subsequently accepted that no new environmental surveys were required to support the environmental assessment of the proposed decommissioning activities.

Table 5-1: Environmental surveys carried out across the A&C area.

Survey Dates	Report	Report Reference
Nov – Dec 2009	Environmental Survey UKCS Block 14/29 & 20/4 Goldeneye Field Environmental Survey Report	Fugro, 2010
Feb 2007 – March 2009	Regional Mapping Project Over Golden Eagle, Blackbird, Ettrick and Buzzard Fields. Environmental Baseline Report. Survey carried out in different phases.	Gardline, 2010
June – July 2011	Rig Site Survey UKCS Block 20/02. Proposed Location 20/02 Ettrick	Fugro, 2011a
June – July 2011	Rig Site Survey UKCS Block 20/02. Proposed Location 20/02 Blackbird	Fugro, 2011b
July – Aug 2011	Rig Site Survey UKCS Block 20/02. 20/02 Panda Bear Site Survey	Fugro, 2011c
Nov 2011 – Jan 2012	Environmental Habitat Assessment Survey Revised Buzzard Site Survey (20/1)	Benthic Solutions Ltd & Calesurvey, 2012
Sept – Oct 2012	Ettrick Site Survey UKCS Blocks 20/2a & 20/3a Results Report	Benthic Solutions Ltd & Calesurvey, 2013
	Ettrick UKCS Block 20/2a & 20/3a Habitat Assessment Survey Report	

Doc. no. ACDP-EGEN-S-HX-7180-00004

Survey Dates	Report	Report Reference
June 2013	Geophysical and Environmental Site Survey UKCS Blocks 20/2, 20/3, 20/7 & 20/8. Proposed Blackbird PB2 Location.	Fugro, 2013a
July 2013	Rig Site Survey Buzzard UKCS Blocks 19/5, 19/10, 20/1 & 20/6. Regional Environmental Survey	Fugro, 2013b
May – June 2014	Geophysical and Environmental Site Survey UKCS Blocks 20/1 & 20/6A. DC2 Option 1 Buzzard	Fugro, 2014
	Geophysical and Environmental Site Survey UKCS Blocks 20/1 & 20/6A. DC2 Option 2 Buzzard	
	Rig Site Survey Buzzard UKCS Blocks 20/1 & 20/6 DC Option 1 and 2. Regional Environmental Survey	
Aug – Sept 2015	Atlantic & Cromarty Fields Pre-Decommissioning Survey Habitat Assessment	Fugro, 2016
	Atlantic & Cromarty Fields Pre-Decommissioning Survey Environmental Baseline Survey	
	Atlantic & Cromarty Fields Pre-Decommissioning Survey Atlantic to Cromarty Route Survey UKCS 13/30a & 14/26a	
	Atlantic & Cromarty Fields Pre-Decommissioning Survey Atlantic to Goldeneye Control Umbilical Route Survey UKCS Blocks 14/26, 14/27, 14/28 & 14/29	
June – July 2021	Greater Buchan Area Development. Gas Route 06a_Buchan - Direct to Ettrick Pipeline End Manifold. Environmental Baseline Survey Report.	Benthic Solutions Ltd, 2021
Aug – Sept 2021	EOGG2037 Golden Eagle NDC Debris Clearance Site Survey Environmental Baseline Report	Gardline, 2022a
	EOGG2037 Golden Eagle NDC Debris Clearance Site Survey Environmental Habitat Assessment Report	
Aug 2022	Goldeneye Post-Decommissioning Environmental Survey Environmental Baseline Report	Gardline, 2022b
	Goldeneye Post-Decommissioning Environmental Survey Habitat Assessment	

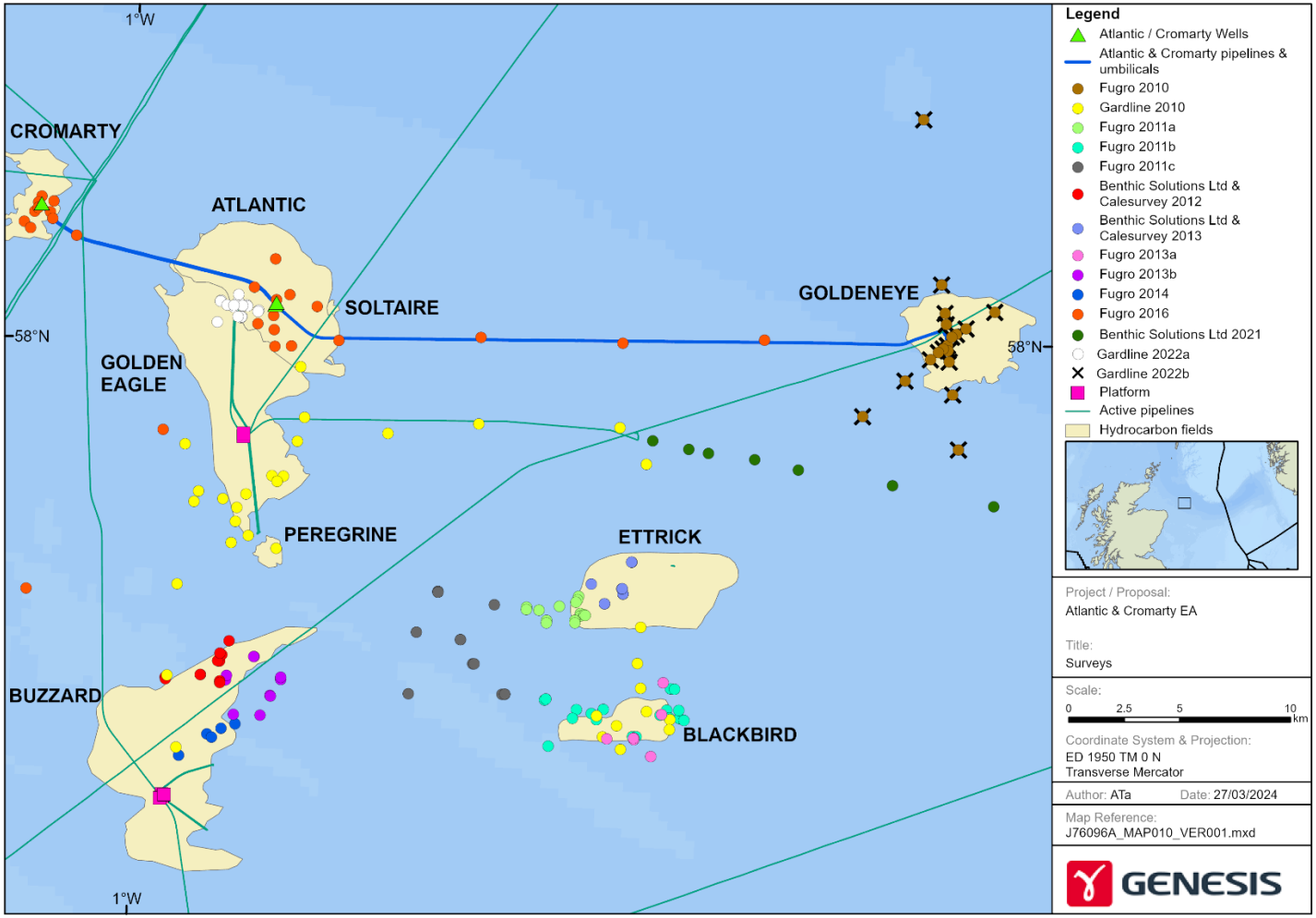

Figure 5-1: Surveys assessed during the A&C gap analysis (Genesis, 2024).

5.3. Metocean Conditions

Metocean (meteorological and oceanographic) conditions including bathymetry, currents, tides and circulation patterns all influence the type and distribution of marine life and the behaviour of emissions and discharges from offshore facilities. For example, the speed and direction of water currents have a direct effect on the transport, dispersion, and ultimate fate of any discharges from a vessel or installation.

5.3.1. Bathymetry

The A&C Field lies in water depths of between 113.6 m and 115.4 m LAT (Lowest Astronomical Tide) with an average gradient of <1° whilst the Cromarty Field lies in water depths of 105 m to 116.4 m LAT with an average gradient of <1°. Along the Atlantic to Goldeneye umbilical (PLU2033) survey corridor water depths ranged from 125.2 m LAT at the platform to 98 m LAT at the manifold (Fugro 2015a, Fugro 2015b).

5.3.2. Hydrology

Water masses, and local current speeds and direction all influence the transport, dispersion, and fate of marine discharges. The major water masses in the North Sea can be classified as Atlantic water, Scottish coastal water, northern North Sea water, Norwegian water, CNS water, southern North Sea water, Jutland water and Channel water (Turrell *et al.*, 1992).

The A&C field is located in the area influenced by the northern Atlantic water mass. The predominant regional current in the CNS originates from the vertically well-mixed coastal water and Atlantic water inflow of the Fair Isle / Dooley current, which flows around the north of the Orkney Islands and into the North Sea (Figure 5-2).

Residual water currents of up to 0.05 m/s occur in the A&C field area and are predominantly driven by the Fair Isle Current and the Dooley Current moving in an anticlockwise direction (Marine Scotland, 2020) (Figure 5-2).

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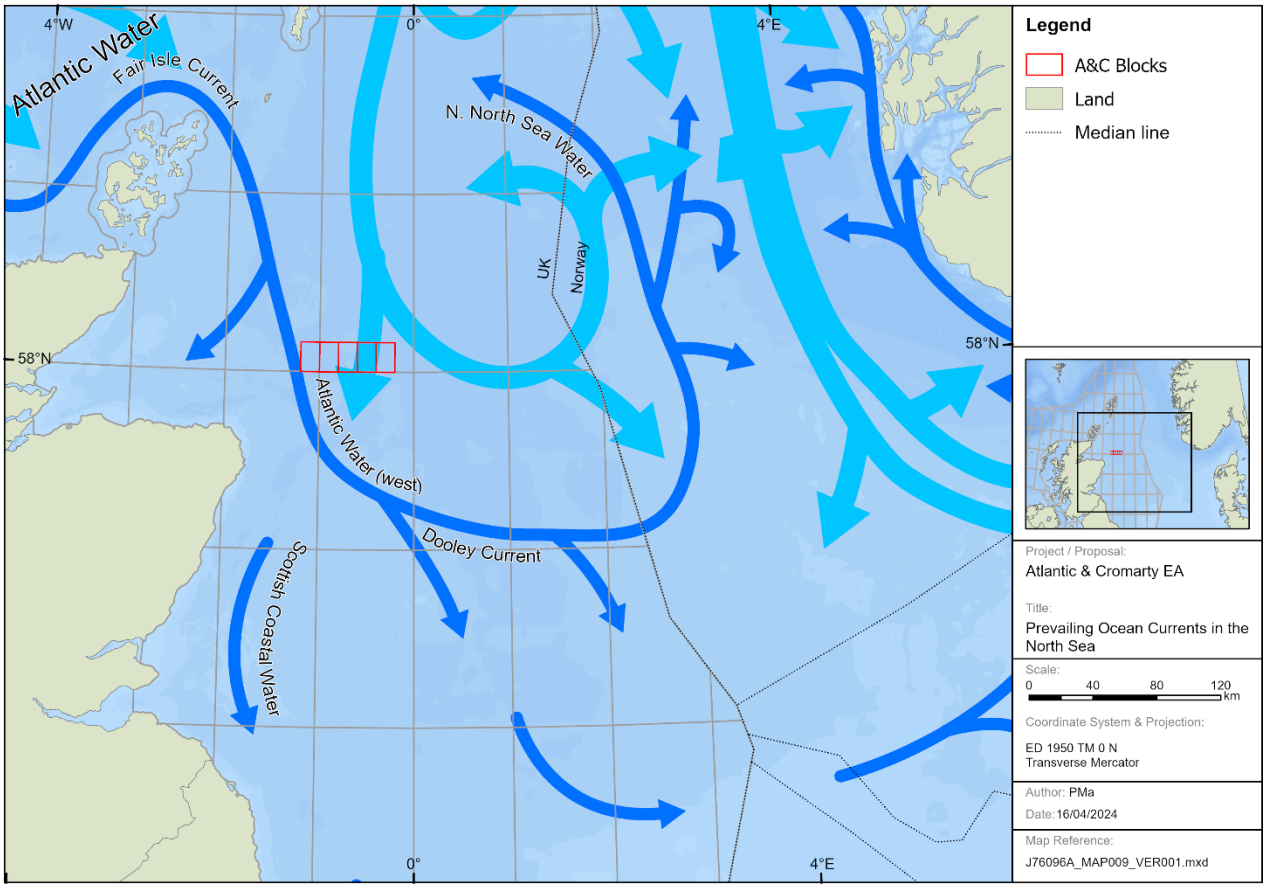

Figure 5-2: General circulation in the North Sea (Turrell *et al.*, 1992).

5.3.3. Meteorology

Wind speed and direction directly influence the transport and dispersion of atmospheric emissions. These factors are also important for the dispersion of water borne emissions, including oil, by affecting the movement, direction and break up of substances on the sea surface. Mean wind speed in the area is 8.6 m/s and winds in the area originate from all directions though primarily from the north and southeast as can be seen in Figure 5-3 (Saha *et al.*, 2010).

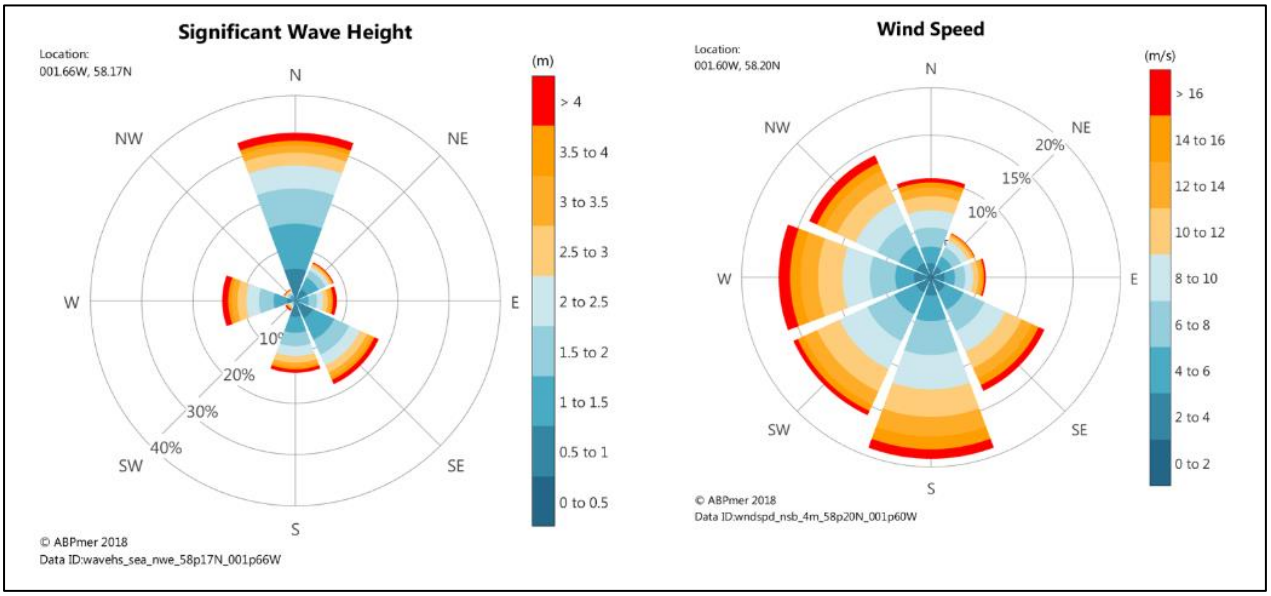

Figure 5-3: Wave height and wind speed within the A&C area (Saha *et al.*, 2010; ABPmer, 2013).

5.3.4. Sea Temperature and Salinity

Sea surface temperature and salinity in the area are governed by the flow of oceanic Atlantic waters into the North Sea through the Fair Isle Channel (Turrell *et al.*, 1992). According to data collected between 1971 and 2000, the annual mean water temperature at the seabed in the A&C area is between 8°C and 9°C (Berx and Hughes, 2009).

Salinity data collected between 1971 and 2000 show little variation through the water column with annual mean salinity near the seabed and in surface waters of 35 ‰ (Berx & Hughes, 2009).

Most years, density stratification in the central and northern North Sea is well developed during the summer months, with the relative strength of the thermocline determined by solar heat input and turbulence generated by wind and tides. The area of the CNS in which the Montrose platforms are located is stratified in the summer. This stratification starts to break down in the autumn with the water being well mixed during the winter and becoming weakly stratified again in the spring (DESNZ, 2022).

Fluctuations in salinity are largely caused by the addition or removal of fresh water to / from the sea through natural processes. The salinity of seawater around an installation has a direct influence on the initial dilution of aqueous effluents. As salinity decreases the solubility of effluents generally increases. Salinity of surface waters in the A&C area varies between 35.1 ‰ to 35.2 ‰ in winter months and between 35.0 ‰ and 35.2 ‰ in summer months (BODC, 1998).

Over the past 30 years, sea temperature around the UK has been increasing. The pace of warming is highest to the north of Scotland and over much of the North Sea, rising at up to 0.24 °C per decade. Plankton and fish communities are already changing in response to warming, as discussed in Section 5.5. Warming of UKCS waters is projected to continue at a rate of 0.25 °C to 0.4 °C per decade over the next century (DESNZ, 2022).

5.4. Seabed Sediments

The seabed sediments around the A&C area are shown in Figure 5-4 (EMODnet, 2023a). The sediments around the A&C wells and relevant pipeline and umbilicals predominantly comprise of the Marine Strategy Framework Directive (MSFD) broad habitat type 'Offshore circalittoral mud', with just a short section of the PLU2033 passing through an area of 'Offshore circalittoral sand'.

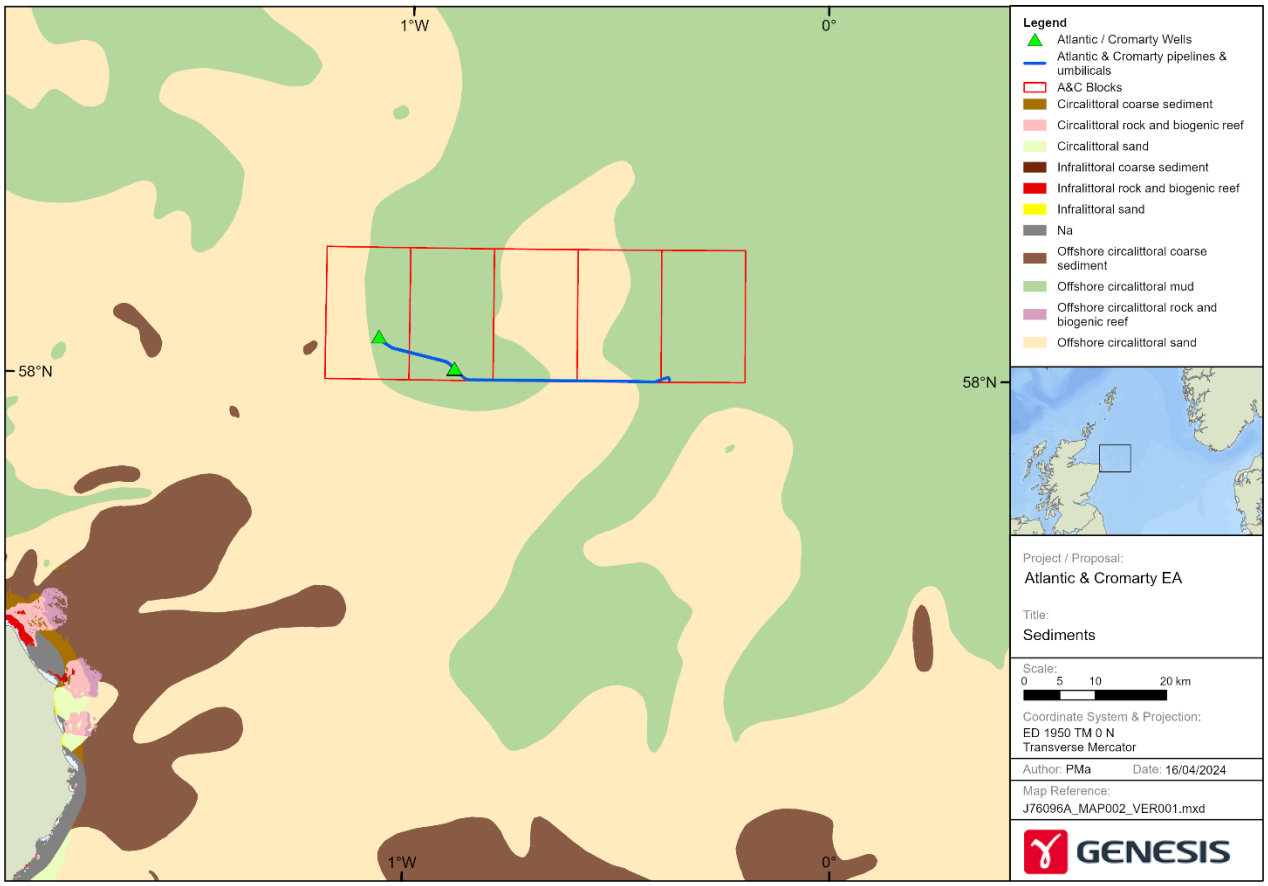

Figure 5-4: Modelled distribution of seabed sediments in the vicinity of Blocks 14/27, 14/26, 13/30, 14/28 and 14/29 (EMODnet, 2023a).

