Petrofac

PERENCO

Tyne Pipelines and Stabilisation Materials Decommissioning

Environmental Appraisal Report

For Perenco UK

200605-S-REP-0009 Rev 2

16/06/2025

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Petrofac Facilities Management Limited

Company No: SC075047

Registered in Scotland Registered Office:

Bridge View

1 North Esplanade West

Aberdeen

AB11 5QF

UK

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ABBREVIATIONS

Abbreviation	Description
As	Arsenic
AIS	Automatic Identification System
Ba	Barium
BAC	Background Ambient Concentration
BEIS	Business, Energy, and Industrial Strategy
boepd	Barrels Of Oil Equivalent Per Day
BSH	Broad Scale Habitat
BSL	Benthic Solutions ltd
CA	Comparative Assessment
Cd	Cadmium
CEFAS	Centre For Fisheries and Aquaculture Science
CH_4	Methane
cm	Centimetres
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CoP	Cessation of Production
CPI	Carbon Preference Index
Cr	Chromium
CSQG	Canadian Sediment Quality Guidelines
CTE	Coal Tar Enamel
Cu	Copper
DDC	Drop-down camera
DEFRA	Department for Environment, Food & Rural Affairs
DP	Decommissioning Programme
e.g.	For Example
EA	Environmental Appraisal
EBS	Environmental Baseline Survey
EC	European Council
EEC	European Economic Council
EF	Emission Factor
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ENVID	Environmental Impacts Identification
ERL	Effects Range Low

Abbreviation	Description
EU	European Union
EUNIS	European Nature Information System
FBE	Fusion Bonded Epoxy
Fe	Iron
GC	Gas chromatography
HCF	Hydrocarbon Free
Hg	Mercury
HGV	Heavy Good Vehicles
HM	Heavy Metals
HOCI	Habitat of Conservation Importance
HRA	Habitat Risk Assessment
hrs	Hours
HSE	Health and Safety Executive
HSSE	Health, Safety, Security and Environment
i.e.	That is
ICES	International Council for the Exploration of the Sea
INNS	Invasive Non-Native Species
ISO	International Organisation for Standardisation
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
kg	Kilogram
km	Kilometre
KP	Kilometre Point
LAT	Lowest Astronomical Tide
m	Metre
MBES	Multi Beam Echo Sound
MCZ	Marine Conservation Zones
MEG	Mono Ethylene Glycol
mg	Milligram
mm	Millimetre
MMMU	Marine Mammal Management Units
MMO	Marine Mammal Observer
MOAB	Mobile Offshore Application Barge
MoD	Ministry of Defence
MPA	Marine Protected Area
n.a.	Not Available

Abbreviation	Description
N/A	Not Applicable
N_2O	Nitrous oxide
ND	No Data
Ni	Nickel
NO_x	Nitrogen oxides
nm	Nautical miles
NMFS	National Marine and Fisheries Service
NNS	Northern North Sea
NSTA	North Sea Transition Authority (Formally Oil and Gas Authority)
OEUK	Offshore Energies UK (formally Oil and Gas UK)
OPRED	Offshore Petroleum Regulator for the Environment and Decommissioning
OSPAR	Oslo Paris Agreement
Pb	Lead
PL	Pipeline
POMS	PUK Operating Management System
ppt	Parts per thousand
PSD	Particle Size Distribution
PUK	Perenco UK Limited
PWA	Pipeline Works Authorisation
Q	Quarter
ROV	Remotely Operated Vehicle
RPP	Risk Profiling of Pressures
SAC	Special Area of Conservation
s	Second
SCANS	Small Cetacean Abundance of the North Sea
SD	Standard Deviation
SEMS	Safety and Environmental Management System
SNS	Southern North Sea
SOSI	Seabird Oil Sensitivity Index
SO_2	Sulphur dioxide
SPA	Special Protection Area
spp	Species
SSS	Side Scan Sonar
TBa	Barium by Fusion
te	Ton (UK)
TEL	Threshold Effect Level

Abbreviation	Description
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TOM	Total Organic Matter
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association
VOC	Volatile Organic Compound
w/w	Wet Weight
Zn	Zinc
µm	Micrometre
µg	Microgram
^{2}	Square
^{3}	Cubic
"	Inch
°C	Degree Celsius
£	Pound sterling
%	Percentage
>	Greater than
<	Less than

HOLDS

Section	Hold	
3	1	PUK to confirm stakeholder responses

EXECUTIVE SUMMARY

In accordance with the Petroleum Act 1998, Perenco UK Limited (PUK) are applying to the Department for Business, Energy and Industrial Strategy (BEIS) to obtain approval for the decommissioning of the Tyne Pipelines (PL) 1220 and PL 1221 and associated stabilisation material.