5.4.1. Particle Size Distribution

Particle size analysis conducted by Gardline (2022a) in the vicinity of the Atlantic manifold and wells supported geophysical interpretation and observation from seabed imagery and recovered sediment samples and presented a homogenous muddy sediment type. Mean particle diameter ranged from 47-63 µm, which is described as coarse silt under Wentworth (1922). However, sand was the dominant sediments fraction across all samples, accounting for 62-70% of sediment.

Sediments around the Cromarty well were predominantly classified as very fine sand but with some areas of fine sand also. Along PLU2033 sediments were mainly classified as fine sand, with one station classified as very fine sand and another as coarse silt. The mean sediment particle size ranged from 71.4-238 µm in the area around the Cromarty well and between 60.1-223.6 µm along PLU2033

towards Goldeneye (Fugro, 2016). Sand was the dominant sediment fraction at Cromarty and along PLU2033 at 79.9 ± 6% and 79.6 ± 9% respectively.

Post-decommissioning surveys at Goldeneye classified all particles as poorly sorted very fine sand under Wentworth (1922), ranging between 35-62 μm and presenting a relatively homogenous muddy sand sediment (Gardline, 2022b). Sand dominated the sediment fraction accounting for 43.4-66.5%.

5.4.2. Sediment Hydrocarbons

5.4.2.1. Total Hydrocarbon Concentrations

Across Gardline (2022a) sediments samples taken around the Atlantic manifold and wells the total hydrocarbon (THC) concentration ranged from 8.0 to 11.6 μg g^{-1}, with a mean of 9.6 μg g^{-1}. THC at Cromarty was found to range between 1.4 and 3.0 μg g^{-1} while the route along PLU2033 ranged between 1.5 and 1.9 μg g^{-1} (Fugro, 2016). Gardline (2022b) reported that the THC at Goldeneye ranged between 7.1 μg g^{-1} and 11.9 μg g^{-1}, with a mean of 9.3 μg g^{-1}.

To put these results into wider context, UKOOA (2001) reported a mean THC concentration of 9.51 μg $g^{-1}$and a 95th percentile of 40.1 μg g^{-1} for CNS stations over 5 km from existing infrastructure between 1975 and 1995. Sediment THC was therefore considerably lower than the UKOOA (2001) mean at Cromarty and along PLU2033, however was very similar to this value at Atlantic and Goldeneye. All areas were well below the UKOOA (2001) 95th percentile of 40.1 μg g^{-1}.

5.4.2.2. Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbon (PAH) concentrations ranged between 0.084 μg g^{-1} and 0.160 μg g^{-1} at the Atlantic area, between 0.042 μg g^{-1} and 0.105 μg g^{-1} at Cromarty, between 0.041 μg g^{-1} and 0.068 μg g^{-1} along PLU2033 and between 0.147 μg g^{-1} and 0.723 μg g^{-1} at Goldeneye (Fugro, 2016; Gardline 2022a; Gardline, 2022b). All PAH concentrations throughout the A&C area were therefore below the UKOOA (2001) mean of 0.287 μg g^{-1} apart from the one station at Goldeneye with a concentration of 0.723 μg g^{-1}.

5.4.3. Heavy Metals

Barium (Ba) can be an important element in the detection of localised anthropogenic sediment pollution. It is often used in the form of barite as a weighing agent in drilling fluids. Barite is predominantly insoluble in oxic seawater, although may be mobilised under anoxic conditions and can therefore provide a useful indication of drilling mud dispersion since discharge.

Concentrations of Ba following hydrofluoric acid digest ranged from 354 μg g^{-1} to 1,090 μg g^{-1}, in the Atlantic area, with a mean concentration of 528 μg g^{-1} (Gardline, 2022a). It was also reported that cadmium (Cd) and tin (Sn) were below the limit of detection at all stations, while mercury (Hg) was below at three stations. All concentrations were below their respective estimated range low (ERL) thresholds (Long *et al.*, 1995) and apparent effects thresholds (AETs) (Buchman, 2008). Sediment samples from Fugro (2016) spanned across the Atlantic and Cromarty fields as well as along PLU2033. Analysis of mean metal concentrations (normalised to 5% aluminium) across this area revealed that all metals were below their ERL thresholds. Similarly, Gardline (2022b) found that all metal concentrations around Goldeneye were below their respective ERL thresholds.

5.5. Biological Environment

The A&C area occurs in the Offshore Energy Strategic Environmental Assessment 4 (OESEA 4) Regional Sea 1 which, since a plankton regime shift in the late 1980s, is considered to be a temperate province. Plankton in this area generally comprise Atlantic and offshore species. Dinoflagellates typically comprise a greater proportion of the phytoplankton community than diatoms from June to October, when waters are most stratified. The spring bloom in this region is stronger, relative to the autumn bloom, than elsewhere. Harmful algal blooms observed in the region include the diatom *Pseudonitzschia*, a cause of amnesic shellfish poisoning, and the dinoflagellate *Alexandrium tamarense* (DESNZ, 2022).

The richness and seasonal variability of zooplankton species is higher in Regional Sea 1 than further south. The zooplankton community is dominated by calanoid copepods such as the cold-water copepod *Calanus finmarchicus* and the temperate copepod *Calanus helgolandicus*. Between 1960 and 2015, *C. finmarchicus* abundance declined significantly in Regional Sea 1, whilst *C. helgolandicus* increased. Other important components of the zooplankton assemblage include *Paracalanus*, *Pseudocalanus* and larval stages of *Calanus*, *euphausiids*, *Acartia*, and decapods (DESNZ, 2022).

Rising sea surface temperature has resulted in migration of warmer water species and an increase in the diversity of zooplankton in UK waters. During the 21st century, non-native plankton species such as *Mnemiopsis leidyi* and *Sargassum muticum* have been recorded in UK waters, whilst a number of warm water *Tripos* species were recorded 40-100 miles off the coast of north-west Scotland in 2009, the furthest north these species have ever been recorded. Mechanisms including ships' ballast water and aquaculture are recognised as potential sources for the introduction of non-native and potentially harmful organisms. Species including the Indo-Pacific diatoms *Odontella sinensis* and *Coscinodiscus wailesii*; and the east-Asian copepod *Pseudodiaptomus marinus*, have been recorded in northern European and UK waters (DESNZ, 2022).

5.5.1. Habitat Type and Benthic Communities

5.5.1.1. Habitat Type

Both Gardline (2022a) and Fugro (2016) survey areas comprised the broad habitat 'Sublittoral sediment' (A5). Seabed photography and grab samples also revealed the presence of similar biotopes between the two surveys. Gardline (2022a) areas were characterised by the biotope 'Circalittoral fine mud' (A5.36), while Fugro (2016) areas were characterised by 'Circalittoral muddy sand' (A5.26). Both survey areas also consisted of extensive areas of muddy sands with shell fragments and bioturbation. Further to this, surveys used to support the 2003 A&C Environmental Statement (ES) identified dense silty fine sand and fine muddy silty sand at the Atlantic and Cromarty fields respectively (DSND, 1999; Fugro, 2001).

5.5.1.2. Benthic Communities

Bacteria, plants, and animals living on or within the seabed sediments are collectively referred to as benthos. Species living on top of the sea floor may be sessile (e.g., seaweeds) or freely moving (e.g., starfish) and collectively are referred to as epibenthic or epifaunal organisms. Animals living within

the sediment (e.g., clams, tubeworms, and burrowing crabs) are termed infaunal species. Semi-infaunal animals, including sea pens and some bivalves, lie partially buried in the seabed. The majority of marine benthic invertebrates exhibit a life cycle that includes a planktonic larval phase from which the bottom dwelling juvenile and adult phases recruit.

Benthic animals display a variety of feeding methods. Suspension and filter feeders capture particles which are suspended in the water column (e.g., sea pens) or transported by the current (e.g., mussels). Deposit feeders (e.g., sea cucumbers) ingest sediment and digest the organic material contained within it. Benthic species can be herbivorous (e.g., sea urchins), carnivorous (e.g., crabs) or omnivorous (e.g., nematodes). Benthic communities show a strong correlation with habitat type, with depth mainly influencing epifauna, and sediment characteristics typically influencing the infauna (Basford *et al.*, 1990). Benthic communities in deeper soft sediment habitats tend to be spatially distributed over large scales, with distinctive species assemblages associated with particular substrate types. However, depending on the intensity and spatial extent of sampling, localised community types or subtler variations may be distinguished, often associated with topographic features (DESNZ, 2022).

Activities that result in the disruption of the seabed, such as the proposed decommissioning activities, can affect the benthic fauna (Clark, 1996). The recognition that aquatic contaminants may alter benthic fauna, together with the relative ease of obtaining quantitative samples from specific locations, has led to the widespread use of infaunal communities in monitoring the long-term impact of disturbance to the marine environment. The species composition and relative abundance in a particular location provides a reflection of the immediate environment, both current and historic (Clark, 1996). Sessile infaunal species are particularly vulnerable to external influences that may alter the physical, chemical or biological community of the sediment as they are unable to avoid unfavourable conditions. Each species has its own response and degree of adaptability to changes in the physical and chemical environment.

The most abundant taxonomic group throughout the A&C area has consistently been annelids, accounting for 51% of individuals identified by Gardline (2022a), 52% by Fugro (2010) and 63% by Gardline (2010). Mollusca was the second most abundant taxonomic group, identified by Gardline (2022a), accounting for 24% of adult individuals and 20% taxa. This was followed by Arthropoda, with 15% of adult individuals and 26% of taxa, indicating this taxonomic group was relatively diverse.

The polychaete *Diplocirrus glaucus* was the most abundant taxon in the 2021 survey by Gardline (2022a) and also ranked within the top ten taxa in the Gardline (2010) comparison survey. This polychaete has been found to be tolerant of habitats which have increased nutrients and/or that have been contaminated by hydrocarbons (Hiscock *et al.*, 2004; Gomez Gesteira & Dauvin, 2005). However, this species has also been found to be intolerant of both physical disturbance and increased copper concentrations (Hiscock *et al.*, 2005).

5.5.2. Fish and Shellfish

At present more than 330 fish species are thought to inhabit the shelf seas of the UKCS (Pinnegar *et al.*, 2010). Pelagic species (e.g. herring (*Clupea clupea*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*) and sprat (*Sprattus sprattus*) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g. cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), sandeels (*Ammodytes* sp.), sole (*Solea solea*) and whiting (*Merlangius merlangus*)

live on or near the seabed and, similar to pelagic species, many are known to passively move (e.g. drifting eggs and larvae) and / or actively migrate (e.g. juveniles and adults) between areas during their lifecycle.

Fish occupying areas in close proximity to offshore oil and gas installations will be exposed to aqueous discharges and may accumulate hydrocarbons and other contaminating chemicals in their body tissues. The most vulnerable stages of the life cycle of fish to general disturbances such as disruption to sediments and oil pollution are the egg and larval stages, hence recognition of spawning and nursery grounds within a development area is important. It should be noted that spawning and nursery areas tend to be transient and therefore cannot be defined with absolute accuracy.

Several fish species use the area as nursery and / or spawning grounds at different times of the year. Table 5-2 shows approximate spawning and nursery times of the fish species occurring in or near the A&C area. Fish species found within the North Sea tend to be widely distributed with large, widely scattered spawning and nursery grounds.

Of the fish species identified in the area, anglerfish, blue whiting, cod, herring, ling, mackerel, Norway pout, sandeel, spurdog (spiny dogfish), and whiting have been assessed by NatureScot and JNCC as Priority Marine Features (PMFs) in Scotland (Tyler-Walters *et al.*, 2016).

Table 5-2: Spawning activity and nursery areas within the blocks.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish[1]	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Blue whiting	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Cod	SNJ	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Haddock	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Herring	NJ	NJ	NJ	NJ	NJ	NJ	NJ	SNJ	SNJ	SNJ	NJ	NJ
Lemon sole	N	N	N	SN	SN	SN	SN	SN	SN	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Nephrops	SN	SN	SN	S*N	S*N	S*N	SN	SN	SN	SN	SN	SN
Norway pout [2]	SNJ	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Plaice	S*J	S*J	SJ	J	J	J	J	J	J	J	J	SJ
Sandeel	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Spotted ray	N	N	N	N	S*N	S*N	S*N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting[1]	NJ	SNJ	SNJ	SNJ	SNJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ

Key: S = Spawning; S* = Peak Spawning; N = Nursery; J = Juveniles (i.e. 0 group fish)

[1] High intensity nursery.

[2] High intensity spawning.

References: Coull *et al.* 1998; Ellis *et al.* 2012; Aires *et al.* 2014.

5.5.3. Marine Mammals

5.5.3.1. Cetaceans

Cetaceans regularly recorded in the North Sea include harbour porpoise, white-beaked dolphin, minke whale, Atlantic white-sided dolphin, bottlenose dolphin (primarily in inshore waters) and killer whale (Reid *et al.*, 2003). Risso's dolphin and large baleen whales are also occasionally sighted. Spatially and temporally, the harbour porpoise, white-beaked dolphin and minke whale are the most regularly sighted cetacean species in the North Sea. Table 5-3 shows that Atlantic white-sided dolphin, harbour porpoise, minke whale, killer whale and white-beaked dolphin may be present in the A&C area.

Table 5-3: Marine mammal seasonal abundance in the vicinity of A&C (Reid *et al.*, 2003).

Species	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Killer whale	3	3	3								3	3
Atlantic white-sided dolphin							3					
Harbour porpoise		3			3	3	2	2	3			
Minke whale	3	3	3	3	2	2	2	2			3	3
White-beaked dolphin	3	2				3	3	3	3	3		3
Key: 1 = High Density, 2 = Moderate Density, 3 = Low Density, Blank = No Data												
Sources: Reid *et al.*, 2003.												

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys were conducted to obtain an estimate of cetacean abundance in North Sea and adjacent waters, the most recent of which is SCANS-IV (Gilles *et al.*, 2023).

The A&C field is located within SCANS-IV Blocks 'NS-D' and 'NS-E'. Aerial survey estimates of animal abundance and densities (animals per km^2) within this area are provided in Table 5-4. These data show that minke whale and Risso's dolphin occurs in low densities while fin whales may occur at very low densities. Harbour porpoise and white-beaked dolphin occur more frequently.

The JNCC has also published the 'regional' population estimates for the seven most common species of cetacean occurring in UK waters (IAMMWG, 2022). Divided into Management Units (MU), these provide an indication of the spatial scale and the relevant populations at which potential impacts should be assessed. The relevant MU population estimates are also presented in Table 5-4. Note that the SCANS-IV survey excluded killer whales. Although, Atlantic white-sided dolphin was identified by Reid *et al.* (2003), there was insufficient data to produce modelled surface densities of these species during the SCANS-IV survey.

Table 5-4: Cetacean Abundance in SCANS-IV Survey Blocks 'NS-D' and 'NS-E'.

Species	Animal Abundance[1] Block NS-D	Density (animals/km²) Block NS-D	Animal Abundance[1] Block NS-E	Density (animals/km²) Block NS-E	MU Population[2]
Harbour Porpoise	38,577	0.5985	33,735	0.5156	346,601
Risso's dolphin	-	-	4,589	0.0702	12,262
Minke whale	2,702	0.0419	795	0.0121	20,118
White-beaked dolphin	5,149	0.0799	11,611	0.1775	43,951
White-sided dolphin	-	-	958	0.0146	18,128
Fin Whale	57	0.0009	-	-	-
Sources: [1] Gilles *et al.* (2023) [2] IAMMWG (2022).					

5.5.3.2. Pinnipeds

Two species of seal are resident in British waters: the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Although both species are Annex II species, they are not listed on Annex IV of the EU Habitats Directive, and as such are not classified as European Protected Species (EPS). Seals are protected in the UK under the Conservation of Seals Act 1970, and both species are considered Scottish PMFs.

Both grey seals and harbour (also called common) seals tend to frequent inshore waters but have been seen offshore from a number of platforms in the North Sea (Cosgrove, 1996).

During a study by Carter *et al* (2022) grey (n = 114: 45 male, 69 female) and harbour seals (n = 239: 107 male, 132 female) were tagged at 26 sites in the UK and Ireland between (2005 – 2019). Haulout counts were scaled to total population size for UK and Ireland using the mean estimated proportion of the population hauled-out during the survey window (and thus available to count). Total population size was then scaled to at-sea population size using the mean estimated proportion of time seals spend at-sea based off the telemetry data gathered during the study period.

Telemetry data were analysed at a 5 km² cell resolution, enabling the percentage of the at-sea population for the UK and Ireland (i.e. excluding hauled-out animals) present in each cell at any one time to be estimated. The resulting distribution maps indicate that harbour seals are unlikely to occur in the project area, though to the west of Block 13/30 > 0 ≤ 0.001% of UK and Ireland at-sea population. Grey seal could be present in the area at > 0.001 ≤ 0.005% of UK and Ireland at-sea seal population (Carter *et al.*, 2022; Figure 5-5).

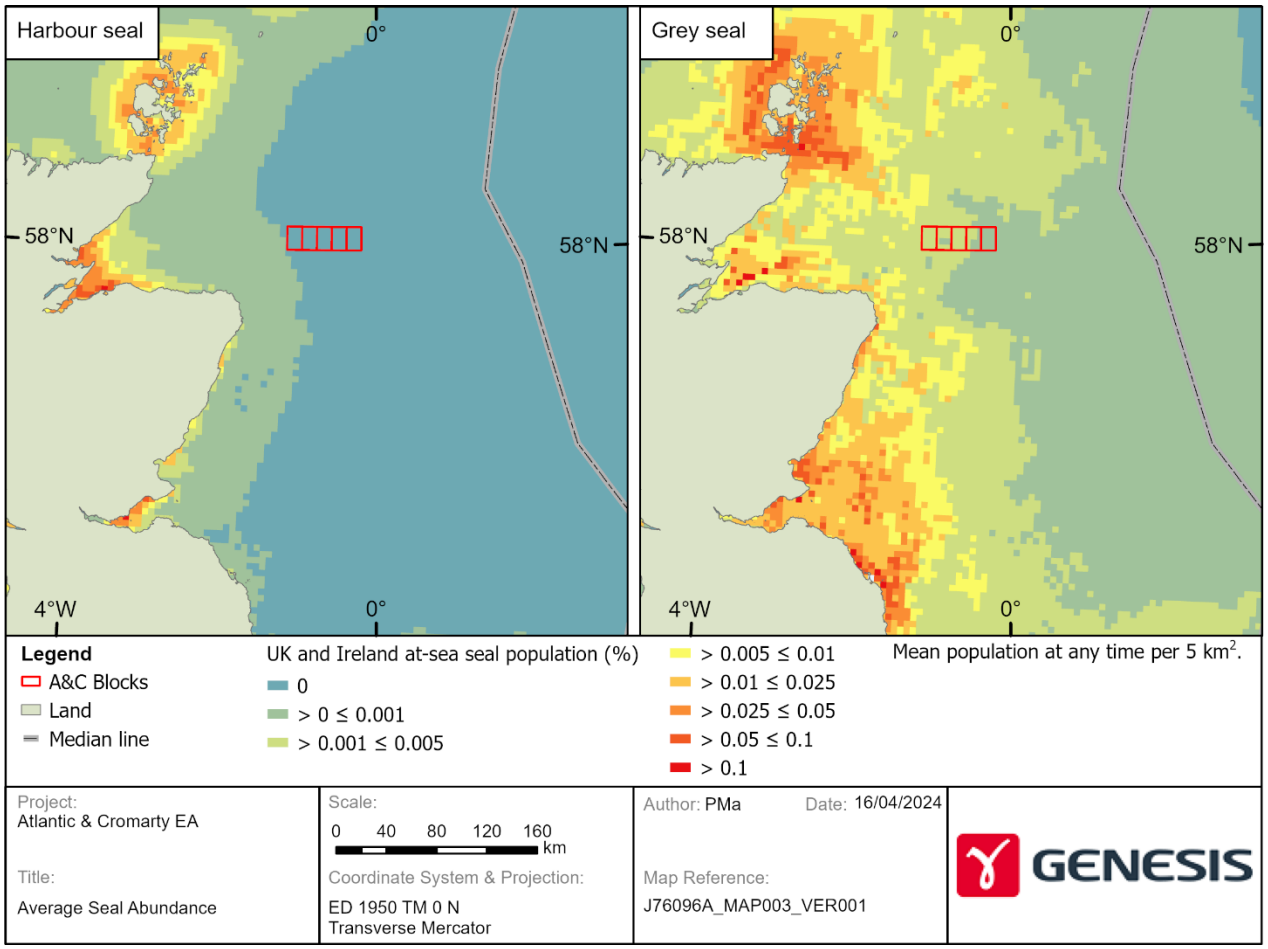

Figure 5-5: Mean UK and Ireland at-sea seal population distribution in the vicinity of the A&C area (Carter *et al.*, 2022).