The PL 1220/ PL 1221 pipeline and stabilisation material were installed in 1996, connecting the Tyne platform to the Trent installation to export processed gas to Bacton gas terminal on the East Anglia coastline (Figure 1-3). In 2016, as part of the Tyne Hydrocarbon Free (HCF) campaign, PL 1220/ PL 1221 pipelines were flushed clean and cut from the topsides of the Tyne and Trent Platforms. Both pipelines were left in situ and filled with seawater. Following approval of the Tyne Installation Decommissioning Programme (DP), the topside and jacket were disassembled and removed in December 2019. During this campaign, both PL 1220 and PL 1221 were cut at the base of the risers at the Tyne and Trent locations and left open to the sea.

In line with legislation and regulatory guidance, this Environmental Appraisal (EA) report has been produced to support the Tyne Pipelines DP by assessing the potentially significant impacts associated with the preferred decommissioning option as determined by the Tyne Pipelines Comparative Assessment (CA) [93].

Through the CA process, it was determined that the preferred decommissioning option taken forward to the EA assessment would be rock placement of scour basin (Option 3b).

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with the Tyne pipelines and stabilisation materials decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level.

Contact Details

Any questions, comments, or requests for additional information regarding this EA should be addressed to:

Oliver Felmingham

Decommissioning Manager

Perenco UK Limited

3 Central Avenue

St Andrews Business Park

Norwich

Norfolk NR7 0HR

E-mail: oliver.felmingham@perenco.com

Telephone (Direct): +44 (0) 1603 771151

Switchboard: +44 (0) 1603 771000

1 INTRODUCTION

1.1 Purpose of Document

This EA report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with the Tyne pipelines and stabilisation materials decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level. The key components and structure of this report are laid out in Table 1.1.

Table 1.1: EA structure

Section	Description
	Executive summary
Section 1	Introduction to the decommissioning project for the Tyne pipelines and stabilisation materials and a description of the EA report scope and structure.
Section 2	The regulatory context and guidance for undertaking a decommissioning EA.
Section 3	A summary of the stakeholder engagement process and activities carried out by PUK to date.
Section 4	An outline of the options considered for decommissioning, the decision-making process undergone by PUK to arrive at the selected decommissioning strategy and a description of the proposed decommissioning activities.
Section 5	A summary of the baseline sensitivities relevant to the activities taking place and the assessments that support this EA.
Section 6	A summary of the project Environmental Issues Identification process and findings.
Section 7	An outline of the EA method used a review of the potential impacts from the proposed decommissioning activities and justification for scoping potential impacts in or out of assessment in this EA report.
Section 8	Assessment conclusions.
Section 9	Environmental management.
Section 10	References.
Section 11	Appendices.

1.2 Field and Infrastructure Description

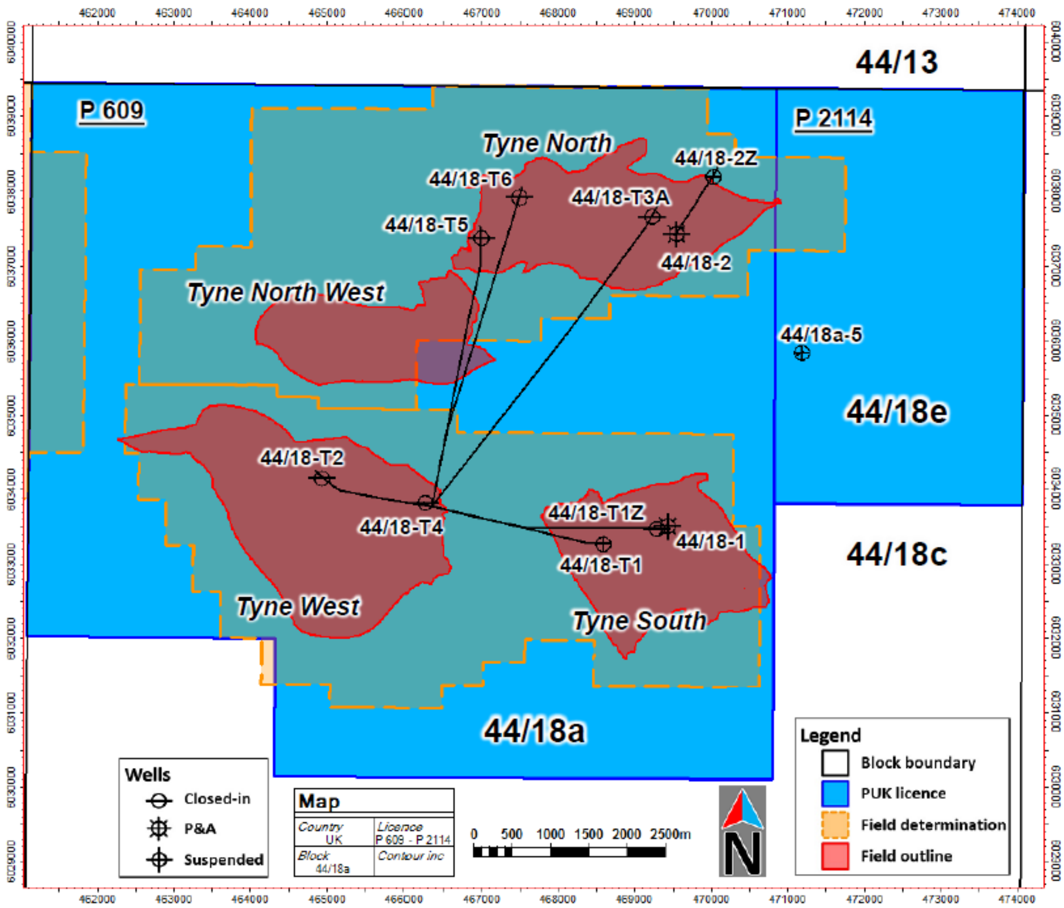
The Tyne Gas Field is located across United Kingdom Continental Shelf (UKCS) Block 44/18a in the Southern North Sea (SNS), in water depths of 17.5m. The field was discovered in 1992 (under licence P609) and was developed, together with the Trent Gas Field. The Tyne Gas Field is comprised of five separate fault blocks. Four of these fault blocks have been drilled: Tyne North, Tyne South, Tyne West and Tyne East, as illustrated in Figure 1-1.

The PL 1220/ PL 1221 pipelines and associated stabilisation material connecting Tyne platform to Trent installation were installed in 1996. Wet gas was exported through a 20" line to the Trent Platform Mobile Offshore Application Barge (MOAB). On Trent MOAB, gas was processed, and water separated, cleaned and discharged. After compression the gas was exported to Bacton on the Norfolk coast via the EAGLES pipeline system.

The pipelines route fall within six UKCS blocks 43/24, 43/25, 43/20, 44/16, 44/17 and 44/18 Figure 1-3). Table 4.1 provides details of the Tyne pipelines and stabilisation materials that will be subject to the Tyne DP and this EA.

In 2015, PUK explored all avenues for continuing production from the field and reached the conclusion that it was uneconomical. Approval for Cessation of Production (CoP) from the field was subsequently granted by the North Sea Transition Authority (NSTA) on 3rd November 2015.

Figure 1-1: Tyne field reservoir



In 2016, as part of the Tyne HCF campaign, PL 1220/ PL 12201 pipelines were flushed clean and cut from the topsides of the Tyne and Trent Platforms. Both pipelines were left in situ and filled with seawater. Following approval of the Tyne Installation DP, the topside and jacket were disassembled and removed in December 2019. During this campaign, both PL 1220 and PL 1221 were cut at the base of the risers at the Tyne and Trent locations and left open to the sea (Ref. Pipeline Works Authorisation (PWA) Variations PA/2120 and PA/2584). The Tyne subsea template was removed in June 2020. Recent geotechnical surveys indicated that PL 1220/ PL 1221 are mainly buried, with an average burial depth of 0.9m along the pipeline route.