5.5.4. Seabirds

The North Sea is an internationally important area for breeding and feeding seabirds. Using seabird density maps from European Seabirds at Sea (ESAS) data collected over 30 years, Table 5-5 identifies a number of the bird species (and their predicted maximum monthly abundance) known to occur in the A&C area (Kober *et al.*, 2010).

The data indicates that a number of seabird species are likely to occur in the area over the summer breeding season and winter months. For all species combined, a maximum of 16 seabirds are predicted to occur per km^2 during the breeding season (January to December), whilst during the winter months (October to April) a maximum of 10 seabirds are predicted to occur per km^2.

Table 5-5: Predicted monthly seabird surface density in the A&C area (Kober *et al.*, 2010).

Species	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern Fulmar	Breeding												
	Winter												
Sooty shearwater	Summer												
Manx shearwater	Breeding												
European storm-petrel	Breeding												
Northern gannet	Breeding												
	Winter												
Arctic skua	Breeding												
Great skua	Breeding												
	Winter												
Black-legged kittiwake	Breeding												
	Winter												
Great black-backed gull	Breeding												
	Winter												
Lesser black-backed gull	Breeding												
Herring gull	Breeding												
	Winter												
Arctic tern	Breeding												
Common guillemot	Breeding												
	Additional Season												
	Winter												
Razorbill	Breeding												
	Additional Season												
	Winter												
Little auk	Winter												
Atlantic puffin	Breeding												
	Winter												
All species	Breeding												
	Summer												
	Winter												

Key: Maximum number of individuals per km²	Not recorded	≤ 1.0	1.0 – 5.0	5.0 – 10.0	10.0 - 15.0	> 15.0

Seabirds are generally not at risk from routine offshore oil and gas production operations. However, they may be vulnerable to pollution from less regular offshore activities such as accidental hydrocarbon spills.

The vulnerability of seabirds to surface oil in the blocks and surrounding areas has been assessed according to the Seabird Oil Sensitivity Index (SOSI). The purpose of this index is to identify areas where seabirds are likely to be most sensitive to oil pollution by considering factors that make a species more or less sensitive to oil-related impacts.

The SOSI combines the seabird survey data with individual seabird species sensitivity index values. These values are based on a number of factors which are considered to contribute towards the sensitivity of seabirds to oil pollution, and include:

- Habitat flexibility (the ability of a species to locate to alternative feeding grounds);
- Adult survival rate;
- Potential annual productivity; and
- The proportion of the biogeographical population in the UK (classified following the methods developed by Certain *et al.*, (2015).

The combined seabird data and species sensitivity index values were then subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. The mean sensitivity SOSI data for the area is shown in Table 5-6. For blocks with 'no data', an indirect assessment has been made (where possible) using JNCC guidance (JNCC, 2017a). The sensitivity of birds to surface oil pollution within the A&C Decommissioning Project area ranges from low to extremely high throughout the year.

Table 5-6: SOSI or indirect assessment for Blocks 13/30, 14/26, 14/27, 14/28 and 14/29 (including adjacent Blocks; JNCC, 2017a).

Block	Jan	Feb	Mar	Apr	Mar	Jun	Jul	Aug	Sep	Oct	Nov	Dec
13 / 24	3	5	5	5*	5*	5	5	5	5	2	5	3
13 / 25	3*	5	5	5*	5*	5	5	4	5	2	2*	3
13 / 29	5	2	5	5*	5*	5	5	5	5	2	2	3
13 / 30	3*	5	5	5*	5*	5	4	5	5	2	2*	3
14 / 21	3*	5	5	5*	4*	4	5	4	5	2	4	3
14 / 22	3*	5	5*	N	4*	4	5	4	4	1	4	3
14 / 23	5*	5	5*	N	4*	4	5	5	4	4*	5	5
14 / 24	4	4*	2**	N	2*	2	5	5	4	4*	4*	4
14 / 25	4	4*	2**	N	5*	5	5	5	3	3*	3*	3
14 / 26	3*	5	5	5*	5*	5	4	4	5	2	2*	3
14 / 27	3*	5	5*	N	4*	4	4	5	5	1	1*	3
14 / 28	4*	5*	5	5*	4*	4	3	5	5	5*	4*	4
14 / 29	5*	4*	4	4*	4*	4	4	5	4	4*	5*	5
14 / 30	1	1*	2	2*	5*	5	5	5	3	3*	4*	4
19 / 04	5	2	5	5*	5*	5	3	5	5	3	2	3
19 / 05	4*	4	5	5*	5*	5	3	5	5	2	2*	4
20 / 01	3*	5	5	5*	5*	5	3	5	5	2	2*	3
20 / 02	4*	5	5	5*	5*	5	4	5	5	5*	4*	4

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Block	Jan	Feb	Mar	Apr	Mar	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20 / 03	5*	5*	5	5*	5*	5	4	5	5	5*	5*	5
20 / 04	4*	5*	5	5*	5*	5	4	5	5	5*	4*	4
20 / 05	1	1*	3	3*	5*	5	5	5	5	5*	4*	4
Key	1 Extremely High			2 Very High		3 High		4 Medium			5 Low	
	Indirect Assessment – Data gaps have been populated following guidance provided by JNCC (JNCC, 2017a). * Data gap filled using data from the same Block in adjacent months. ** Data gap filled using data from the adjacent blocks within the same month. Note where no data available, cells have been left blank with "N".											

5.5.5. Marine Protected Areas

A network of Marine Protected Areas (MPA) are in place to aid the protection of vulnerable and endangered species and habitats through structured legislation and policies. These sites include SACs and Special Protected Areas (SPAs), which were designated in the UK under the EU Nature Directives (prior to January 2021) and are now maintained and designated under the Habitats Regulations for England and Wales, Scotland and Northern Ireland. Amendments to the Habitats Regulations mean that the requirements of the EU Nature Directives continue to apply to how European sites (SACs and SPAs) are designated and protected. The Habitats Regulations also provide a legal framework for species requiring strict protection, e.g. EPS. MPAs are designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009.

The protected sites in closest proximity to the A&C field are shown in Figure 5-6. Table 5-7 describes the closest protected areas and their qualifying features.

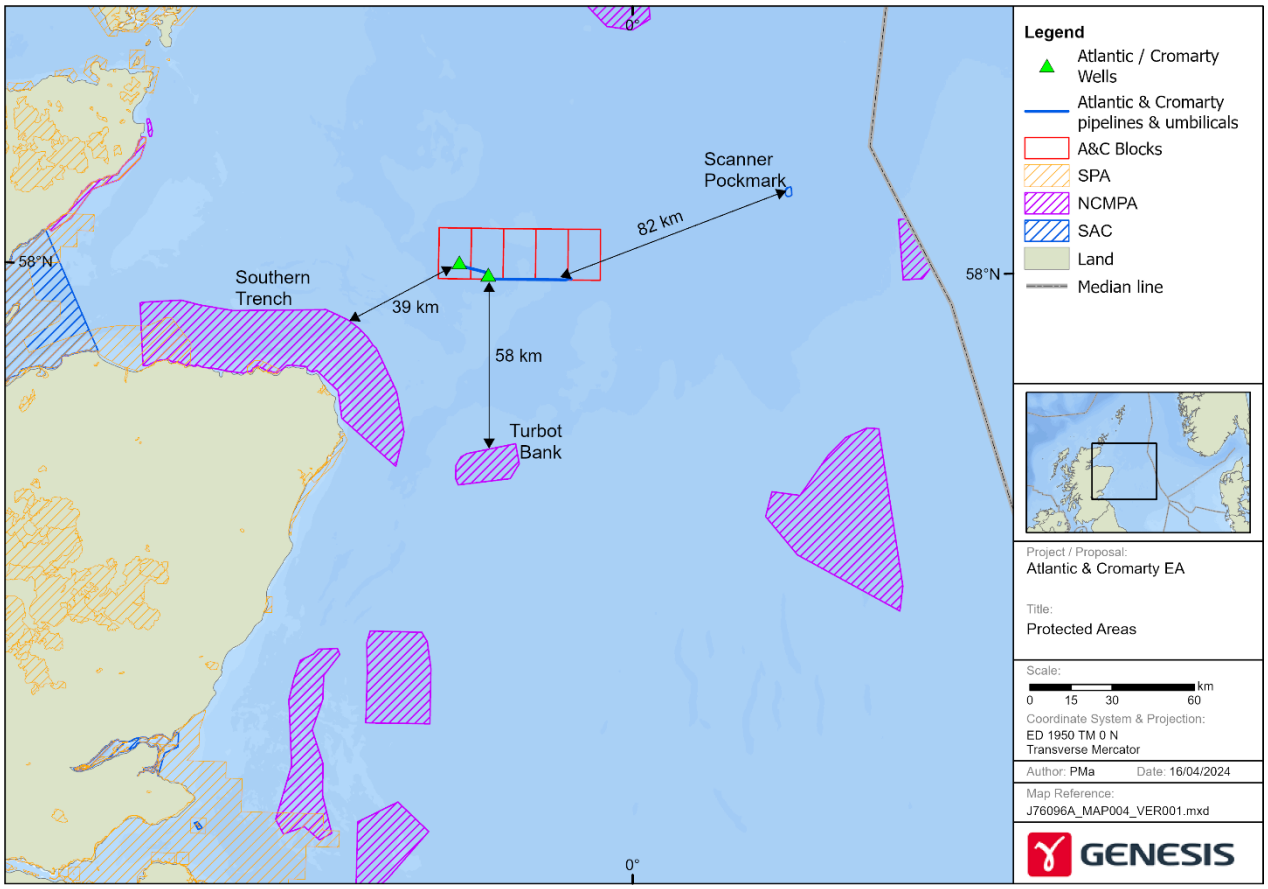

Figure 5-6: Protected areas in the vicinity of Atlantic & Cromarty field.

Table 5-7: Protected areas in closest proximity to the Atlantic & Cromarty field (JNCC, 2017b).

Area	Qualifying Features	Approximate distance from A&C fields (km)
Southern Trench NCMPA	Burrowed mud; Minke whale; Fronts; Quaternary of Scotland; Shelf deeps; and Submarine Mass Movement.	39
Turbot Bank NCMPA	Sandeels.	58
Scanner Pockmark SAC	Annex I habitat: Submarine structures made by leaking gases.	82

5.5.6. Sensitive Habitats and Species

Seapens and faunal burrows were consistent across surveys by Gardline (2022a), Fugro (2016) and Gardline (2010). Both seapens and burrows were identified at the Superabundant, Abundant, Common, Frequent, Occasional and Rare (SACFOR) densities of 'frequent' or more at all investigated stations and transects during the Gardline (2022a) surveys. Thus, it was concluded that the overall surveyed area showed similarity to the OSPAR (2010) protected 'Seapen and burrowing megafauna community' habitat and the Scottish PMF 'burrowed mud' (JNCC, 2012). Likewise, Fugro

(2016) reported that seapens, *Nephrops norvegicus* and faunal burrows were among the most common species and features identified during the surveys. A SACFOR assessment of seapens and faunal burrows was not conducted by Fugro (2016), however both were revealed to be present in the majority of seabed photography captured around the Atlantic wells and Cromarty well. Further to this, Gardline (2022a) identified at least one juvenile *Arctica islandica* at each station, while Fugro (2016) also identified several of these PMFs around the Cromarty well and the umbilical between the Atlantic Manifold and the Goldeneye Platform.

Seapens have been shown to recover rapidly from disturbance. Eno *et al* (2001) found that *Pennatula phosphorea*, one of the most common species observed during the Fugro (2016) surveys, was capable of righting itself when dislodged, with 100% re-establishment 72 hours post disturbance. *Virgularia mirabilis*, which was occasionally observed by Fugro (2016), has also been observed to rapidly withdraw into its burrow thus avoiding uprooting by creels (Eno *et al.*, 2001). In summary, both seapen species have been found to recover rapidly from the effects of dragging, uprooting and smothering (Eno *et al.*, 2001). Additionally, Gardline (2022a) recorded areas of elevated THC concentrations, however 'Seapen and burrowing megafauna communities' remained frequent implying their tolerance to these THC concentrations. The resilience of these seapen species, combined with the fact that Gardline (2022a) noted relatively little disturbance or contamination to the A&C area suggests that the habitats and species identified by Gardline (2022a) will remain consistent over time.

Fugro (2016) assessed areas of coarse, gravelly sediment, classified as 'Circalittoral mixed sediments' (A5.44) for their potential as Annex I stony reef habitat in accordance with JNCC guidelines. The results of this assessment indicated that six patches showed potential as stony reef habitat, although it was not possible to reliably distinguish these areas from the surrounding, less stony, areas of mixed sediment, from geophysical data alone.

Camera transect data, from Fugro (2016), also showed evidence of *Sabellaria spinulosa* aggregations were assessed for their potential as Annex I reef habitat using JNCC guidance. Nine patches of continuous *S. spinulosa* were identified along three transects although all of these patches scored 'low' in terms of overall reefiness. Overall, review of transect data suggested that aggregations do not form a contiguous reef and it would not, therefore, be appropriate to consider the entire 'area of numerous boulders' to be *S. spinulosa* reef.

As described in Section 5.5.3.1, a number of cetacean species occur in the area. All cetaceans in UK waters are EPS under Annex IV of the Habitats Regulations and it is an offence to deliberately disturb, capture, injure or kill an EPS at any time. Harbour porpoise is further protected under Annex II of the Habitats Directive. Additionally, grey seals may occur in the area and are classified as an Annex II species and a PMF.

Several species of fish are also classified as PMFs and have potential to occur in the A&C area (Tyler-Walters *et al.*, 2016):

A list of the fish, cetacean and pinniped species, classified as PMFs, which may occur in te A&C area is provided below.

Fish and Shellfish

- Anglerfish
- Blue whiting
- Cod
- Herring
- Ling
- Mackerel
- Norway pout
- Sandeel
- Spurdog
- Whiting

Cetaceans

- Minke whale
- Atlantic white-sided dolphin
- White-beaked dolphin
- Harbour porpoise
- Killer whale

Pinnipeds

- Grey Seal

No other Annex I habitats or Annex II species, OSPAR threatened and / or declining species and habitats, or Scottish PMFs (OSPAR, 2010; JNCC, 2012) were observed within the survey area.

5.6. Socio-Economic Environment

This section describes the socio-economic activities in the vicinity of the proposed operations at A&C field, which primarily include fishing, shipping and oil and gas operations.

5.6.1. Commercial Fisheries

The A&C field is located within International Council for the Exploration of the Seas (ICES) rectangle 45E8 and 45E9, and on the boundary of 44E9. Data provided by the Scottish Government demonstrates that trawls were the dominant gear type used throughout 44E9, 45E8 and 45E9 in 2023 (Scottish Government, 2024).

Fishing effort statistical data, of UK vessels over 10 m in length, between 2019 and 2023 for the ICES rectangles are provided in Table 5-8, Table 5-9 and Table 5-10.

5.6.1.1. Fishing Effort

The data suggests that the ICES rectangles encompass an area that is of relatively moderate importance to the UK fishing industry, contributing , on average, 0.8-1.2% of the total number of days fished by UK fishing vessels (> 10 m length) between 2019 and 2023 (Scottish Government, 2024).

Table 5-8: Fishing effort (days) taken from ICES rectangle 44E9 (2019-2023) (Scottish Government, 2024).

Year	Month												44E9 total (days)	UK total (days)	44E9 as % of UK Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
2019	318	50	13	23	10	410	251	100	82	21	102	29	1,411	126,386	1.1%
2020	56	32	39	59	44	166	67	65	62	74	36	18	717	104,027	0.7%
2021	29	15	123	154	220	212	198	54	55	26	62	17	1,165	105,793	1.1%
2022	23	23	159	118	306	49	207	81	73	45	20	71	1,176	95,211	1.2%
2023	172	106	142	260	50	329	159	75	133	45	25	31	1,526	95,358	1.6%
Mean	120	45	95	123	126	233	176	75	81	42	49	33	1,199	105,355	1.1%

Notes:
[1] Monthly effort data are shown where five or more UK vessels over 10 m undertook fishing activity in a given year. Where less than five such vessels undertook fishing activity in a given month, the data are "disclosive" (D) and not shown.
[2] Includes disclosive days.
[3] A measure of the fishing activity of vessels including the time spent travelling to fishing grounds as well as the time spent fishing.

Table 5-9: Fishing effort (days) taken from ICES rectangle 45E8 (2019-2023) (Scottish Government, 2024).

Year	Month												45E8 total (days)	UK total (days)	45E8 as % of UK Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
2019	73	34	42	21	150	108	66	22	31	71	81	98	797	126,386	0.6%
2020	75	77	70	14	52	68	54	45	74	75	107	68	779	104,027	0.7%
2021	44	52	18	45	107	108	125	16	55	63	62	87	782	105,793	0.7%
2022	54	55	130	57	67	12	D	14	60	100	193	147	890	95,211	0.9%
2023	46	28	98	114	44	218	106	33	33	63	196	42	1,019	95,358	1.1%
Mean	58	49	72	50	84	103	88	26	51	74	128	88	853	105,355	0.8%

Notes:
[1] Monthly effort data are shown where five or more UK vessels over 10 m undertook fishing activity in a given year. Where less than five such vessels undertook fishing activity in a given month, the data are "disclosive" (D) and not shown.
[2] Includes disclosive days.
[3] A measure of the fishing activity of vessels including the time spent travelling to fishing grounds as well as the time spent fishing.

Table 5-10: Fishing effort (days) taken from ICES rectangle 45E9 (2019-2023) (Scottish Government, 2024).

Year	Month												45E9 total (days)	UK total (days)	45E9 as % of UK Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
2019	171	12	9	30	56	148	80	474	100	61	57	144	1,342	126,386	1.1%
2020	21	222	19	D	35	76	281	139	166	68	73	64	1,163	104,027	1.1%
2021	25	21	230	85	102	198	110	121	291	34	33	28	1,278	105,793	1.2%
2022	15	82	62	30	14	8	169	165	61	94	65	277	1,041	95,211	1.1%
2023	49	306	47	143	12	14	135	74	161	189	91	143	1,362	95,358	1.4%
Mean	56	128	73	72	44	89	155	194	156	89	64	131	1,237	105,355	1.2%

Notes:
[1] Monthly effort data are shown where five or more UK vessels over 10 m undertook fishing activity in a given year. Where less than five such vessels undertook fishing activity in a given month, the data are "disclosive" (D) and not shown.
[2] Includes disclosive days.
[3] A measure of the fishing activity of vessels including the time spent travelling to fishing grounds as well as the time spent fishing.

5.6.1.2. Fishing Landings

The weight (te) and value (£) of landings from UK vessels for demersal, pelagic, and shellfish species from ICES rectangles 44E9, 45E8 and 45E9 are shown in Table 5-11. These landings equate to 0.5% (by weight) and 0.7% (by value) for 44E9, 0.3% (by weight) and 0.5% (by value) for 45E8 and 0.7% (by weight) and 0.7% (by value) for 45E9 of total UK reported landings in 2023.

Table 5-11: Landings (by species type) from ICES rectangle 44E9, 45E8 and 45E9 in 2023 (Scottish Government, 2024).

Species	2023					
	44E9		45E8		45E9	
	Value (£)	Live weight (te)	Value (£)	Live weight (te)	Value (£)	Live weight (te)
Demersal	1,875,479	1,895	1,791,180	1,276	1,544,779	1,346
Pelagic	58,579	94	2,145	2	926,215	1,640
Shellfish	3,863,582	960	2,121,702	571	3,222,076	847
ICES Rectangle Total	5,797,639	2,950	3,915,026	1,849	5,693,069	3,833
UK Total	800,550,253	545,648	800,550,253	545,648	800,550,253	545,648
% of UK total	0.7	0.5	0.5	0.3	0.7	0.7

5.6.2. Shipping

The 2022 vessel densities in the North Sea have been presented by EMODnet (2023b) as hours per km^2 per month. The vessel density in Blocks 14/26, 14/27, 14/28, 14/29 and 13/30 ranges from 0 to > 89.5 hours per km^2 per month (Figure 5-7).

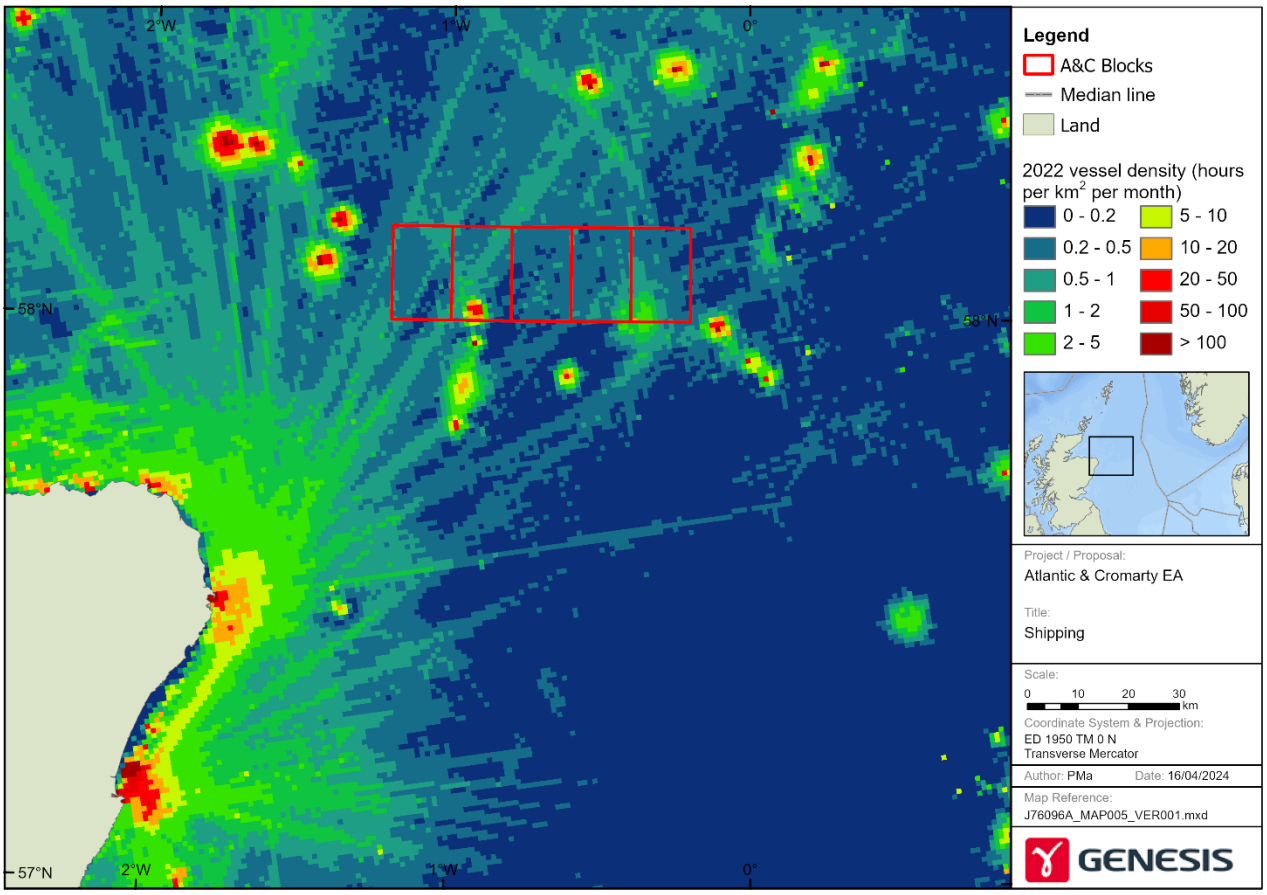

Figure 5-7: Shipping Density in the vicinity of Blocks 14/26, 14/27, 14/28, 14/29 and 13/30 (EMODnet, 2023b).

5.6.3. Wrecks

A large number of ship and aircraft wrecks are known in UK waters, including more than 5,200 records in Scottish waters. There is also potential for substantial unidentified aircraft remains (primarily World War II) to be found on the seabed, since there are extensive documentary sources relating to aviation loss at sea, but these do not provide accurate positions (DESNZ, 2022).

There are no protected wrecks or sites in the vicinity of the proposed operations within A&C field. The closest non-dangerous wreck to the proposed operations is located *c.* 0.52 km to the south of the Goldeneye to Atlantic umbilical. There is also multiple area of foul ground located in the vicinity of the Cromarty pipelines and umbilical, the closest foul ground is located *c.* 0.02 km west to the Goldeneye to Atlantic umbilical (Admiralty, 2023; Figure 5-8).

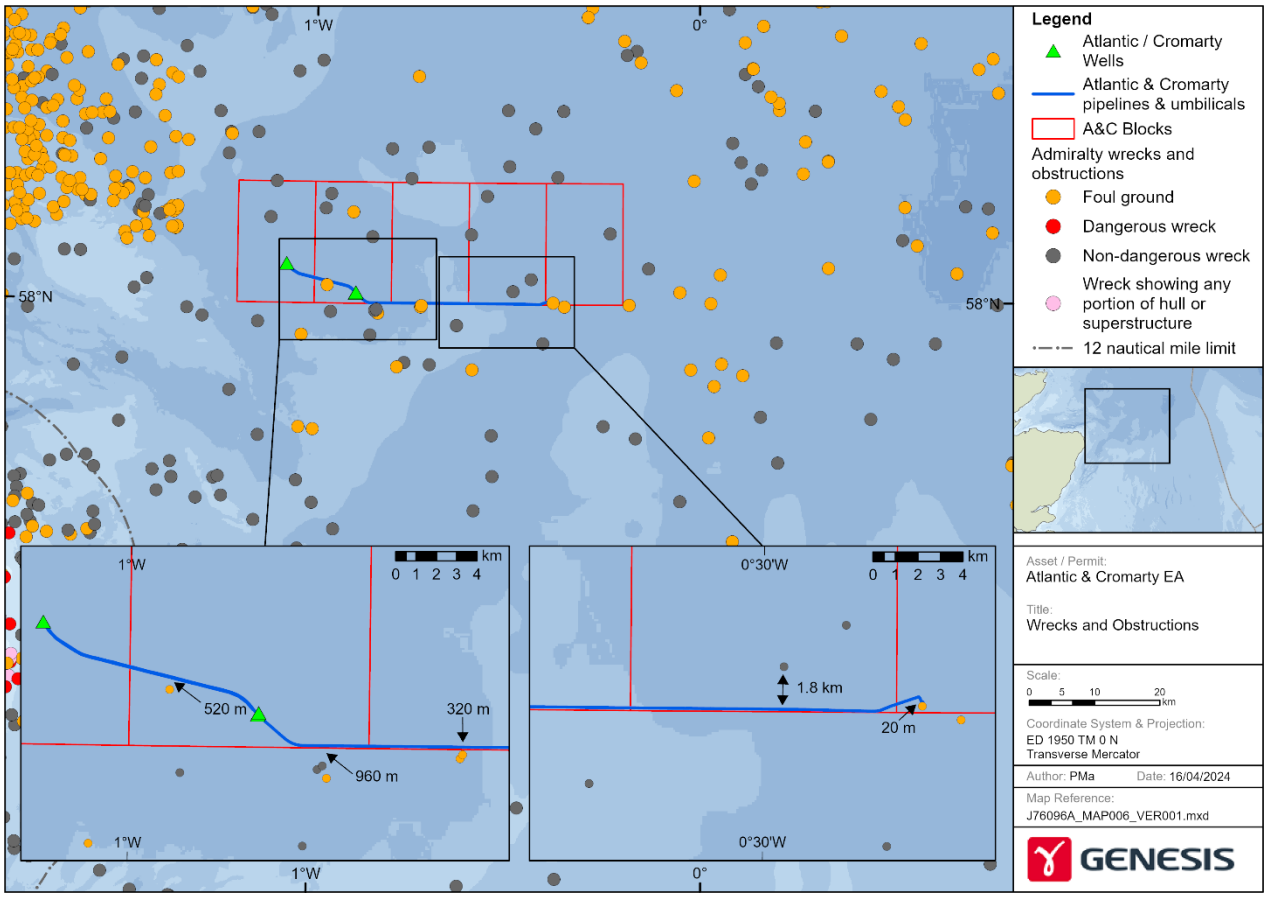

Figure 5-8: Wrecks in the vicinity of the proposed operations at A&C field (Admiralty, 2023).

5.6.4. Oil and Gas Infrastructure

The A&C field is situated within a well-developed area of the North Sea, featuring a lot of oil and gas infrastructure and activity. Figure 5-9 shows installations in closest proximity to the A&C field area. The Golden Eagle wellhead platform and Golden Eagle Process, Utilities and Quarters (PUQ) platform is located *c.* 5.4 km southeast of Goldeneye to Atlantic umbilical.

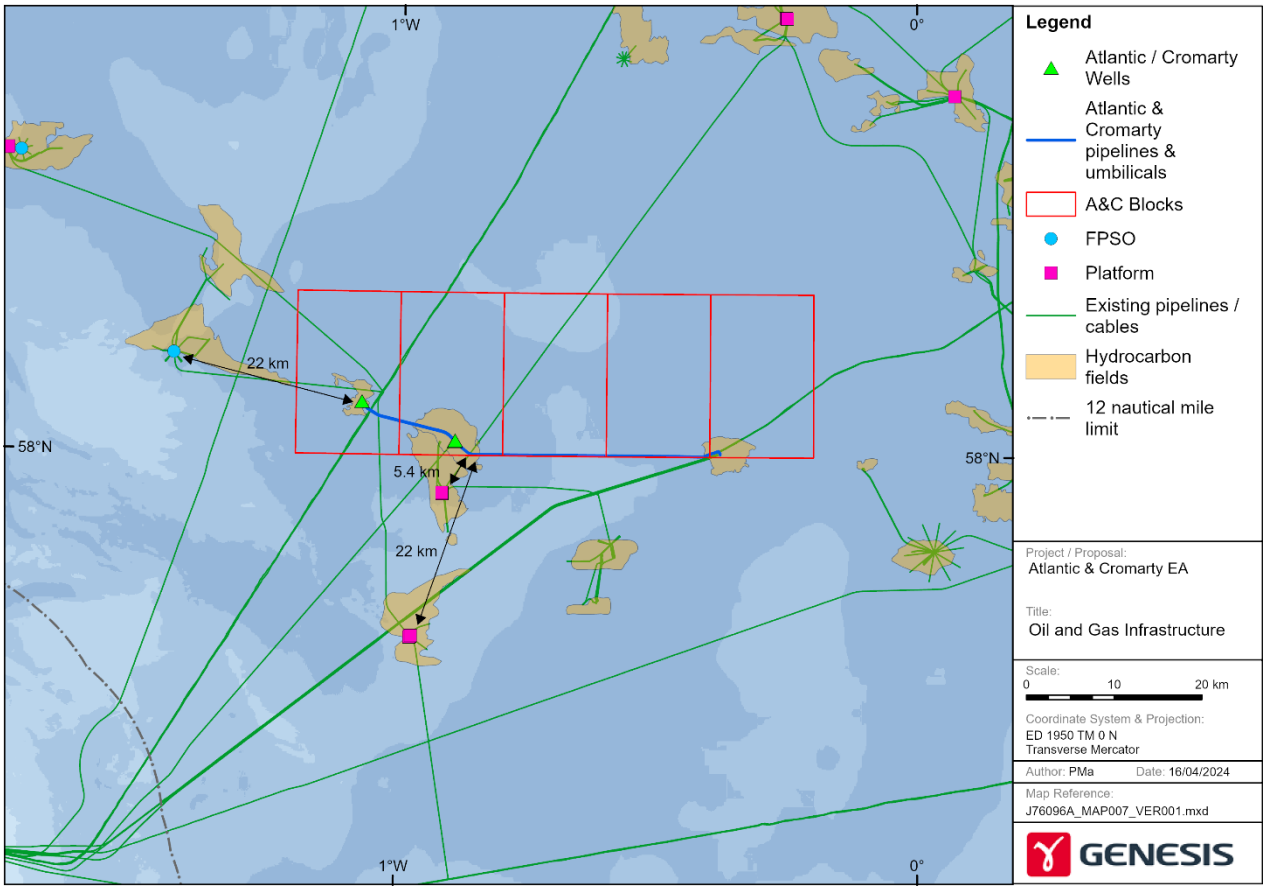

Figure 5-9: Existing oil and gas installations within the vicinity of the A&C field.

5.6.5. Other Activities

There are no military exercise areas within the vicinity of the A&C infrastructure (Scottish Government NMPi). The closest offshore wind site is the MarramWind pre-planning site, which is located *c.* 1 km north of the Goldeneye to Atlantic umbilical. The closest successful Innovation and Targeted Oil & Gas (INTOG) application site is a Flotation Energy site *c.* 6.7 km south of the Goldeneye to Atlantic umbilical (Figure 5-10).

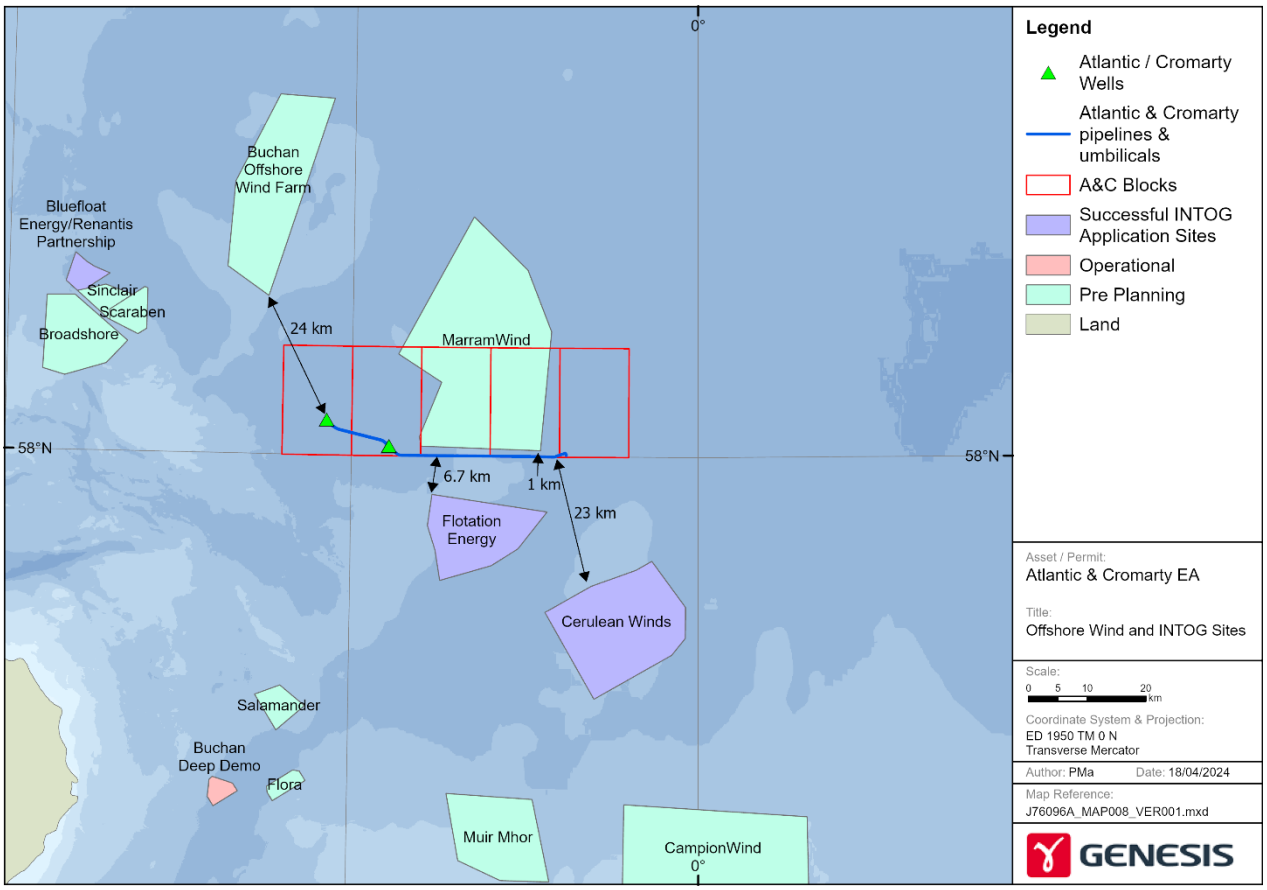

Figure 5-10: Location of the proposed activities in relation to offshore wind sites.

6. Scoping of Potential Impacts

6.1. Methodology

To determine the severity of the potential impacts associated with the proposed decommissioning activities, an ENVID was undertaken in accordance with Shell's Impact Assessment Procedure as described in Appendix A (Section 13).

The potential impact of the proposed activities on the key environmental and socio-economic sensitivities were considered and those impacts which required further assessment within the EA were identified. The decision on which impacts required further assessment was reinforced by a review of industry experience of decommissioning impact assessment.

For the ENVID, the proposed A&C decommissioning activities were divided into four nodes as follows:

1. Vessel use.
2. Decommissioning of subsea infrastructure and associated stabilisation material.
3. Over-trawl trials.
4. Legacy impacts.

Using a detailed description of the activities, the ENVID process systematically reviewed those project activities associated with each node which could interact with the environment (including socio-economic receptors).

In summary the impact assessment methodology assigns a level of sensitivity (Table 13-3) to the receptors (e.g. climate change, water quality, marine mammals and the fishing industry). A level of Magnitude of Impact of the activity (Table 13-2) being considered is identified. Assignment of the level of Magnitude of Impact assumes standard industry mitigations and project specific mitigations are in place e.g. all discharges from vessels will be MARPOL compliant. Significance of impact takes account of the receptor sensitivity and the magnitude (Table 13-4). For accidental events, the likelihood of the event (Table 13-5) taking place is considered along with the impact significance to provide a level of environmental risk (Table 13-6).

6.2. Results

The results from the ENVID are presented in Table 6-1. The table also provides a justification for not assessing further the majority of the aspects identified in the EA, with the exception of:

- Seabed disturbance (Section 7);
- Legacy impacts on the environment and on other sea users (Section 8); and
- Impact of gaseous emissions on climate change (Section 9).

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Table 6-1: ENVID results and justification for deselecting different impacts for further assessment in the EA.

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1. Vessel Use								
1.1	Gaseous Emissions. Power generation.	Receptor: Air quality. Fuel combustion emissions (CO_2, CO, SOx, NOx, etc.) from vessels. UK and EU Air Quality Standards not exceeded.	-Minimise use of vessels through efficient journey planning and use of relevant vessels for each activity. -Prior to contract award Shell will review vessel Common Marine Inspection Documents (CMID) as part of vessel assurance (evidence of maintenance). -All vessels will be MARPOL compliant.	A	1	Slight	Estimated emissions associated with the proposed decommissioning activities are presented in Section 9. Given the offshore location, the sensitivity of air quality as a receptor is considered Low (A). Given the relatively short vessel campaigns and the fact that any emissions to atmosphere are expected to disperse rapidly the Magnitude of Impact is considered Slight (1). The Impact Significance of the proposed activities on air quality is therefore considered Slight and is not considered further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.2	Gaseous Emissions. Power generation	Receptor: Climate Change	Mitigation measures as for Row 1.1 above.	C	1	Minor	The assessment methodology does not easily lend itself to assessing climate change, with the Sensitivity of climate change as a receptor being considered High (C) in line with 2014 Climate Change Report produced by the Intergovernmental Panel on Climate Change. Shell acknowledges that the atmospheric emissions can contribute to climate change. However, the Magnitude of Impact of the incremental increase in emissions to the atmosphere from the project vessels is considered Slight (1) given the relatively short duration of the activities, such that the Impact Significance is considered Minor. The impacts of vessel emissions on climate change are therefore considered further in the EA (Section 9).	Yes

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.3	Usage of space: socio-economic impact of presence of vessels.	Receptor: Other sea users. Presence of vessels will have the potential to impact on other sea users for example through collision with towed fishing gear or to cause ships to avoid an area normally traversed.	-Minimise use of vessels, through efficient journey planning. -Notify other sea users - e.g. Kingfisher and SFF with ongoing collaboration with SFF. -All vessels will have markings and lightings as per the International Regulations for the Prevention of Collisions at Sea (COLREGS) (International Maritime Organisation, 1972). -Navigational aids including radar, lighting and Automatic Identification Systems (AIS) will be used. -A vessel Collision Risk Assessment (CRA) will be produced if required. -All vessels will be in compliance with Shell's Marine Assurance Standards (MAS).	B	1	Slight	Fishing effort in the area is considered relatively important to the UK fishing industry (see Section 5.6.1), such that sensitivity of other sea users as a receptor is considered Medium (B). Taking account of the mitigation measures identified, the relatively short duration of the activities and the fact that a number of the activities will take place within existing 500 m zones, the Magnitude of Impact is considered Slight (1). The Impact Significance is therefore considered Slight and is not considered further in the EA.	No

1.4	Usage of space: environmental impact of presence of vessels.	Receptors: marine mammals and birds. Possible behavioural changes in marine mammals e.g. could be attracted to the vessel or may move away from the area. Migrating birds could be attracted to the lights on the vessels.	-Minimise use of vessels, through efficient journey planning.	B	1	Slight	Receptor sensitivity is considered Medium (B) given the presence of marine mammals and potential presence of birds from coastal SPAs. In addition to being a busy shipping area, the North Sea has well developed fishing and oil and gas industries, such that marine mammals in the region are habituated to the presence of vessels. In addition, the evidence for lethal injury from boat collisions with marine mammals suggests that collisions with vessels are very rare (Cetacean Stranding Investigation Programme, 2011). The Magnitude of Impact of the proposed vessel use on marine mammals is therefore considered Slight (1). The vessels have the potential to cause displacement of seabirds from foraging habitat and may cause birds to detour from their flight routes. For example, auk species (e.g. guillemot and little auk) are believed to avoid vessels by up to 200 to 300 m but gull species (e.g. kittiwake, herring gull and great black-backed gull) are attracted to the presence of them (Furness *et al.*, 2012 and Weise *et al.* 2001). Though evidence suggests that the presence of the vessels could cause some bird species to be displaced from their foraging area, the very small proportion of their overall available habitat that will be occupied by the vessels means the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area, it is	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
							expected that the impact of the vessels on bird migration routes (e.g. they could be attracted to the vessel lights at night) is not expected to be significant. The Magnitude of Impact on birds is therefore considered to be Slight (1) The Impact Significance of the presence of vessels on marine mammals and birds is therefore considered Slight and is not considered further in the EA.	