Areas of pipeline exposures within the Tyne 500m exclusion zone were identified at the previously located Tyne jacket location. The scour basis was predicted to infill by natural remediation post-removal of the Tyne jacket in 2019; however, the recent geophysical survey and associated PUK scour basin analysis over the 10-year period [82] showed that the seabed infilling rate is not following the predicted pattern. In addition to the Tyne 500m exclusion zone scour basin, three other exposure locations along the pipeline length were identified, one between two parallel crossings and two surrounded by areas of scour, totalling 196.1m of pipeline exposure in length. These are however non-reportable exposures with no freespans.

A total of 32 concrete mattresses were installed within the Tyne 500m exclusion zone; 26 of these mattresses are exposed, and the remaining six are completely buried.

There are historical records of 50 grout bags (size unknown) being used on PL 1220/ PL 1221 to support the riser at the Tyne end; however, these have not been observed in any subsequent surveys of the pipelines and are therefore assumed to be fully buried.

Figure 1-2: Tyne Pipelines and surrounding PUK assets

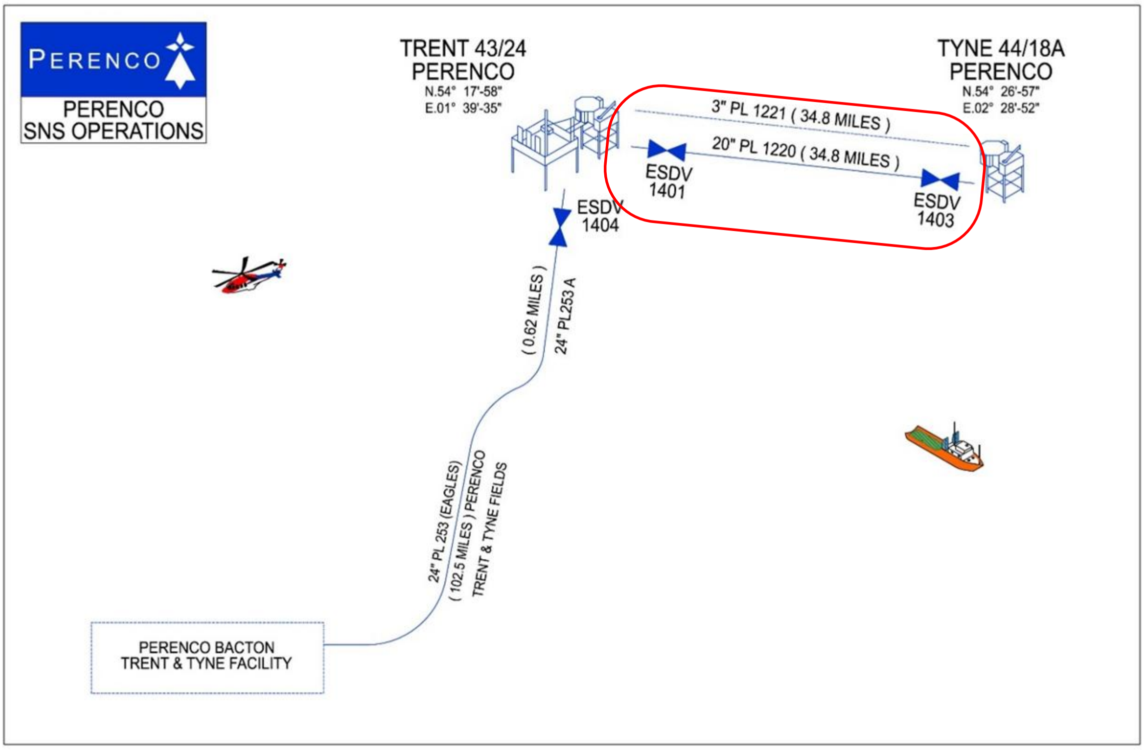
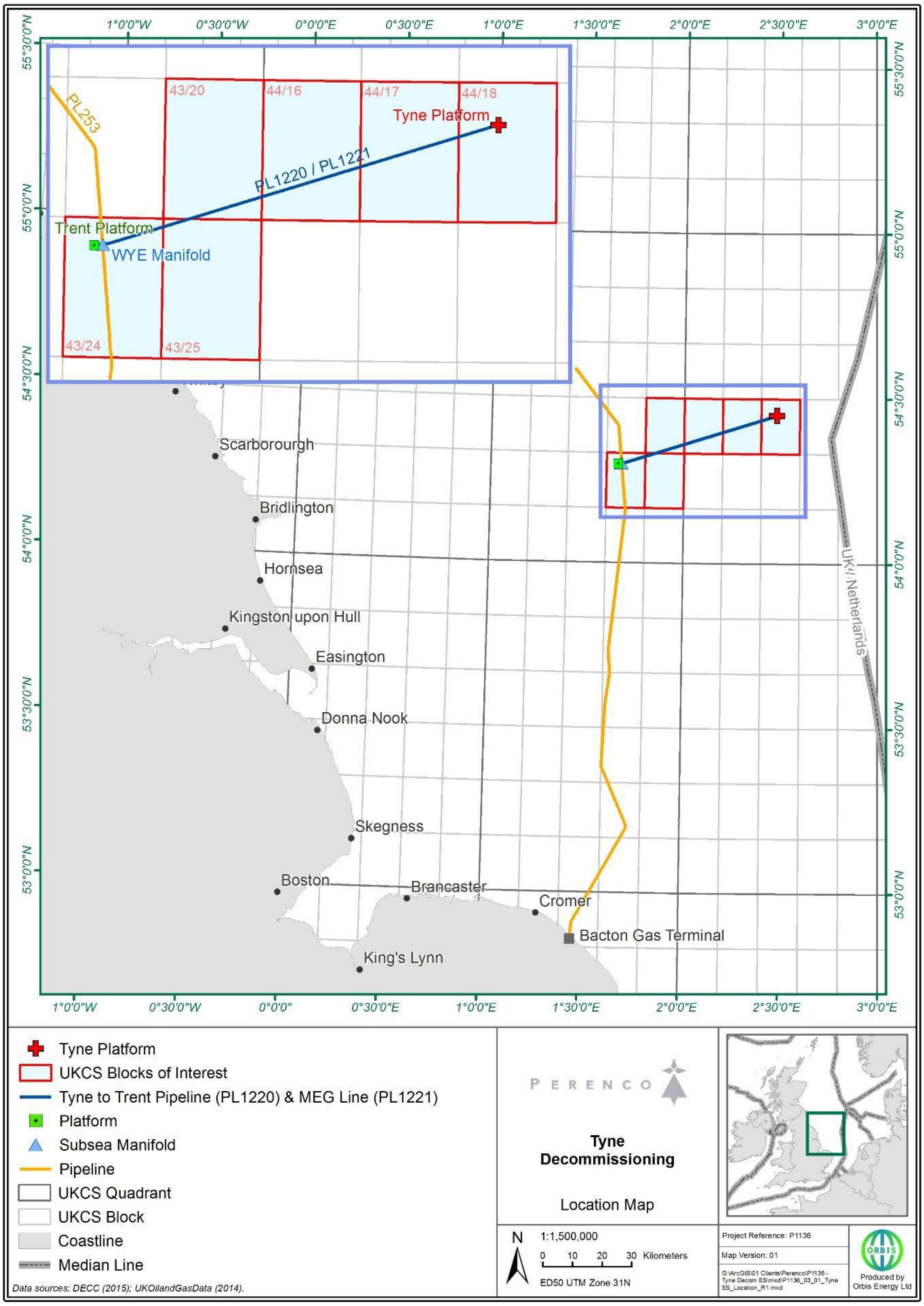


Figure 1-3: Tyne pipeline UKCS location plan in SNS



1.3 PUK Limited

PUK, a subsidiary of Perenco, is an independent oil and gas company operating in the UK, specialising in hydrocarbon exploration, development, and production.

Perenco operates in 13 countries across the globe, ranging from Northern Europe to Africa and from South America to Southeast Asia.

Perenco currently produces approximately 450,000 barrels of oil equivalent per day (BOEPD), of which 250,000 BOEPD is net to the company. The group is present in world-class exploration basins such as Brazil, Peru, northern Iraq, Australia and the North Sea. While PUK's growth has been driven by acquisitions, the Group's strategy evolved rapidly towards increasing production and reserves, renewing licenses, and securing additional acreage for new exploration and development opportunities.

In the Southern North Sea (SNS) gas basin, PUK and other operators, manage 17 offshore fields own by PUK, along with associated pipelines and onshore processing facilities including the Bacton and Dimlington Terminals. PUK’s gas production in the North Sea is around 72,000 boepd.