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.5	Fluids and other materials into water. Vessel sewage, ballast water and biofouling.	Receptors: water quality and fauna associated with the water column. May result in organic enrichment and chemical contaminant effects in water column and seabed sediments. Ballast water could introduce invasive species depending on vessel routes. Bio invasions as a result of biofouling (accumulation of organisms including plants, algae, or animals such as barnacles) on vessels could also occur.	-Minimise use of vessels, through efficient journey planning. -Shell will review vessel CMID as part of vessel assurance and all vessels will be compliant with the Company's MAS. -Vessels will be MARPOL compliant. -All contracted vessels will originate from countries adhering to the International Maritime Organisation (IMO) Convention. -The Company's audit procedures will ensure that the contracted vessels ballasting procedures are in line with IMO Convention. -All discharges of ballast water will be monitored, and records maintained. -As part of the Company's auditing process, only vessels adhering to the IMO 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Species will be used. All member states of IMO are signed up to these guidelines.	B	1	Slight	The Sensitivity of marine mammals as a receptor is considered Medium (B) given that they are protected species. Similarly as a number of fish species in the area are PMFs, they are also considered to be of Medium (B) sensitivity. Given the proposed mitigation measures the Magnitude of Impact of any discharges is considered Slight (1). The Impact Significance is therefore considered Slight and is not discussed further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.6	Noise and vibrations	Receptors: marine mammals and fish. Vessels will use dynamic positioning and will have the potential to cause disturbance to marine mammals and fish in the form of temporary displacement from the area. Marine mammals and fish are expected to return once the vessel(s) has/have left the area.	Minimise use of vessels, through efficient journey planning.	B	1	Slight	The sensitivity of marine mammals as a receptor is considered Medium (B) given that they are protected species. Similarly as a number of fish species in the area are PMFs, they are also considered to be of Medium (B) sensitivity. As described in Row 1.4 marine mammals and fish in the region are habituated to the presence of vessels in the North Sea. Any impacts from vessel noise will be behavioural rather than physical, such that they may cause marine mammals or fish to vacate the area, however they would be expected to return once the vessels have left the field. The Magnitude of Impact of underwater noise on marine mammals and fish is therefore considered Slight (1). The Impact Significance is therefore considered Slight and is not discussed further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.7	Waste materials. General waste from vessels.	Receptor: use of landfill. Following application of the waste hierarchy, minimal quantities of materials will go to landfill.	-Prior to contract award Shell will review the vessels Waste Management Plans (WMP) which will adhere to the waste hierarchy principle. -The Company will ensure vessels are compliant with MARPOL and, as such, meet Shell 's MAS. -As part of their auditing procedures, Shell will ensure the contractor adheres to the Waste Duty of Care Code of Practice. -Only landfill sites with approved Pollution Prevention and Control (PPC) permits will be used.	B	1	Slight	Shell recognise landfill sites as a finite resource such that receptor sensitivity is considered Medium (B). MARPOL Annex V applies to all ships/vessels and generally prohibits the discharge of all garbage into the sea (there are some exceptions which relate for example to food waste and cleaning agents). As vessels will be compliant with MARPOL, there will be no significant impact offshore. As the vessels will have WMPs in place that will adhere to the waste hierarchy principle of reduce, reuse recycle, the Magnitude of Impact on the availability of landfill sites is considered Slight (1). As the Impact Significance of any waste from the vessels is considered Slight and given that Section 12.8 of OPRED's Guidance Notes (BEIS, 2018) advises that an assessment of wastes returned to shore is not required in the EA (as it is not relevant to the impacts in the marine environment), the onshore impacts associated with vessel waste is not discussed further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.8	Energy consumption.	Receptor: fuel availability	-Scheduling/design to optimise opportunities to use vessels more efficiently (i.e. minimise transits, ensure vehicles are fully loaded). -Under MARPOL Annex VI, all vessels will adhere to the Ship Energy Efficiency Management Plan (SEEMP) such that the vessels will have best practices for fuel efficiency in place.	B	1	Slight	Shell recognise that hydrocarbon-based fuel is a finite resource such that receptor sensitivity is considered Medium (B). Given the relatively short duration of the proposed decommissioning activities and the use of MARPOL compliant vessels the Magnitude of Impact is considered Slight (1). The Impact Significance is therefore considered Slight and is not discussed further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
1.9	Unplanned event: diesel spill. Unforeseen event during operations for example a collision or fire resulting in a loss of fuel inventory.	Receptors: water quality, sediment quality, fisheries, marine mammals, birds, fish, plankton, benthic communities. Given the nature of diesel, a large percentage of any diesel spill would be expected to evaporate. Given the offshore location, the probability of diesel beaching is expected to be low. In addition it is expected that the probability of surface oiling above 3 µm crossing any transboundary lines is also relatively low.	-Vessel assurance inspections. -Pre-hire vessel audits. -Emergency response plans in place including the vessels SOPEPs (Shipboard Oil Pollution Emergency Plan). -SIMOPS (simultaneous operations) will be managed through bridging documents and communications. -All vessels engaged in the project operations will have markings and lightings as per the COLREGS whilst the navigational aids will include radar, lighting and AIS. -Compliance activities will be managed by means of the independently verified Company integrated Safety and Environmental Management System (SEMS).	C	2	Impact Significance is considered **Moderate** Environmental Risk is considered **Minor**.	Receptor sensitivity is considered High (C) given the potential extent of the impacts such that marine mammals within areas designated for marine mammals could be impacted. The Magnitude of Impact of a loss of diesel inventory is considered Minor such that the Impact Significance of such an event is considered Moderate. With the application of the mitigation measures the likelihood of a total loss of fuel inventory from a vessel is considered Remote (B) such that the Environmental Risk is considered Minor. In line with Subsection 12.4 of the OPRED Decommissioning Guidance (BEIS, 2018), the impacts of accidental events are not assessed in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
2.0 Decommissioning of subsea infrastructure including stabilisation material								
2.1	Disruption to the soil and subsoil. Recovery of: surface laid infrastructure and mattresses, concrete tunnels and grout bags. In addition this row item also captures the impact of recovery of the 12.97 km of PLU2033.	Receptors: sediment quality and benthic communities. All activities will take place out with any designated areas. The environmental survey identified the presence of megafauna burrowing communities at a density considered to be representative of the UK Habitat Feature of Conservation Importance of 'mud habitats in deep water'. such that the receptor sensitivity is considered to be Medium.	Cutting/dredging/jetting work plans will be in place. Internal cutting of manifold piles. Dredging/jetting will be minimised. Lifting procedures in place.	B	2	Minor	Note this row item captures recovery of spools and umbilical jumpers; exposed ends and midline sections of the trenched and buried pipelines and umbilicals; manifold and piping structure; and the mattresses, concrete tunnels, concrete deflector and grout bags. Given the presence of potentially sensitive habitats, receptor Sensitivity is considered Medium (B). Given the expanse of infrastructure to be recovered the Magnitude of Impact is considered Minor (2). The Impact Significance is therefore considered Minor and is discussed further in the EA.	Yes

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
2.2	Disturbance to the seabed. Remediation of exposed pipeline / umbilical ends and mid-line sections using rock cover.	Receptors: sediment quality and benthic communities. Addition of rock cover would result in a change in habitat type. Some mortality of benthic animals belonging to species which are generally considered widespread throughout the CNS. Presence of megafauna burrowing communities at a density considered to be representative of the UK Habitat Feature of Conservation Importance of 'mud habitats in deep water'.	-Minimise use of rock cover. -Consultation with SFF regarding rock cover profile. -Over-trawlability survey. -Location of rock added to FishSafe.	B	1	Slight	Seabed habitat in the area is relatively homogenous and comprises two main habitats: Offshore circalittoral mud and Offshore circalittoral sand (see Section 5.4), such that the addition of rock cover would result in a long-term habitat change. In addition, the majority of the A&C area was observed to show similarity to the OSPAR listed threatened and/or declining habitat 'Sea-pen and burrowing megafauna communities'. If this remediate in situ option was selected during the C&P tendering phase, the overall impact significance is considered to be Slight as remediation activities would be limited to the exposed lengths of line. However, this impact will be considered further in the EA, in order to allow an assessment of the cumulative seabed disturbance across all activities.	Yes

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
2.3	Discharges to sea. Discharges from infrastructure during recovery and discharges from cut ends of pipelines and umbilicals.	Receptor: water quality which subsequently could impact on fauna. Discharge of flushing fluids (inhibited freshwater from the pipelines and spools) and discharge of hydraulic fluids and MEG from umbilical cores.	All pipelines used to transport hydrocarbons have been flushed and cleaned in line with BAT/BEP procedures to minimise hydrocarbon concentrations.	B	1	Slight	Given the pipeline and umbilical flushing and cleaning activities, the Magnitude of Impact of any discharges during cuttings and/or recovery activities is considered Slight such that the impact significance is considered Slight. The impact of these discharges are therefore not considered further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
2.4	Waste processing. Treatment of recovered materials.	Receptor: use of landfill. In addition, there is the potential for impact on communities located in proximity to the landfill site (e.g. from traffic, noise and odour). Following application of the waste hierarchy, minimal quantities of materials will go to landfill.	As part of Shell's Duty of Care, contract award will be to an established yard with appropriate experience, capability, licences and consents in place. As part of this the sites must demonstrate waste stream management throughout the deconstruction process. Waste management will follow the waste hierarchy: reduce, reuse, recycle. All waste will be handled and disposed of in line with regulations which will be detailed in the Waste Management Plan (WMP).	B	1	Slight	As described in Row 1.7 above Sensitivity of landfill as a receptor is considered Medium (B). Considering the relatively small volumes of material to be returned the impact significance on the availability of landfill sites is considered Minor. Similarly, as only permitted sites will be used, the impact significance on local communities is also considered Minor. Section 12.8 of OPRED's Guidance Notes (OPRED, 2018) advises that an assessment of wastes or waste management returned to shore for treatment or disposal is not required in the EA as it is not relevant to the impacts in the marine environment. For this reason, the processing of waste returned to shore and any onshore impacts associated with the returned material is not discussed further in the EA.	No

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
3.0 Over trawl trials								
3.1	Disturbance to the seabed. Clear seabed surveys and over trawl trials.	Receptor: benthic communities. Potential for over trawl trials to be carried out to demonstrate a clear seabed and/or over trawl trials. Will result in disturbance to the seabed habitats in the area.	Preference will be given to the use of side scan sonar surveys (SSS) or similar to determine a clear seabed. Possible that SSS surveys would also negate requirement for an over trawl trial. Note: Magnitude of Effect assigned assuming that over trawl trials will be carried out.	B	3	Moderate	As a worst case the Magnitude of Impact assumes an over trawl trial will be required to demonstrate a clear seabed. As fishing in the area is considered moderate, the impact of a trawl sweep or over trawl trial is not expected to be more significant than the impact of the demersal trawl gear associated with the wider area. However given the expanse of the area that would require to be over trawled, the Magnitude of Impact is considered Moderate (3) such that the Impact Significance is considered Moderate. The impact of over trawl trials will therefore be considered further in the EA.	Yes

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
4.0 Legacy Impacts								
4.1	Legacy socio-economic impacts associated with pipelines, umbilicals and rock cover left *in situ*.	Receptor: other sea users. Potential for access to seabed area being impeded due to infrastructure/ stabilisation features decommissioned *in situ*.	All surface laid infrastructure will be recovered. Seabed clearance surveys. Over trawl trials to be carried out if considered necessary. Additional rock cover will be minimised and if used it will be laid in profiles aligned with industry standards. Independent verification of a safe seabed will be obtained. Post decommissioning survey strategy.	B	2	Minor	Pipeline status reports have found the seabed to be stable over the trenched and buried pipelines and umbilical such that the potential for additional exposures to occur along these lines is considered low. Shell recognise that demersal trawl gear is used in the area (see Section 5.6.1), however given the stability of the seabed in the area and with the application of the mitigation measures identified, the impact significance with respect to impact on fishing activities is considered Minor. Given stakeholder interests with respect to a clear seabed, the decommissioning of the buried pipelines and umbilicals, and rock cover (existing and any potential rock added to remediate exposed sections) will be considered further in the EA.	Yes

4.2	Legacy environmental impacts associated with potential discharges from pipelines and umbilicals decommissioned *in situ* following degradation.	Receptors: sediment quality and benthic communities. Over time the trenched and buried pipelines and umbilicals decommissioned *in situ* will degrade. Following degradation, there is the potential that any hydrocarbons/ chemicals that may have remained in the pipelines/umbilicals following the flushing and cleaning activities being released to the surrounding sediment.	The pipelines and umbilicals will be buried under sediment/rock such that following eventual degradation, it is expected that the disintegrated line components and contents will be restricted to their current location and will not make it into the water column. Cleaning and flushing of pipelines and umbilical cores in line with BAT/BEP.	B	2	Minor	All infrastructure decommissioned *in situ* will be trenched and buried or covered with rock such that impacts of degradation will be contained within a limited area around the pipelines and umbilicals. The lines have been flush and cleaned after which the production and MEG lines were filled with RX-5227 (corrosion inhibitor, oxygen scavenger and biocide) dosed at 1,000 pm. Over the likely timeframe that the lines will take to corrode all products that may be present in the inhibited water will have reacted (in the case of oxygen scavengers) or degraded (in the case of corrosion inhibitors and biocides). Therefore, any discharge will not cause a significant impact to the surrounding sediments. Given the contents of the pipelines and umbilicals at the time of decommissioning and the fact that all infrastructure decommissioned *in situ* is trenched and buried or covered with rock, the impact significance of pipeline and umbilical degradation over time is considered Minor. However, given public concern with respect to the impact of plastics (associated with the umbilicals) in the environment the legacy impact of decommissioning the buried pipelines and umbilicals *in situ* is considered further in the EA.	Yes

No.	Aspect/ Activity	Observations	Existing Mitigation	Receptor Sensitivity	Magnitude of Impact	Impact Significance	Justification for selecting/deselecting the aspect/impact for further assessment in the EA	Assessed further in EA
4.3	Legacy environmental impact associated with presence of existing rock cover and any additional rock used to remediate exposed sections	Receptors: sediment quality and benthic communities. Addition of rock would result in a change in habitat type. Some mortality of benthic animals belonging to species which are generally considered widespread throughout the CNS.	If option to rock cover is selected, volumes will be minimised.	B	2	Minor	There is an estimated 11,500 te of existing rock associated with the A&C fields (Table 3-3). If following the C&P tendering phase, both options involving rock cover (Option 2a for Group A (preferred option) and Option 2a for Group B (not preferred but still considered acceptable)) are selected, it is estimated that an additional 3,174 te (includes 10% contingency) of rock would be added. Given that the additional rock will be added to an area with existing rock berms the Magnitude of Impact is considered Minor (2) such that the impact significance is considered Minor. The addition of rock will be assessed further in the EA, in order to understand the cumulative impact of disturbance to the seabed.	Yes

7. Seabed Disturbance

When assessing the impact of the proposed activities in the ENVID (Section 6), seabed impacts for the different activities were considered to range from Slight to Minor when the assessment methodology described in Appendix A was applied. The one exception was the impact associated with the disturbance associated with the over trawl trials which was considered Moderate. The ENVID considered the activities in isolation whilst this section considers the cumulative impacts of disturbance resulting from all activities.

7.1. Activities (Cause of Impact)

Activities that will result in an impact to the seabed include:

- Remediation of the exposed line ends and mid-line sections of the pipelines and umbilicals (either through recovery, trench and bury, or the addition of rock cover);
- Potential full recovery of the umbilicals (considered an acceptable decommissioning option for the two umbilicals in the CA);
- Recovery of the Atlantic manifold and Cromarty piping structure;
- Recovery of concrete tunnels, mattresses, concrete deflector and 25 kg grout bags;
- Over trawl sweeps and over trawl trials.

The area of disturbance presented in Table 7-1 assumes the preferred option identified in the CA for each pipeline/umbilical group is selected during the C&P phase. The maximum area of temporary disturbance associated with the proposed activities (excluding the over trawl trials) is estimated to be 0.016 km^2 whilst the area of permanent disturbance is calculated to be 0.006 km^2. Note this is considered a worst-case as many of the assumptions applied assume no overlap in the impacted areas. For example the extended area of temporary disturbance presumed for the mattresses assumes they are not contiguous (i.e. assumes the mattresses are not touching). Therefore, the extended area of disturbance for each mattress is not considered to overlap which will not be the case for many of the mattresses. In addition, it is assumed the area impacted by the recovery of the grout bags does not overlap with the area impacted by the mattresses.

Table 7-2 assesses the area of impact associated with each of the other acceptable decommissioning options for the pipeline and umbilicals.

Table 7-3 presents the maximum area of temporary and permanent disturbance should the alternative acceptable options identified in the CA be selected during the C&P phase. Therefore, excluding the over trawl trials, and depending on which decommissioning option is selected for pipeline Groups A and B during the C&P phase the maximum area of temporary disturbance would be 0.027 km^2 whilst the maximum area of permanent disturbance would be 0.007 km^2

Table 7-1: Anticipated area of disturbance associated with the proposed activities assuming the preferred options identified in the CA are applied for the pipelines and umbilicals.

No.	Activity	Assumptions Made	Area of Disturbance (m²)	
			Temporary	Permanent
1	PL2030/ PL2032 (Group A)	Exposed ends and mid-line sections rock covered i.e. 760 m to be remediated. Corridor width of rock of 7.2 m allows for a depth of cover of 0.6 m. Estimated area of permanent disturbance is 760 m (L) x 7.2 m (W).	-	5,472
2	PLU2033/ PLU2034 (Group B)	Remediate *in situ* with exposed sections cut and removed i.e. 363 m remediated (115 m for PLU2033 and 248 m for PLU2034). Corridor width of temporary disturbance assumed to be 2 m. Permanent disturbance allows for 3 x 10 te of rock being deposited at each cut end of the umbilicals to mitigate potential of snagging. Assumes that 10 te of rock at each location impacts on 10 m2 of seabed.	726	30 m² *
3	PLU2033 (Group C)	Full removal by reverse reel i.e. recover 12.97 km. Temporary disturbance assumes a worst-case of disturbed sediment settling over a corridor of 5 m. Seabed expected to begin recovery once activities are completed such that no permanent disturbance.	6,485	
4	Recovery of Atlantic manifold	Structure dimensions: 7.7 m (L) x 1.5 m (W) To allow for area of disturbance around the structure the temporary area of disturbance is considered to extend 1 m around each side of the structure i.e. 9.7 m x 3.5 m.	310.86	-
5	Recovery of Cromarty piping assembly	Structure dimensions: 17.8 m (L) x 13.7 m (W) To allow for area of disturbance around the structure the temporary area of disturbance is considered to extend 1 m around each side of the structure i.e. 19.8 m x 15.7 m.	33.95	-
6	Recovery of concrete tunnels	12 tunnels measuring 6.31 m (L) x 3 m (W) 6 tunnels measuring 6.31 m (L) x 4.3 m (W) To allow for area of disturbance around the tunnels the temporary area of disturbance is considered to extend 1 m around each side of each concrete tunnel. Therefore area of disturbance is: (8.31 m x 5 m x 12) + (8.31 m x 6.3 m x 6)	642.6	-
7	Recovery of mattresses	199 mattresses measuring 6 m (L) x 3 m (W) to be recovered. To allow for area of disturbance around each mattress the temporary area of disturbance is considered to extend 1 m around each side of each mattress. Therefore area of disturbance is: (8 m x 5 m x 199)	7,960	-

No.	Activity	Assumptions Made	Area of Disturbance (m²)	
			Temporary	Permanent
8	Recovery of concrete deflector	Dimensions: 2.4 m (L) x 2.1 m (W) To allow for area of disturbance around the concrete deflector the temporary area of disturbance is considered to extend 1 m around each side of the structure. Therefore area of disturbance is: (4.4 m x 4.1 m)	18.04	-
9	Recovery of 25 kg grout bags	1,245 x 25 kg grout bags to be recovered i.e. 31.125 te. Area of disturbance assumes recovery of 1 te of grout bags temporarily impacts on 1 m² of seabed.	31.125	-
		Total	**16,209 m² 0.016 km²**	**5,502 m² 0.006 km²**

Notes:

- A separate line item has not been added for recovery of the jumper spools and umbilical jumpers listed in Table 3-1, as these lines occur beneath the mattresses and grout bags and therefore recovery would impact on the same area of seabed.
- The corridor width of rock cover for Group A is based on a required 0.6 m DoC and a slope of 1:3.
- * = The preferred option for Group B does not involve rock cover. However, spot rock cover may be required at points where the umbilicals are cut and removed such that a nominal 10 te of rock has been allowed for at each cut location on the Group B umbilicals.

Table 7-2 Area of disturbance for other acceptable decommissioning options identified in the CA.

No.	Activity	Assumptions Made	Area of Disturbance (m²)	
			Temporary	Permanent
1	Alternative acceptable options for decommissioning of PL2030/PL2032 (Group A)	Exposed ends and mid-line sections trenched and buried i.e. 760 m to be remediated. Assume trench and bury activities would temporarily impact on a corridor width of 10 m.	7,600	-
2		Remediate *in situ* with exposed sections cut and removed i.e. 760 m remediated. Corridor width of temporary disturbance assumed to be 2 m.	1,520	-
3	Alternative acceptable options for decommissioning of PLU2033/ PLU2034 (Group B)	Exposed ends and mid-line sections trenched and buried i.e. 363 m remediated (115 m for PLU2033 and 248 m for PLU2034). Assume trench and bury activities would temporarily impact on a corridor width of 10 m.	3,630	-
4		Exposed ends and mid-line sections rock covered i.e. 363 m to be remediated. Corridor width of 2.8 m rock allows for a depth of cover of 0.6 m. Estimated area of permanent disturbance is 363 m (L) x 2.8 m (W).	-	1,016

Table 7-3: Anticipated maximum/worst-case disturbance scenario.

Table 7-1 and Table 7-2 references	Activity	Area of Disturbance (m²)	
		Temporary	Permanent*
Row 1 of Table 7-1	Group A – addition of rock cover Exposed ends and mid-line sections rock covered.	-	5,472
Row 1 of Table 7-2	Group A- trench and bury Exposed ends and mid-line sections trenched and buried.	7,600	-
Row 4 of Table 7-2	Group B – rock cover Exposed ends and mid-line sections rock covered.	-	1,016
Row 3 of Table 7-2	Group B-trench and bury Exposed ends and mid-line sections trenched and buried.	3,630	-
Row 3 of Table 7-1	Group C- full removal	6,485	
Row 4-9 of Table 7-1	The footprint associated with the activities described in Rows 4-9 of Table 7-1.	8,998	-
	Total	**26,713 m² 0.027 km²**	**6,488 m² 0.007 km²**

7.1.1. Over trawl trials

If over trawl trials are required to demonstrate a 'a safe seabed', the area covered will include the footprint of activities captured within Table 7-4. The maximum area impacted by the over trawl trial is estimated to be *c.* 6.44 km². Table 7-3 shows the worst-case assumptions used to calculate this footprint.

Shell will continue to explore the use of a side scan sonar survey or similar to demonstrate a safe seabed and therefore minimise the area of temporary seabed disturbance.

Table 7-4: Estimate of area impacted by over trawl trials.

No.	Activity	Assumptions Made	Area impact by over trawl (km^2)
1	Over trawl at existing 500 m safety zones (Atlantic and Cromarty wells)	Assumes over trawling of 2 x 500 m safety zones: one at each of the fields. To allow for a turning area by the fishing vessel (where the trawl gear is not lifted), the footprint assumes that disturbance extends 400 m beyond the 500 m area. Therefore total area of disturbance at each drill centre is 2.54 km^2 (based on a radius of disturbance of 900 m)	5.09
2	Over trawl along the midline exposures on PL2030/PL2032	Assumes over trawl of a 100 m corridor along the 560 m mid-line exposures to be remediated *in situ*, between the Atlantic manifold and the Cromarty well and outside of 500 m safety zones.	0.056
3	Over trawl along length of PL2033 recovered	12.97 km of umbilical would be recovered. Over trawl trail of corridor impacted by recovery. Assumes a corridor width of 100 m.	1.297
Total			**6.44 km^2**
Notes: Over trawls of the full lengths of the Group A and B lines not considered necessary and all other sections to be mitigated are located within the 500 m zones captured in Row 1.			

7.2. Impact on Receptors

The proposed decommissioning activities have the potential to impact on the seabed and the habitats populated by the benthic communities in the area.

The maximum area of temporary seabed disturbance is 6.44 km^2 given that the temporary areas of impact associated with the various activities described fall within the footprint of the over trawl trials. However, this area of temporary impact would be significantly should side scan sonar surveys (or alternative) be used to show evidence of a safe seabed.

The maximum area of permanent seabed disturbance associated with the worst-case proposed decommissioning activities is 0.007 km^2 (Table 7-3).

Trenching activities and activities associated with recovery of the buried umbilicals physically disturbs the benthic communities and their habitat within the area impacted and may cause some smothering in the wider region due to the re-deposition of excavated material. In addition, a temporary plume of suspended solids may be created. While some, mostly epifaunal, organisms may be killed by the passage of the trenching machinery, the majority will be displaced and are likely to survive. Some of the exposed organisms may not be able to re-bury before being predated upon while others may be relocated by water movements.

Given the nature of the sediment in the area it is possible that disturbed sediment particles may be transported via tidal currents for re-settlement over adjacent seabed areas. Sessile epifaunal species may be particularly affected by increases in suspended sediment concentrations as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus (Nicholls *et al.*, 2003). In the case of

filter feeders, such as the juvenile *A. islandica*, an increased suspended sediment concentration could impact the ability to feed. Larger, more mobile animals, such as crabs and fish, are expected to be able to avoid areas of deposition and elevated suspended solid concentrations.

As discussed in Section 5.5.6, the OSPAR listed threatened and/or declining habitat 'sea pens and burrowing megafauna communities' may occur in the area. No adult specimens of the Scottish PMF *A. islandica* were identified although juveniles occurred in all of the grab sample taken during the surveys.

Feature Activity Sensitivity Tool (FEAST; Marine Scotland, 2020) reports that burrowed mud habitats (and the species that it supports, such as sea pens) show a medium sensitivity to sub-surface abrasion/penetration and surface abrasion, which may be caused by the over trawl trials. Experimental studies have shown that all three species of sea pen can re-anchor themselves in the sediment if dislodged (by fishing gear) (Eno *et al.*, 2001). In long-term experimental trawling, Tuck *et al.* (1998) found no effect on *V. mirabilis* populations and Kinnear *et al.* (1996) found that sea pens were quite resilient to being dragged or uprooted (by creels). *V. mirabilis* is able to withdraw into the sediment which may provide it with some protection from dislodgement (Hughes, 1988). P. phosphorea recovered within 72 – 96 hours after experimental smothering for 24 hours by pot or creel and after 96 – 144 hours of smothering for 48 hours (Kinnear *et al.* 1996; Eno *et al.* 2001).

The proposed decommissioning activities may therefore impact on the 'sea pens and burrowing megafauna communities' habitat, however this impact is not expected to be significant due to the very localised nature of the operations and the results of the studies cited.

Powilleit *et al.*, (2009) exposed *A. islandica* to increased sediment depths of up to 40 cm and found that the animals were able to burrow to the surface. Based on this evidence, Tyler-Walters and Sabatini (2017) conclude that a deposit of 30 cm of fine material is unlikely to have a negative impact on *A. islandica*. Therefore, though the proposed activities will result is the settling of suspended sediments over an extended area, the area over which burial depths exceed 30 cm is expected to be localised such that the impact of the proposed activities on *A. islandica* is not expected to be significant.

Any impacts from compression (caused for example by potential remedial rock cover) and sediment re-suspension are expected to be short lived since most of the smaller sedentary species associated with the area (such as polychaete worms) have short lifecycles and recruitment of new individuals from outside the disturbed area will be rapid. Recolonisation of the impacted areas can take place in a number of ways, including mobile species moving in from the edges of the area (immigration); juvenile recruitment from the plankton; and burrowing species digging back to the surface (Dernie *et al.*, 2003; Hiddink *et al.*, 2017). Recovery times for soft sediment faunal communities are difficult to predict, although some recent studies have attempted to quantify timescales. Benthic communities are observed to recover at rates similar to physical restoration (Kraus and Carter, 2018). Collie *et al.* (2000) examined impacts on benthic communities from bottom towed fishing gear and concluded that, in general, sandy sediment communities were able to recover rapidly, although this was dependent upon the spatial scale of the impact. It was estimated that recovery from a small-scale impact, such as a fishing trawl, could occur within about 100 days assuming that recolonisation was through immigration into the disturbed area rather than from settlement or reproduction within the area. Recovery through immigration would be expected to take longer for the more extensive trawled areas, and larval recruitment or local reproduction by surviving individuals may be more important determining factors.

The Minerals Management Service (MMS) (1999) quoting various sources, reports that recolonisation takes 1-3 years in areas of strong currents but up to 5-10 years in areas of low current velocity. A later study (Kraus and Carter, 2018) corroborates the finding that restoration is fastest in high energy environments with high sediment supply and slowest in lower energy environments further from

terrestrial sediment inputs. It compiles 12 case studies of subsea power cables that were surveyed at varying intervals after installation. In shallow inner continental shelf waters up to 30 m (not including sensitive nearshore habitats such as seagrass beds) recovery could be seen within a year but in deeper outer continental shelf – continental slope environments (approximately 80 to >130 m water depth) characterised by mud or sandy mud, full recovery could take more than 15 years. Longer recovery times are also reported for sands and gravels where an initial recovery phase in the first 12 months is followed by a period of several years before pre-extraction population structure is attained (MMS, 1999). Communities on gravel may be more sensitive because they generally have a larger proportion of longer living species with lower reproduction rates that take longer to recover (Hiddink *et al.*, 2017). Fine sediments such as the silts and sands, which occur in the A&C area, tend to recover much more quickly than the biologically controlled communities which characterise coarse deposits.

Recovery of the benthic communities also depends on the spatial and temporal scale of the disturbance. In their meta-analysis of the impacts of trawl gear on benthic communities, Hiddink *et al.*, (2017) found that more frequently trawled areas take longer to recover and that proximity to less impacted areas, from which individuals can migrate, also speeds up the recovery process. Given the short duration and small areas of seabed impacted by decommissioning operations, recovery can be expected to occur more quickly than it does in the case of wider ranging and longer-term disturbance.

Therefore, excluding the over trawl trial given the relatively small area of impact and the evidence for recovery from small scale impacts, the cumulative impact significance of the proposed activities on benthic communities is considered Minor. Given the extent of the footprint of the area disturbed by the over trawl trial, the impact significance is considered Moderate, however it is recognised that studies show the seabed will recover if left undisturbed from future fishing activity.

Evidence suggests that the sensitivity of fish to suspended sediments varies greatly between species and their life history stages and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe and Jensen, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to, and affected by, suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink 1999; Clarke and Wilber, 2000). This effect is greatest for juvenile fish as they have small easily clogged gills and higher oxygen demand (FeBEC 2010). As described in Section 5.5.2, a number of fish species recognised as PMFs occur in the area, and it is possible that suspended sediments in the water column resulting from the recovery, and/or trench and bury activities, could impact on individual fish including PMFs. However, given the short duration of the activities, any impacts on fish in the area will be at an individual level such that the impact significance is considered Slight.

7.3. Transboundary and Cumulative Impacts

Given the distance from the nearest transboundary line (*c.* 147 km), there are no transboundary impacts anticipated as a result of the activities captured in this Section.

As all surface laid infrastructure will be recovered, and any additional rock deposits will be minimised, the cumulative impact of the proposed activities in relation to other activities in the area is not considered significant.

7.4. Mitigation Measures

The following mitigation measures are proposed to minimise the environmental impacts on the seabed and its associated habits/ecosystem:

- Cutting/jetting/dredging and lifting procedures will be in place.
- Following cut and removal of exposed ends, if available preference will be given to backfilling/ reprofiling previously excavated material to remediate the exposed flowline and umbilical cut ends as opposed to adding spot rock cover.
- If used, additional rock deposits will be optimised and carefully managed. Size of rock and rock profiles will be in accordance with industry practice.
- A fallpipe will be used to lay any rock that may be used on the seabed.
- Preference will be given to the use of side scan sonar surveys (or similar) to determine a safe seabed.

Shell's commitment to adhering to the mitigation measures identified means that the environmental impact significance of decommissioning is not considered significant.

7.5. Conclusions

The proposed decommissioning activities associated with the Atlantic and Cromarty fields will result in localised short term disturbance to the seabed.

Over trawl trials used to confirm a safe seabed will result in the largest area of impact, and Shell will investigate the use of side scan sonar to determine a safe seabed and therefore remove this impact.

Should rock cover be added to mitigate the exposed pipeline and umbilical ends and mid-line sections, it is estimated that a total of 3,174 te (includes 10% contingency) would be required. As described previously there is existing rock cover in the area such that addition of this rock cover to the area can be considered to be increasing the footprint of existing hard substrate.

The activities assessed in this chapter will not contradict the NMP objectives and as the project progresses, Shell will aim to comply with the NMP policies. In addition, the Project will aim to comply with the oil and gas marine planning policies (Appendix B).

8. Legacy Impacts

When assessing the impact of the proposed activities during the ENVID Workshop (Section 6), several of the activities were considered to result in a potential legacy environmental or social impact. These legacy impacts are considered further here.

8.1. Project Activities (Source of Impact)

The following activities will, or may, result in a legacy impact:

- Decommissioning of the buried pipelines and umbilicals *in situ*;
- Decommissioning of the existing rock cover and rock covered concrete mattresses *in situ*; and
- Potential placement of additional rock cover.

8.2. Environmental Impacts of Infrastructure to be Decommissioned *In-Situ*

8.2.1. Buried Flowline and Umbilicals

Over time the trenched and buried sections of flowlines and umbilicals will break down. Analysis by Atkins indicates that the process of deterioration of rigid steel pipelines in saltwater environments may take from 220 to 600 years (Atkins, 2012) and OEUK suggests that steel structures below the seabed will corrode at rates in the region of 0.01 to 0.02 mm / year (OEUK, 2013). It is expected that the deterioration of plastics within the flowlines and umbilicals will take significantly longer (Dames *et al.*, 1999).

A dataset compiled by Solan *et al.* (2019), based on a literature review of papers published since 1864, found that the mixed sediment depth (bioturbation depth) in the North Sea is up to 25 cm. This means that any material remaining in the seabed sediments at a depth greater than this is unlikely to have any interaction with benthic organisms, provided that it remains buried to this depth.

8.2.1.1. Flowline and Umbilical Contents

As previously mentioned in Section 3.2.5, the A&C flowlines have been flushed and cleaned to reduce hydrocarbon content to ALARP. Production pipelines (including spools and jumpers) are considered hydrocarbon free having been flushed to reach an oil in water content of < 30 mg/l. Following flushing the production and MEG pipelines (including spools and jumpers) were filled with inhibited freshwater containing RX-5227. The umbilical cores are either filled with hydraulic fluids or a 50:50 MEG/water mix and as the lines corrode, their contents will be slowly released into the surrounding sediments. Given that:

- The release will be gradual;
- The flowlines have been flushed to reduce the oil contents to 'as to a level that is low as reasonably practicable';
- Following flushing the lines were filled with inhibited freshwater;
- The chemical cores within the umbilicals have been flushed: and
- The hydraulic fluids remaining with the umbilical are water-based,

The impact significance of these discharges is considered to be Minor.

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8.2.1.2. Metals

The steel and non-ferrous metals associated with the flowlines and umbilicals to be decommissioned *in situ* will over time become exposed to the surrounding sediment as they degrade.

The quantity of steel and non-ferrous metals that will be remain *in situ* will be dependent on whether the preferred decommissioning options are executed or one of the alternative options is executed (Table 8-1).

Table 8-1: Estimate of material left *in situ* depending on decommissioning option execute.

Activity	te		
	Steel	**Copper**	**Plastic**
Preferred decommissioning option executed for all pipelines and umbilicals (includes (i) leaving exposures on Group A in situ, (ii) removal of exposures for Group B (iii) recovery of Group C)	1,687.79	23.65	138.01
Maximum worst-case options*: Includes (i) leaving exposures on Group A *in situ*, (ii) leaving exposures on Group B *in situ* (iii) recovery of Group C	1,691.23	23.85	139.18

Table 8-1 demonstrates that the estimate of material left *in situ* does not vary markedly when different proposed decommissioning options are selected.

Some metals have the potential to exert toxic effects in biota and can bioaccumulate through the food web (Neff, 2002). Within benthic animals, accumulated metals may act as enzyme inhibitors, adversely affect cell membranes, damage reproductive and nervous systems, cause changes in metabolic and respiratory efficiency, affect growth and behaviour or act as carcinogens (Kennish, 1997; and Ansari *et al.*, 2004). Taking account of:

- The buried nature of the lines; and
- The slow anticipated rate of degradation;

the impact significant of the long-term environmental impact of the metals associated with the lines decommissioned in situ is considered Slight.

8.2.1.3. Plastics

The preferred decommissioning options for the pipelines and umbilicals would result in a total of *c.* 138 te of plastic left *in situ* (Table 8-1). It is thought the deterioration of plastics within the lines will take significantly longer than the time expected for the steel pipelines to degrade (Dames *et al.*, 1999).

The sea is a very complicated environment for the degradation of plastics because animals, microorganisms, salt, sunlight, fluctuations of water, etc. all play a part in the degradation process (Krasowska *et al.*, 2015).

The degradation of plastics can take hundreds to thousands of years. There are four mechanisms by which plastics degrade in the natural environment: photodegradation (action of light, usually sunlight), thermooxidative degradation (reaction with oxygen at moderate temperatures), hydrolytic degradation

(reaction with water), and biodegradation (action by microorganisms). In seawater, hydrolytic degradation is usually not a significant mechanism (Andrady, 2011).

The slow degradation process generally begins with photodegradation, where ultraviolet (UV) light from the sun provides the activation energy required to initiate the reaction with oxygen (thermooxidative degradation) (Webb *et al.*, 2012). As the plastic weakens and becomes brittle, mechanical forces such as wind, wave action, and abrasion with sediment can contribute to breaking the plastic into progressively smaller particles (Oliveira *et al.*, 2020). The plastic eventually becomes small enough to be metabolised by microorganisms (biodegradation) (Webb *et al.*, 2012).

When a plastic item is between 5 mm and 1 µm in size, it is defined as microplastic. Plastic items between 1 nm to 1 µm in size are defined as nano plastics (GESAMP, 2015). Microplastic and nano plastic contamination is considered a global environmental problem in the marine ecosystem. Due to their small size, they are easily ingested by a wide range of marine species from high to low trophic levels, particularly those who feed from the water column (e.g., zooplankton and fish) (Wright *et al.*, 2013). Microplastic ingestion can impede food intake, block the digestive tract, and cause physiological stress (e.g., immune responses, metabolism disorders, energy depletion, behavioural alterations, growth prevention, and reproduction disturbance) (GESAMP, 2015; Bai *et al.*, 2021). Plastics can then be transferred up the food chain when the zooplankton and fish etc. are ingested as prey by larger organisms (e.g., marine mammals) (Anderson, *et al.*, 2016).