PUK operates under a Safety and Environmental Management System (SEMS) which is certified to conform to the International Organisation for Standardisation (ISO) 14001 for environmental management systems (EMS). SEMS provides the framework for PUK to achieve safe and reliable operations and ensures compliance with PUK’s Health, Safety, Security and Environment (HSSE) Policy. Further detail on PUK’s SEMS is provided in Section 9.

2 Policy & Regulatory Context

The decommissioning of offshore oil and gas installations and pipelines on the UKCS is principally governed through the Petroleum Act 1998 and is amended by the Energy Act 2008.

The United Kingdom (UK) international obligations in relation to decommissioning is principally governed by the 1992 Convention for the protection of the Marine Environment of the Northeast Atlantic (Oslo-Paris Agreement (OSPAR) convention). Agreement in relation to the offshore decommissioning regime was reached at a meeting of the OSPAR commission in 1998 (OSPAR Decision 98/3). As a result, The Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) guidance in relation to offshore decommissioning is aligned.

The primary objection of OSPAR decision 98/3 remains to prevent the dumping of offshore installations at sea, with the default position of full removal. The decision however allows the granting of derogations to leave all or part of a structure in place, subject to a CA process and regulatory approval.

The decision does not apply to pipelines or stabilisation materials, however despite this OPRED require operators to apply the same framework to pipeline decommissioning projects.

"A comparative assessment (CA) is a mandatory requirement for any potential OSPAR derogation candidate or for all pipeline decommissioning." [5].

Guidance published by the Offshore Energies UK (OEUK) [67] provides detail on regulatory expectations in regard to the decommissioning of pipelines and stabilisation materials:

"Any removal or partial removal of a pipeline should be performed in such a way as to cause no significant adverse effects upon the marine environment and any decision that a pipeline may be left in place should have regard to the likely deterioration of the material involved and its present and possible future effect on the marine environment."

While each case will be considered on its merits and in the light of a comparative assessment of the alternative options the following have been identified as possible candidates for in situ decommissioning:

- ***"Those [pipelines] which are adequately buried or trenched and which are not subject to development of spans and are expected to remain so;***
- ***Those which were not buried or trenched at installation but which are expected to self-bury over a sufficient length within a reasonable time and remain so buried;***
- ***Those where burial or trenching of the exposed sections is undertaken to a sufficient depth and it is expected to be permanent;***
- ***Those which are not trenched or buried but which nevertheless are candidates for leaving in place if the comparative assessment shows that to be the preferred option (e.g. trunk lines);***
- ***Those where exceptional and unforeseen circumstances due to structural damage or deterioration or other cause means they cannot be recovered safely and efficiently. [67]***

Additional Guidance from OPRED states:

"Where rock-dump has previously been used to protect a pipeline it is recognised that removal of the pipeline is unlikely to be practicable and it is generally assumed that the rock-dump and the pipeline will remain in place. Where this occurs, it is expected that the rock-dump will remain undisturbed." [5]

In the context of marine planning and being located in the English offshore waters of the SNS, the pipelines fall within the area of the East Marine Plans [55]. These plans were developed to help ensure sustainable development of the UK marine area; The broad aims and policies outlined in the Marine plan have therefore been considered in this EA report.

In addition to the CA, the primary guidance for offshore decommissioning [5] details the need for an EA to be submitted in support of the DP. The guidance sets out a framework for the required environmental inputs and deliverables throughout the approval process. It now describes a proportionate EA process that culminates in a streamlined EA report rather than a lengthy Environmental Statement as would be required under the Environmental Impact Assessment (EIA) Directive (Directive 2011/92/EU as amended by Directive 2014/52/EU) [28].

3 Stakeholder Consultation

Table 3.1 provides details of stakeholder responses in response to a scoping letter [94] produced and distributed by PUK detailing decommissioning options being considered and a list of items to be scoped in and out. (HOLD 1).

Table 3.1: Stakeholder responses

Stakeholder	Response	PUK comment
OPRED		
NSTA		
Joint Nature Conservation Committee (JNCC)		
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)		
Natural England		
Environment Agency		
Global Marine Systems Limited		
National Federation of Fishermen's Organisations		

Additional stakeholder comments in response to previous consultation around stabilisation materials is presented in appendix 2.

4 Decommissioning Activities & Parameters

This section details the infrastructure being decommissioned and provides details on the selected decommissioning method with timings.

4.1 Relevant Infrastructure

Table 4.1 provides details on the infrastructure relevant to the Tyne Pipelines DP and EA. The infrastructure located within the Trent 500m exclusion zone will be considered as part of the Trent DP.

Table 4.1: Details of Tyne Pipelines and stabilisation material subject to Tyne Pipelines DP

Pipeline no.	Type	Size	Length (km) Note 1	Components	From-To End Points	Status
PL 1220	Hydrocarbon export	20"	56.08	X65 steel with coal tar enamel (CTE) and concrete weight coating	PL1220 Tyne Subsea Pipeline Cut Location #2 at EL-18.700 to Trent Platform Pig Trap	Trenched and buried, except for 52m of exposure within the 500m exclusion zone scour basin and non-reportable exposures outside the Tyne 500m exclusion zone. Flushed clean, cut subsea and filled with seawater at Tyne. HCF verification December 2019
PL 1221	Mono Ethylene Glycol import (MEG)	3"	56.156	X52 steel with Fusion Bonded Epoxy (FBE) coating	PL1221 Trent Platform 3" Ball Valve to Tyne Subsea Pipeline Cut Location #2 at EL-18.700	Trenched and buried, except for 52m of exposure within the 500m exclusion zone scour basin and non-reportable exposures outside the Tyne 500m exclusion zone. Flushed clean, cut subsea and filled with seawater at Tyne. HCF verification December 2019

Stabilisation feature	Total no.	Weight (te)	Location	Exposure/condition
Mattresses	32 total	743.136 (total)	Tyne 500m zone	Concrete Armorflex (steel wire) type with 2 tapered edges either 3.5m x 8.0m x 300mm, 3.6m x 6.m x 150mm or 4.2m x 6.0m x 750mm Weight: between 5 and 20te in air.

Note 1: Pipeline length is original length as per PWA 2/W/96 minus the Tyne pipeline riser and the section of the pipelines within the Trent 500m exclusion zone

4.1.1 Location

The Tyne pipelines (PL 1220 and PL 1221) and stabilisation materials are located within the UKCS blocks 43/24, 43/25, 43/20, 44/16, 44/17 and 44/18 (Figure 1-3).

4.1.2 Pipelines

The scope of the Tyne pipelines DP will cover the pipelines PL 1220 and PL 1221 from the cut end at the recently removed Tyne platform location up to the Trent 500m exclusion zone. The remaining elements of PL 1220 and PL 1221 and associated stabilisation materials within the Trent 500m exclusion zone will be considered as part of the Trent decommissioning scope.