Microplastics can also serve as a vector, transferring toxicants through the food chain (Rodrigues *et al.*,2019; Mei *et al.*, 2020). Firstly, the chemicals incorporated into plastics during production to improve its properties can leach out of weathered plastic debris. Many of these chemicals have endocrine disruptor activity and can lead to detrimental effects in marine biota (Gunaalan *et al.*, 2020). Secondly, microplastics may adsorb hazardous compounds from the water column, such as persistent organic pollutants (POP), due to their large surface area to volume ratio and hydrophobicity (water-repelling nature) (Rodrigues *et al.*, 2019).

In the marine environment, 90% of UV light from the sun is absorbed in the upper 50 m of the water column (Tedetti and Sempéré, 2006). At the seabed, the lack of UV light to initiate the degradation process, as well as lower temperatures and lower oxygen concentration makes extensive degradation far less likely compared to debris floating on the sea surface, or those on the beach (Andrady, 2011). As a result, the longevity of plastic debris increases with increasing depth. Although benthic plastics will eventually degrade via action by microorganisms (biodegradation), the process will be significantly slower than photodegradation (Chamas *et al.*, 2020). This is especially true for plastics buried in seabed sediment. Burial is an additional inhibitor of plastics degradation on the seafloor. The overlying sediment would, in addition to the water column itself, shield the plastics from UV light and warm temperatures, possibly leading to preservation of plastics in the sediment (Barrett *et al.*, 2020).

Physical forces such as heating / cooling or seabed movements could also cause mechanical damage such as the cracking of polymeric materials, however, this is not expected to impact on the A&C flowlines and umbilicals. Plastic components of the flowlines and umbilicals could be degraded and released into the sediments by mechanisms such as biodegradation. he growth of microorganisms within the sediment can also cause small-scale swelling and bursting of plastics (Krasowska *et al.*, 2015).

As the sections of flowlines and umbilicals to be decommissioned in situ are buried with a good depth of cover, it can be expected that the majority of the degradation sources described above (such as UV light and high temperatures), will not be relevant. In addition, given the buried status of the lines, any plastics degraded via biodegradation would be contained within the sediment and prevented from reaching the water column.

Taking account of:

- The buried nature of the lines;
- The slow anticipated rate of degradation;
- The low mechanical forces predicted to be acting on the lines; and
- The fact that much of the eventual plastic contaminants produced will be contained within the sediment and prevented from reaching the water column,

the long-term significance of the environmental impact of the plastics associated with the lines decommissioned *in situ* is considered Minor.

8.2.2. Existing Rock and Additional Rock Deposits

Approximately 11,500 te of rock cover has previously been deposited at various locations across the A&C fields. Some of this rock has been in place for over 18 years creating a habitat for benthic organisms that live on hard substrate. If the options to rock cover the exposed sections of the pipelines and umbilicals is selected, up to 3,174 te (includes 10% contingency) of additional rock will be required.

It is recognised that this additional rock will extend the current footprint of rock, changing the habitat where it is laid from a muddy habitat to a rocky one thereby providing a habitat for a different type of ecosystem. It is recognised the additional rock will create further hard substrate in an area of naturally softer seabed, however given the relatively small additional footprint (a maximum of 0.007 km^2) it is unlikely that the decommissioning *in situ* of existing rock or the introduction of any additional rock will have a significant impact on the benthic species that occur in the area. The environmental impact of decommissioning existing rock in situ or adding new rock to mitigate the exposed ends of the pipelines and umbilical is therefore considered Minor.

8.3. Socio-Economic Impacts of Infrastructure to be Decommissioned In-Situ

As described in Section 5.6.1, demersal trawl gear is used in the area of the A&C fields and therefore has the potential to interact with any infrastructure or rock remaining on the seabed. The buried pipelines and umbilical to be decommissioned in situ have a depth of lowering / cover in general of over 0.4 m and occur in an area where the seabed is stable. Trawl gear currently working in the area, have regularly traversed the buried sections of the pipelines and umbilical without any interaction.

Based on a range of penetration depths of main fishing gear components (demersal trawls, seines and dredges) across different sediment types as estimated from a literature review by Eigaard (Eigaard, et al., 2016), the depths of penetration from different fishing gear for a seabed dominated by mud and sand ranges from 0 cm to 35 cm. Any material remaining in the seabed sediments at a depth greater than 35 cm is therefore unlikely to have any interaction with fishing gear, providing that it remains buried to this depth.

Assuming a worst case whereby rock is used to mitigate the exposed sections of the trenched and buried pipelines and umbilical, *c.* 3,174 te of rock (includes 10% contingency) will be required. In the event that any rock cover is laid, the rock size and profiles selected will be in accordance with industry best practice and SFF recommended practice such that demersal trawl gear would be expected to be able to access the area.

Following decommissioning activities independent verification of the seabed state will be obtained and evidence of a safe seabed will be provided to all relevant governmental and non-governmental organisations.

As part of the DP process, Shell will commit to a post decommissioning survey strategy (agreed with OPRED) to monitor the burial status of the lines and stability of the rock profiles.

Therefore taking:

- the current buried condition of the lines into account;
- the stability of the seabed;
- the used of industry preferred rock size and profiles;
- demonstration of a safe seabed; and
- a post decommissioning survey strategy,

the socio-economic impact significance of these lines and rock being decommissioned in situ is considered Minor.

8.4. Transboundary and Cumulative Impacts

Given the distance from the nearest transboundary line (*c.* 147 km), there are no transboundary impacts anticipated as a result of the activities captured in this Section.

As all surface laid infrastructure will be recovered, and any additional rock deposits will be minimised, the cumulative legacy impacts of the proposed activities in relation to other activities in the area is not considered significant.

8.5. Mitigation Measures

The following mitigation measures are proposed to minimise the environmental and socio-economic impacts associated with the infrastructure to be decommissioned *in situ* and any additional rock deposits.

- All surface laid infrastructure will be removed and recovered.
- A safe seabed will be achieved as part of the decommissioning activities.
- Following cut and removal of exposed ends, if available preference will be given to backfilling/reprofiling previously excavated material to remediate the exposed flowline and umbilical cut ends as opposed to adding spot rock cover.
- Lines decommissioned in situ have been flushed to reduce hydrocarbons and chemicals to 'as low as reasonably practicable'.
- If used, additional rock deposits will be optimised and carefully managed. Size of rock and rock profiles will be in accordance with industry practice.
- Locations of remaining materials will be marked on FishSAFE.
- Adherence to a post-decommissioning survey strategy agreed with OPRED.

8.6. Conclusions

Shell's commitment to adhering to the mitigation measures identified means that the environmental and socio-economic impact significance of decommissioning the buried flowlines, umbilicals, existing rock and any new rock *in situ* is considered low.

The activities assessed in this chapter will not contradict the NMP objectives and as the project progresses, Shell will aim to comply with the NMP policies. In addition, the Project will aim to comply with the oil and gas marine planning policies (Appendix B).

9. Atmospheric Emissions

When assessing the impact of the proposed activities in the ENVID (Section 6), the impacts on climate change and air quality were considered Slight when the assessment methodology described in Appendix A was applied. The predominant source of emissions associated with the proposed decommissioning activities at the A&C fields is emissions from the vessels using during the operations.

The main combustion products associated with power generation on the vessels is CO_2 with small quantities of methane (CH_4), volatile organic compounds (VOCs), oxides of nitrogen (NOx), carbon monoxide (CO) and very small quantities of nitrous oxide (N_2O) and sulphur dioxide (SO_2).

In 2020, the UK's independent Committee on Climate Change (CCC) released their publication 'Net Zero: The UK's contribution to stopping global warming' (CCC, 2020). In the report, the CCC concluded that it is achievable for the UK to implement a new target of net-zero greenhouse gas (GHG) emissions by 2050 in England and Wales, and by 2045 in Scotland. The report acknowledges that a diverse energy mix is needed in the transition to a net-zero future to maintain security of supply, which includes the continued extraction and use of oil and gas.

To achieve the net zero goal, the CCC report calls for concerted effort and action by all to reduce emissions and for any remaining emissions in 2050 to be offset. As part of this, the offshore oil and gas industry is focussed on the continued management and reduction of its operational emissions (OEUK, 2021) and the North Sea Transition Deal (NSTD) (DESNZ, 2021) further commits the sector to early targets for the reduction of greenhouse gas emissions from production, against a 2018 baseline.

Greenhouse gases differ in their abilities to trap heat. Global Warming Potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere; usually expressed as CO_2 equivalent (CO_2e). For example, CH_4 is estimated to have a GWP up to 34 times greater than CO_2 over 100 years (Intergovernmental Panel on Climate Change (IPCC), 2014), although it has a shorter life span in the atmosphere. Overall, CO_2e emissions from UK upstream oil and gas operations in 2018 contributed three percent (14.63 million te) of total domestic CO_2e emissions (OEUK, 2021).

9.1. Impact on Receptors

Table 9-1 shows the expected worst case vessel emissions based on predicted vessel requirements identified in Table 3-5. Emissions factors used were taken from the Environmental Emissions Monitoring System (EEMS) Atmospheric Emission Calculations guidance (EEMS, 2008).

Table 9-1: Predicted atmospheric emissions associated with the proposed vessel use.

Source		Atmospheric emissions (te)							
		CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC	CO_2e[2]
EEMS Emissions Factor [1]		3.2	0.0594	0.00022	0.002	0.0157	0.00018	0.002	-
GWP		1	-	265	-	-	28	-	-
Total fuel use (see Table 3-5)	1,375	4,400	82	0.30	2.75	22	0.25	2.75	4,487
2018 total upstream UKCS emissions [3]									18,900,000
Total project emissions as a % of UKCS emissions in 2018									0.024
2022 UKCS Upstream O&G CO_2e Emissions [3]									14,300,000
Total Emissions as a % of UKCS Upstream O&G CO_2e Emissions, 2021									0.031

[1] Emissions calculated using EEMS emission factors (EEMS, 2008).

[2] CO_2e figure is calculated by multiplying CO_2, N_2O and CH_4 by their relevant GWP value (IPCC, 2014).

[3] OEUK, 2023.

The emissions from the anticipated vessel use will amount to approximately 0.024% of the total upstream UKCS emissions in 2018 and approximately 0.031% of the total upstream UKCS emissions in 2022 (Table 9-1) and therefore represents a small contribution to total UKCS emissions.

The emissions associated with these operations may result in short-term deterioration of local air quality within the vicinity of the well location, however, in the exposed conditions that prevail offshore, these emissions are expected to disperse rapidly such that they are not expected to have a significant impact on air quality. These emissions will also have a cumulative effect on climate change as described in Section 9.2.

9.2. Transboundary and Cumulative Impacts

The A&C fields are *c.* 147 km from the UK/Norway median line, therefore transboundary impacts with respect to air quality are not expected to occur.

The potential cumulative effects associated with the atmospheric emissions produced by vessel use during the decommissioning operations include global warming (greenhouse gases), acidification (acid rain) and local air pollution as well as, elevated levels of atmospheric emissions in the immediate area. The emissions associated with these operations may result in short-term deterioration of local air quality within the vicinity of the A&C fields, however, in the exposed conditions that prevail offshore, these emissions are expected to disperse rapidly such that emissions from the vessels are not considered to have a significant impact. Given the worst-case estimates of emissions presented, the cumulative impact is also not considered to be significant.

9.3. Mitigation Measures

The impact of the vessel emissions will be mitigated by optimising vessel efficiency (i.e. minimising the number of vessels used and vessel trips required) and hence minimising fuel use and avoiding the unnecessary operation of power generation/combustion equipment. Shell will review the Offshore Vessel Inspection Database (OVID) as part of the vessel assurance process. Due to the high dispersion rates and minimal nature of the emissions in relation to total UKCS emissions, no further mitigation measures are proposed.

9.4. Conclusions

Emissions generated during the proposed operations are expected to disperse quickly and with the mitigation measures in place, are not expected to have a significant impact on air quality such that the impact significance is considered Slight. It is recognised the emissions will contribute to climate change, however given the quantity of emissions associated with the proposed activities, the impact significance is considered Minor.

The activities assessed in this chapter will not contradict the NMP objectives and as the project progresses, Shell will aim to comply with the NMP policies. In addition, the Project will aim to comply with the oil and gas marine planning policies (Appendix B).

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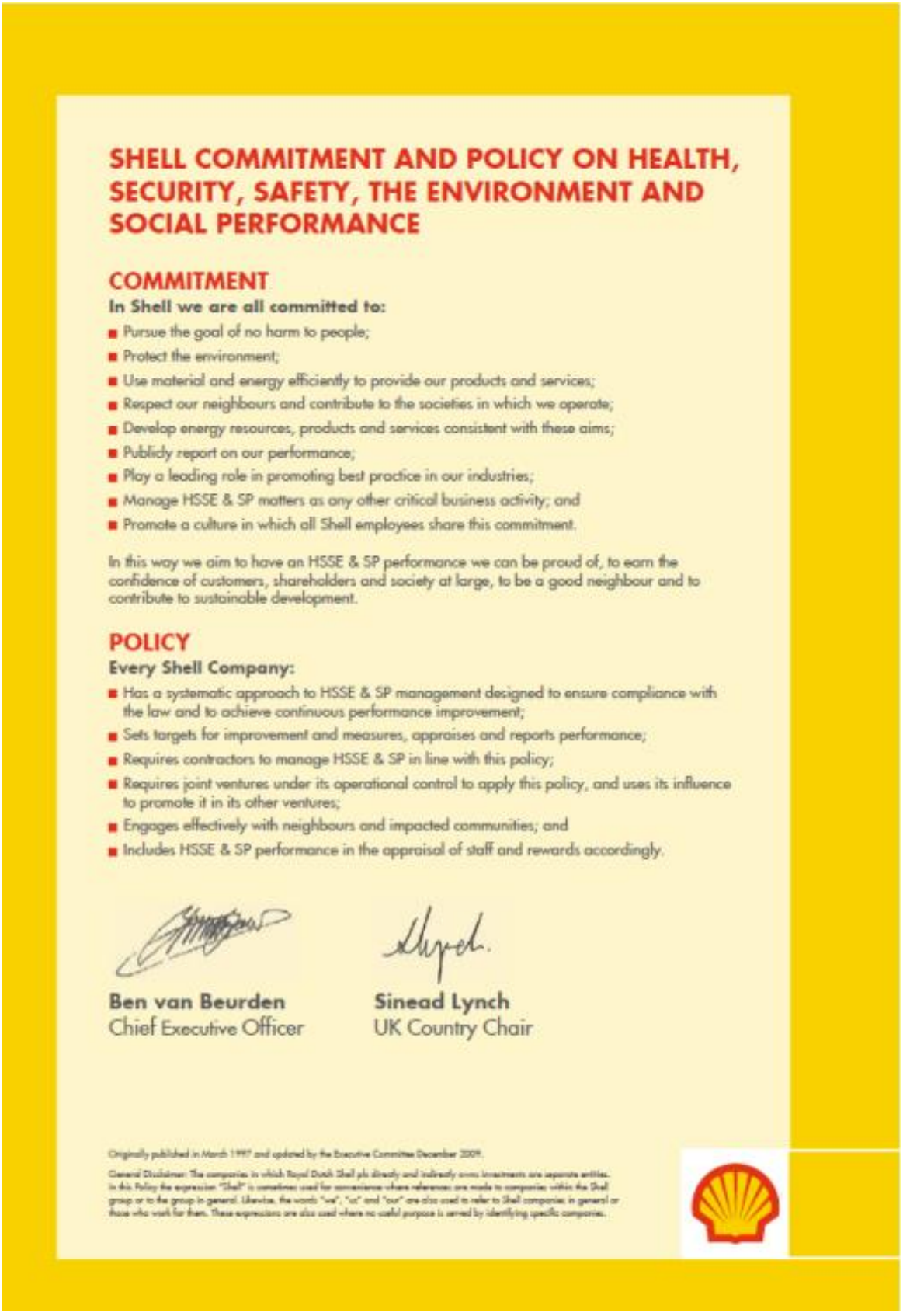
10. Environmental Management

Shell's Environmental Management System (EMS) is integrated into the Shell UK Health, Safety and Environment (HSE) Management System. The EMS is a system of internal controls that demonstrates how Shell complies with laws and regulations, and which facilitates the implementation of the company's HSE policy. The EMS is independently verified to ISO 14001:2015, which meets the requirements of OSPAR Recommendation 2003/5 to promote the use and implementation of EMSs by the offshore industry.

A copy of the Shell Policy on Health, Safety, Security, Environment and Social Performance (HSSE-SP) is shown in Figure 10-1. This Policy contains a commitment to protect the environment and states that Shell has a systematic approach to HSSE-SP management designed to ensure compliance with the law and to achieve continuous performance improvement.



SHELL COMMITMENT AND POLICY ON HEALTH, SECURITY, SAFETY, THE ENVIRONMENT AND SOCIAL PERFORMANCE

COMMITMENT

In Shell we are all committed to:

- Pursue the goal of no harm to people;
- Protect the environment;
- Use material and energy efficiently to provide our products and services;
- Respect our neighbours and contribute to the societies in which we operate;
- Develop energy resources, products and services consistent with these aims;
- Publicly report on our performance;
- Play a leading role in promoting best practice in our industries;
- Manage HSSE & SP matters as any other critical business activity; and
- Promote a culture in which all Shell employees share this commitment.

In this way we aim to have an HSSE & SP performance we can be proud of, to earn the confidence of customers, shareholders and society at large, to be a good neighbour and to contribute to sustainable development.

POLICY

Every Shell Company:

- Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires contractors to manage HSSE & SP in line with this policy;
- Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures;
- Engages effectively with neighbours and impacted communities; and
- Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

Ben van Beurden
Chief Executive Officer

Sinead Lynch
UK Country Chair

Originally published in March 1997 and updated by the Executive Committee December 2009.

General Disclaimer: The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this Policy the expression "Shell" is sometimes used for convenience where references are made to companies within the Shell group or to the group in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell companies in general or those who work for them. These expressions are also used where no useful purpose is served by identifying specific companies.

Figure 10-1: Shell UK HSSE-SP Commitment & Policy.

11. Conclusions

The infield infrastructure associated with the A&C fields is to be decommissioned by Shell. Included in the decommissioning activities is the recovery of all subsea structures, spools, jumpers, exposed mattresses, concrete tunnels, a concrete deflector, and exposed 25 kg grout bags.

A CA was carried out to determine the optimal approach to decommissioning the buried pipelines and umbilicals. A preferred option whereby the exposed sections are to be rock covered was selected for the piggy backed pipelines (PL2030 and PL2032: Group A). The preferred option for the flexible EHC umbilicals (PLU2033 and PLU2034: Group B) with DoC > 0.6 m was to recover the exposed sections. In addition to the preferred option, several other acceptable options were identified for the decommissioning of the pipelines and umbilicals. For Group A the acceptable options included trenching and burying exposed sections as well as recovery of exposed sections. For Group B the acceptable options also included trenching and burying exposed sections as well as utilising rock cover for the exposed sections. The only acceptable option for the flexible EHC umbilicals (PLU2033 and PLU2034: Group C) with DoC < 0.6 m was full removal.

Following a detailed review of the project activities, the environmental sensitivities of the project area, industry experience and stakeholder concerns, it was determined that further assessment of the following issues was required to properly define the potential impact of the proposed decommissioning activities for the A&C fields:

- Seabed disturbance impacts – during recovery of infrastructure, potential trench and bury activities, potential rock cover and over trawl sweeps/ trials.
- Legacy impacts:
    - The release of chemicals, and the breakdown of metals and plastic as material decommissioned *in situ* degrades.
    - The physical presence of infrastructure decommissioned in situ on other sea users, both in terms of physical exclusion and risk of snagging.
- Atmospheric emissions associated with vessel use.

A review of each of these potentially significant environmental interactions has been completed. Considering the mitigation measures that will be built into the decommissioning project activities, the impact of all activities apart from the over trawl survey was considered to be either Slight or Minor such that the impacts are not considered to degrade or impair the function and value of the impacted receptors.

The impact significance of the potential over trawl trial is considered Moderate such that the impacts are likely to be noticeable though the overall value of the receptors is not disrupted. Shell will continue to consider the potential to use an alternative approach such as SSS to provide evidence of a safe seabed.

As part of this review, cumulative and transboundary impacts were assessed and determined to be not significant.

The potential impact on protected sites in the wider vicinity has been considered in the assessment. The protected sites in closest proximity to the fields are the Southern Trench NCMPA located *c.* 39 km south-west of the fields and the Turbot Bank NCMPA located *c.* 58 km south of the fields. Having assessed the impact of the decommissioning activities, there is not expected to be a significant impact on any protected sites.

The EA has considered the objectives and marine planning policies of the Scottish NMP across the range of policy topics including biodiversity, natural heritage, cumulative impacts and oil and gas. Shell considers that the proposed decommissioning activities are in broad alignment with such objectives and policies. Similarly, Shell considers that the proposed activities are aligned with the oil and gas specific marine planning policies.

Based on the findings of this EA and the identification and subsequent application of the mitigation measures identified for each potentially significant environmental and societal impact, it is concluded that the proposed A&C infield decommissioning activities will result in no significant environmental or societal impacts.

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13. Appendix A: Shell Impact Assessment Methodology and Matrices

13.1. Impact Identification and Aspects

Initially, potential impacts were identified using the environmental aspects in Table 13-1. Each environmental impact was assessed for significance to determine those impacts which require active management.

Table 13-1: Environmental aspects used for the ENVID.

No.	Environmental Aspect	Definition/Comments
Emissions to air		
1	Gaseous Emissions	The emission of hazardous gases (such as but not limited to CO_2, NOx, SOx, CO, SO_2, H_2S, CH_4) resulting from flaring off, venting, heating, leaks, transport, etc. Comment: this concerns continuous emissions (flares, vents, heating installations, losses through leaks), discontinuous emissions (well tests, depressurising installations), leaks of HCFCs from cooling installations and emissions arising from accidental fires and explosions.
Discharges to water		
2	Fluids and other materials into water	The controlled discharge to surface water of production water, household waste water, decontamination water, drainage water at well points, (contaminated) rainwater and discharge to sewer as part of normal operations. The discharge of oil, chemicals and other materials as a result of incidents including for example vessel collision and dropped objects. Comment: this concerns both discharges offshore and to surface waters onshore.
Effects on land including groundwater		
3	Fluids into soil	The controlled or uncontrolled discharge of liquids such as rainwater, oil and condensate into the soil (soil and groundwater). Includes discharges and spills arising as a result of accidental events e.g. fire and explosion. Comment: the surface water can also become contaminated as a result of infiltration and runoff.
4	Waste Materials	All materials that the holder disposes of, with the intention of permanent removal. Waste includes hazardous waste, operational waste, office waste, domestic waste, clinical waste, WEEE, batteries and small volumes of chemical waste. Important waste materials are drilling fluid / drilling dust, production water, waste water, contaminated soil and waste contaminated with mercury and LSA.

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No.	Environmental Aspect	Definition/Comments
5	Disruption to the soil and subsoil	1) Disruption to the subsoil resulting from product extraction with the possible consequence being earth tremors and subsidence. 2) Disruption to soil layers as a result of drilling, pile driving and seismic shot holes with the possible consequence being the lowering of the water table, seepage, etc.
Extraction and consumption of resources		
6	Raw materials, additives and materials	The use of (depletable or regulated) raw materials additives and materials for operational purposes. Comment: including chemicals; excluding water.
7	Water consumption	The operational and incidental consumption of water for instance for combating emergencies (killing wells, fighting fires), cooling, rinsing, cleaning activities, catering, making shot holes. Comment: this concerns seawater, fresh surface water, groundwater and mains water.
8	Energy consumption	The use of energy carriers such as natural gas, diesel oil, petrol, kerosene, electricity for operating installations, transport and (office) buildings.
9	Usage of space	The temporary or permanent use of space that has an influence on the flora, fauna and the appearance of the landscape. Also includes physical presence in the context of other stakeholders including fishing vessels and other shipping movements. Examples: installations, pipelines, buildings, transport, survey operations.
10	Product extraction	The extraction of oil, gas, condensate and sulphur (as depletable resources). Comment: subsidence and earth tremors as effects of this are included in a separate environmental aspect (no. 5).
Others		
11	Radiation (heat and ionising)	Disruption to the surroundings resulting from heat radiation and ionising radiation from natural and unnatural sources. Example of heat radiation: flaring during production activities and well testing. Example of ionising radiation: the settling of LSA in sludge and parts of an installation (and as a result in materials and equipment), and radiation emitted by measuring equipment (drilling tools, x-ray equipment).

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No.	Environmental Aspect	Definition/Comments
12	Noise and vibrations	Disruption to the surroundings as a result of operational and incidental noise and vibration resulting from operational activities. Examples: seismic vibration vehicles and explosives, pile driving activities, drilling activities, etc.
13	Smell / odour	Disruption to the surroundings resulting from operational activities. Examples: ammonia, H_2S, combustion gases, hydrocarbons.
14	Light	Disruption to the surroundings (mainly at night) by light radiated from locations and operational activities. Examples: drilling rigs, offshore platforms and seismic vehicles.
15	Dust	Disruption to the surroundings from dust particles such as those created by construction and abandoning activities and during the execution of sandblasting and painting activities. Examples: grit, asbestos, blown sand.
16	Materials to subsurface/disturbance to the soil or subsoil	The intended or unintended introduction of liquids and gases in deep layers of the earth, including associated earth tremors and subsistence. For instance: the injecting of production water into layers of the earth intended for it: the undesired leaking into formations of drilling fluid and possibly the future injection of CO_2.
17	Aesthetics	Disruption to local residents and visitors to an area. Examples: landscape and visual effects.
18*	Biodiversity	Disruption to flora, fauna and ecosystems both onshore and offshore including seabed disturbance. Examples: effects on local, national and internationally important ecological interests including protected habitats and species.
* For impact assessment, biodiversity is considered in terms of receptor sensitivity for aspects 1 - 17.		

13.2. Assessment of Impact Significance

The significance of environmental impacts was assessed in terms of:

- Magnitude based on the size, extent and duration of the impact;
- The sensitivity of the receiving receptors;
- The likelihood of an unplanned event occurring.

13.2.1. Magnitude

Levels of magnitude of environmental impacts are outlined in Table 13-2. The magnitude of an impact or predicted change takes into account the following:

- Nature of the impact and its reversibility;
- Duration and frequency of an impact;
- Extent of the change; and
- Potential for cumulative impacts.

The impact magnitude is defined differently according to the type of impact. For readily quantifiable impacts, such as discharge volumes, numerical values can be used whereas for other topics (e.g. ecology), a more qualitative definition may be necessary.

Table 13-2: Magnitude.

Level	Definition	Environmental Impact
0	No effect	• No environmental damage or effects.
1	Slight effect	• Slight environmental damage contained within the premises. Example: Small spill in process area or tank farm area that readily evaporates; • Effects unlikely to be discernible or measurable; • No contribution to transboundary or cumulative effects; • Short-term or localised decrease in the availability or quality of a resource, not effecting usage.
2	Minor effect	• Minor environmental damage, but no lasting effects; • Change in habitats or species which can be seen and measured but is at same scale as natural variability; • Unlikely to contribute to trans-boundary or cumulative effects; • Short-term or localised decrease in the availability or quality of a resource, likely to be noticed by users.
3	Moderate effect	• Environmental damage that will persist or require cleaning up; • Widespread change in habitats or species beyond natural variability; • Observed off-site effects or damage, e.g. fish kill or damaged vegetation; • Groundwater contamination; • Localised or decrease in the short-term (1-2 years) availability or quality of a resource affecting usage; • Local or regional stakeholders' concerns leading to complaints; • Minor transboundary and cumulative effects.
4	Major effect	• Severe environmental damage that will require extensive measures to restore beneficial uses of the environment;

Level	Definition	Environmental Impact
		• Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort; • Major oil spill over a wide area leading to campaigns and major stakeholders' concerns; • Transboundary effects or major contribution to cumulative effects; • Mid-term (2-5 year) decrease in the availability or quality of a resource affecting usage; • National Stakeholders' concern leading to campaigns affecting Company's reputation.
5	Massive effect*	• Persistent severe environmental damage that will lead to loss of use or loss of natural resources over a wide area; • Widespread long-term degradation to the quality or availability of habitats that cannot be readily rectified; • Major impact on the conservation objectives of internationally/nationally protected sites; • Major trans-boundary or cumulative effects; • Long-term (≥5 year) decrease in the availability or quality of a resource affecting usage; • International public concern.
*To be used for unplanned events only		

13.2.2. Receptor Sensitivity

Receptors could be categorised into different groups:

- Atmosphere;
- Water (Marine, Estuarine, River or Groundwater);
- Habitat or species;
- Community; and
- Soil or seabed.

Receptor sensitivity criteria are based on the following key factors:

- **Importance of the receptor at local, national or international level:** for instance, a receptor will be of high importance at international level if it is categorised as a designated protected area (such as Ramsar site or Special Area of Conservation (SAC)). Areas that may potentially contain e.g. Annex I Habitats are of medium importance if their presence/extent has not yet been confirmed.
- **Sensitivity/vulnerability of a receptor and its ability to recovery:** for instance, certain species could adapt to changes easily or recover from an impact within a short period of time. Thus, as part of the receptor sensitivity criteria (Table 13-3) experts should consider immediate or long term recovery of a receptor from identified impacts. Should also consider if the receptor is under stress already.
- **Sensitivity of the receptor to certain impacts:** for instance, flaring emissions will potentially cause air quality impacts and do not affect other receptors such as seabed.

Table 13-3: Sensitivity.

Sensitivity	Definition
Low (A)	Receptor with low value or importance attached to them, e.g. habitat or species which is abundant and not of conservation significance. Immediate recovery and easily adaptable to changes.
Medium (B)	Receptor of importance e.g. recognised as an area/species of potential conservation significance for example, Annex I Habitats of Annex II species. Recovery likely within 1-2 years following cessation of activities, or localised medium-term degradation with recovery in 2-5 years.
High (C)	Receptor of key importance e.g. recognised as an area/species of potential conservation significance with development restrictions for example SACs, Marine Protected Areas (MPAs). Recovery not expected for an extended period (>5 years following cessation of activity) or that cannot be readily rectified.

13.3. Evaluation of Significance

13.3.1. Planned Events

The magnitude of the impact and sensitivity of the receptor was then combined to determine the impact of significance as shown in Table 13-4. Mitigation measures were then identified to reduce the impact. The residual impact following mitigation was then determined.

Table 13-4: Evaluation of significance - planned events.

		Sensitivity		
		A - Low	**B - Medium**	**C - High**
Magnitude	**0 - No effect**	No effect	No effect	No effect
	1 - Slight effect	Slight	Slight	Minor
	2 - Minor effect	Minor	Minor	Moderate
	3 – Moderate effect	Minor	Moderate	Major
	4 - Major effect	Moderate	Major	Major

13.3.2. Unplanned Events

For unplanned events, the likelihood of such an event occurring also requires consideration. For example, based on magnitude and sensitivity alone, a hydrocarbon spill associated with a total loss of fuel inventory could be classed as having a major impact significance; however, the likelihood of such an event occurring is very low. Thus, unplanned events also require assessment in terms of environmental risk.

As with planned activities, the potential impacts of unplanned events were identified and their magnitude and the sensitivity of the environment defined and combined in order to determine the impact significance. The significance of the impact was then combined with the likelihood of the event occurring (Table 13-5), in order to determine its overall environmental risk as summarised in Table

13-6. Mitigation measures were then identified to reduce the risk of such an event occurring in order to determine residual risk.

Table 13-5: Likelihood criteria.

Likelihood	Definition
A	• Never heard of in the industry - Extremely remote; • <10-5 per year; • Has never occurred within the industry or similar industry but theoretically possible.
B	• Heard of in the industry – Remote; • 10^{-5} – 10^{-3} per year; • Similar event has occurred somewhere in the industry or similar industry but not likely to occur with current practices and procedures.
C	• Has happened in the Organisation or more than once per year in the industry – Unlikely; • 10^{-3} – 10^{-2} per year; • Event could occur within lifetime of similar facilities. Has occurred at similar facilities.
D	• Has happened at the location or more than once per year in the Organisation – Possible; • 10^{-2} – 10^{-1} per year; • Could occur within the lifetime of the development.
E	• Has happened more than once per year at the location – Likely; • 10^{-1} - >1 per year; • Event likely to occur more than once at the facility.

Table 13-6: Evaluation of environmental risk - unplanned events.

		Likelihood				
		A	**B**	**C**	**D**	**E**
Impact significance	**0 - No effect**	No effect				
	1 - Slight effect	Negligible	Negligible	Minor	Minor	Minor
	2 - Minor effect	Negligible	Minor	Minor	Moderate	Moderate
	3 – Moderate effect	Minor	Minor	Moderate	Moderate	Major
	4 - Major effect	Moderate	Moderate	Moderate	Major	Major
	5 – Massive effect	Major	Major	Massive	Massive	Massive

Table 13-7 provides the definitions of impact significance for planned and unplanned events, along with the required management procedures depending on the impact significance.

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13.3.3. Definition of Significance

Table 13-7 provides a description of each impact significance ranking.

Table 13-7: Impact significance definitions.

Impact	Definition	Management
Massive (unplanned events)	**"Significant"** Impacts with a "massive" significance are likely to result in major long-term and wide-spread damage to the function and value of the resource/ receptor / habitat, and may have a broader systemic (e.g. ecosystem or social well-being) consequences.	• Top priority for mitigation to prevent or reduce the consequences of the unplanned events. • Impact mitigation hierarchy must be applied to reduce the impact significance. • Written demonstration of ALARP. • Apply a Bow-Tie or equivalent methodology for risk management of accidental events per Shell Risk Management manual.
Major	**"Significant"** Impacts with a "major" significance are likely to disrupt the function and value of the resource/ receptor, and may have a broader systemic (e.g. ecosystem or social well-being) consequences.	• Top priority for mitigation to avoid or reduce the consequences. • Impact mitigation hierarchy must be applied to reduce the impact significance. • Identify criteria for the best available technique (BAT) and apply these criteria. • Written demonstration of BAT or ALARP (As Low As Reasonable Practicable). • For accidental events, apply a Bow-Tie or equivalent methodology for risk management of accidental events per Shell Risk Management manual.
Moderate	**"Significant"** Impacts with moderate significance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause degradation of the resource or receptor, although the overall function and value of the resource or receptor is not disrupted.	• These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact. • Impact mitigation hierarchy must be applied to reduce the impact significance • BAT or equivalent ALARP must be demonstrated.
Minor	**Detectable but not significant** Impacts are expected to be noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation or impair the function and value of the resource or receptor.	• Warrant the attention and should be avoided and mitigated where practicable • Businesses may set lower priority for further Risk reduction • Manage for continuous improvement through effective implementation of the HSSE & SP Management System.

Impact	Definition	Management
Slight / Negligible	**Not significant** Any impacts are expected to be indistinguishable from the baseline or within the natural level of variation.	• Impacts do not require further mitigation and are not a concern for decision making. • Management within the existing management standards (MS) processes and practices.
No effect	-	-

14. Appendix B: Assessment Against Relevant Policies

14.1. Scotland's National Marine Plan

Scotland's NMP (Marine Scotland, 2015) covers the management of both Scottish inshore waters (out to 12 nm) and offshore waters (12 to 200 nm). The aim of the NMP is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the NMP areas. The activities associated with the proposed Atlantic and Cromarty Decommissioning Project have been assessed against each of the NMP objectives, details of which can found in Table 14-1.

Table 14-1: Scotland's NMP Planning Principles.

Scotland's NMP Principle Number	Assessment Against Principle
GEN 1 General planning principle	
There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	The proposed project is the decommissioning of an existing field. The EA assesses the impacts to the environment and to other sea users.
GEN 3 Social benefit	
Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.	The EA considers impacts to other sea users in decision making e.g. fisheries and pipelines. Lifecycle of the project is assessed for environmental and economic implications.
GEN 4 Co-existence	
Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision-making processes, when consistent with policies and objectives of this Plan.	Shell will ensure that any potential impacts on other sea users associated with the decommissioning operations will be kept to a minimum, and that liaison with other marine users will be undertaken prior to and during the decommissioning phase.
GEN 5 Climate change	
Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	Vessel movements and therefore associated fuel use will be minimised.
GEN 9 Natural heritage	
Development and use of the marine environment must: a) Comply with legal requirements for protected areas and protected species. b) Not result in significant impact on the national status of Priority Marine Features. c) Protect and, where appropriate, enhance the health of the marine area.	Decommissioning activities will take account of existing environmental surveys in the area to minimise the impact to any PMFs.

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Scotland's NMP Principle Number	Assessment Against Principle
GEN 10 Invasive non-native species	
Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	All vessels will follow IMO regulations. All vessels will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GEN 11 Marine litter	
Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	Contractor management plans will be in place. All vessels will follow IMO requirements.
GEN 12 Water quality and resource	
Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, MSFD or other related Directives apply.	Discharges to sea resulting from the proposed decommissioning activities were considered in the ENVID and not considered significant.
GEN 13 Noise	
Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.	There will be no piling or explosive use associated with the proposed activities. Vessel noise is not expected to significantly impact on the receptors in the area.
GEN 14 Air quality	
Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.	Given the offshore location, impacts of vessel emissions are not considered significant and will be minimised through project planning.
GEN 21 Cumulative impacts	
Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.	Cumulative impacts are considered in the EA and are considered proportionate to the size of the project. Cumulative impacts will be limited to impacts on climate change. Project planning will minimise the use of vessels.

14.2. Marine Strategy Framework Directive (MSFD)

The aim of the European Union's MSFD is to protect more effectively the marine environment across Europe. The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities which supports the sustainable use of marine goods and services. The overarching goal of the Directive is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment. Note following Brexit, the UK has made amendments to the Marine Strategy Regulations 2010, which transpose the requirements of the EU's Marine Strategy Framework Directive into domestic law, so that they continue to be effective now that the UK is no longer part of the EU.

The MSFD does not state a specific programme of measures that Member States should adopt to achieve GES, except for the establishment of MPAs. The MSFD does, however, outline 11 high level descriptors of GES in Annex I of the Directive. The activities associated with the proposed Atlantic and Cromarty Decommissioning Project have been assessed against each of the GES descriptors details of which can be found in Table 14-2.

Table 14-2: The proposed Atlantic and Cromarty Decommissioning Project assessed against the MSFD GES descriptors.

Marine Strategy Framework Directive: Good Environmental Status Objectives	Assessment Against Objective
GES 1	
Biological diversity is maintained and recovered where appropriate. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	Linked to GEN 9. Environmental surveys undertaken in the project area.
GES 2	
Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.	Linked to GEN 10. All vessels will follow IMO regulations. All vessels will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GES 3	
Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	Linked to GEN 9. Environmental surveys undertaken in the project area.
GES 4	
All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full	Linked to GEN 9. Environmental surveys undertaken in the project area.

Marine Strategy Framework Directive: Good Environmental Status Objectives	Assessment Against Objective
reproductive capacity.	
GES 5	
Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters.	Linked to GEN 9. Environmental surveys undertaken in the project area.
GES 6	
Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	Linked to GEN 9. Environmental surveys undertaken in the project area.
GES 7	
Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	Linked to GEN 12. Seabed disturbance and potential impact on marine ecosystems assessed in EA.
GES 8	
Concentrations of contaminants are at a levels not giving rise to pollution effects.	Linked to GEN 12. The proposed activities will not result in the noticeable deterioration of water quality in the project vicinity.
GES 9	
Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.	Linked to GEN 12. The proposed activities will not result in the noticeable deterioration of water quality in the project vicinity.
GES 10	
Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	Linked to GEN 11. Contractor management plans will be in place. All vessels will follow IMO requirements.
GES 11	
Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	Linked to GEN 11. Contractor management plans will be in place. All vessels will follow IMO requirements.

14.3. Oil and Gas Marine Planning Policies

Objectives and policies for the Oil and Gas sector should be read subject to those set out in the NMP and the MSFD. It is recognised that not all of the objectives can necessarily be achieved directly through the marine planning system, but they are considered important context for planning and decision making. The proposed project activities have been assessed against the oil and gas marine planning policies, details of which can be found in Table 14-3.

Table 14-3: Oil and Gas Marine Planning Policies.

Oil and Gas Marine Planning Policies	Assessment Against Policy
Oil & Gas 1	
The Scottish Government will work with BEIS, the new Oil and Gas Authority and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	Shell have used and will continue to use BAT as a key tool for the proposed Project. Environmental risks addressed/assessed where necessary in the EA.
Oil & Gas 2	
Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	Infrastructure will be decommissioned in line with legislation in force at the time. The DP will be developed in consultation with the relevant statutory authorities and will ensure that potential effects on the environment resulting from the decommissioning activities are considered and minimised.
Oil & Gas 3	
Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.	The proposed decommissioning Project is located over 50 km from the nearest coastline such that this principle is not relevant.

Oil and Gas Marine Planning Policies	Assessment Against Policy
Oil & Gas 5	
Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	The Atlantic and Cromarty infrastructure will be decommissioned in a way that that there will not be a significant impact on the physical, biological and socio-economic environment. The DP will be developed in consultation with the relevant statutory authorities and will ensure that potential effects on the environment resulting from the decommissioning of the decommissioning activities are considered and minimised.
Oil & Gas 6	
Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan (NCP) and the Offshore Safety Directive.	The proposed decommissioning Project has been subject to this EA process and potential environmental impacts have been assessed and appropriate mitigation measures developed. The Shell response strategy to an emergency will be developed with due reference to the NCP.