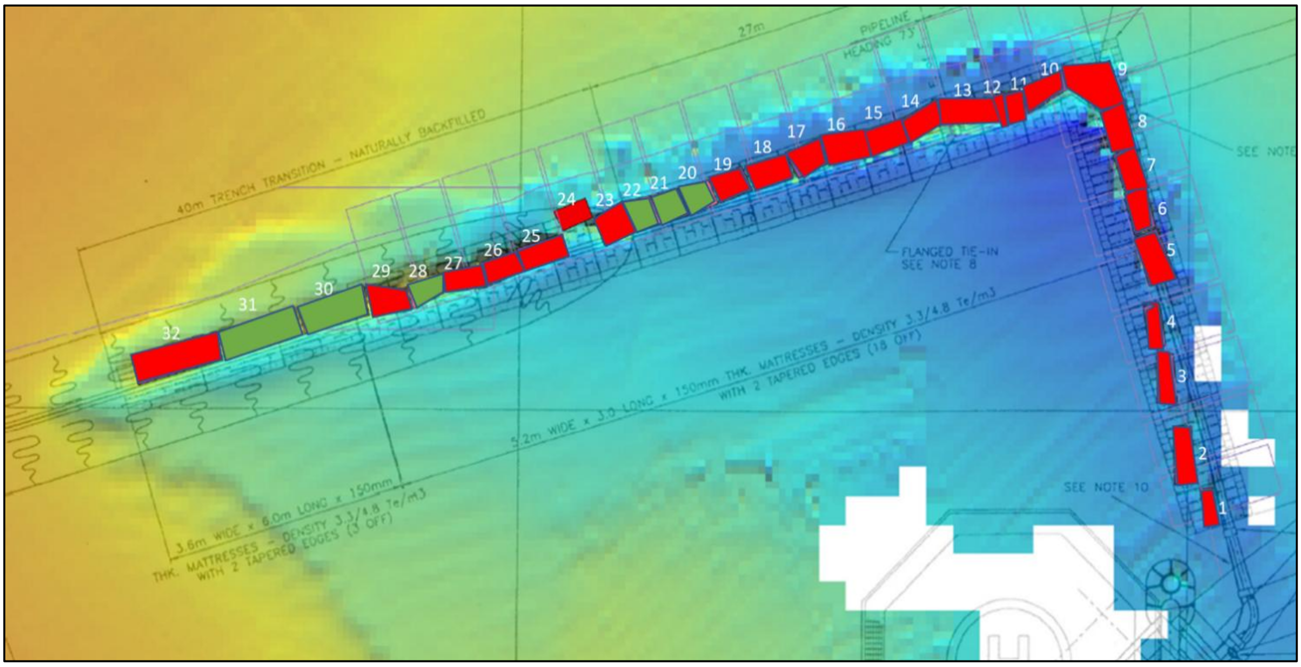
4.1.3 Stabilisation Materials

The scope of the Tyne pipelines DP will include the stabilisation materials detailed in Table 4.1.

In total, 32 concrete mattresses have been used to stabilise PL 1220 and PL 1221 pipelines within the Tyne 500m exclusion zone. Recent surveys have identified that 26 of these mattresses are exposed, but 21 are still serving their original function as pipeline stabilisation material, and the remaining six are fully buried (Table 4.2).

There are historical records of 50 grout bags (size unknown) being used on PL 1220/ PL 1221 to support the riser at the Tyne end; however, these have not been observed in any subsequent surveys of the pipelines and are therefore assumed to be fully buried.

Table 4.2: Mattress location within the Tyne 500m exclusion zone (red exposed, green buried)



4.1.4 Rock Placement

Recent geotechnical surveys indicated that pipelines at the approach of the Tyne platform are covered by a historical rock placement. Two small pipelines exposure areas were recorded within the rock placement area, with a large scour area adjacent mainly to the south. Additionally, rock placement protection was observed at three crossings of third-party assets.

4.1.5 Pipeline Crossings

Table 4.3 provides details of the pipeline crossings along the entire length of PL 1220 and PL 1221 from the previously located Tyne to installation to the Trent installation.

Table 4.3: Pipeline crossings on PL 1220/ PL 1221

Pipeline number	Pipeline description	Crossing cover	Crossing over or under PL 1220/1221	Status
PL 1925	Hawksley to Murdoch methanol pipeline	Rock	Over	Non-Operational
PL 1922	Hawksley to Murdoch gas pipeline	Rock	Over	Non-Operational
UM6 (PLU4685)	Hawksley to McAdam's manifold umbilical	Rock	Over	Non-Operational
PL 3088	Cygnus to Esmond Transportation System gas pipeline	Rock	Over	Operational
PL 2285	Cavendish methanol supply line	Rock	Over	Non-Operational

4.2 Decommissioning Option

The results of the CA indicate that the preferred decommissioning option for both pipelines (PL 1220 and PL1221) and stabilisation material is leave in situ with rock placement of the scour basin (option 3b) or leave in situ without remediation (option 4a) (Table 4.4; Figure 4-1). Option 4a obtained a negligible preferred score over option 3b when compared under equal weighting assessment for the main criteria. However, further detailed assessment of the sub-criteria revealed that both options had identical scores.

Scores across all criteria were very similar between option 3b and option 4a, with the exception of the environmental and safety criteria. Options 2a, 3a and 3b scored lower for the safety criteria due to the reduced snagging risk of removing or burying the exposed pipeline sections, while option 4a scored lower at the environmental criteria due to the zero impact on the seabed.

While scores were almost identical between option 3b (Leave in situ with remediation by rock placement of the scour basin) and option 4a (Leave in situ without remediation), PUK wishes to progress with option 3b as this option represents the lowest overall impact across all remaining criteria after committing to the option with the lowest safety impact score.

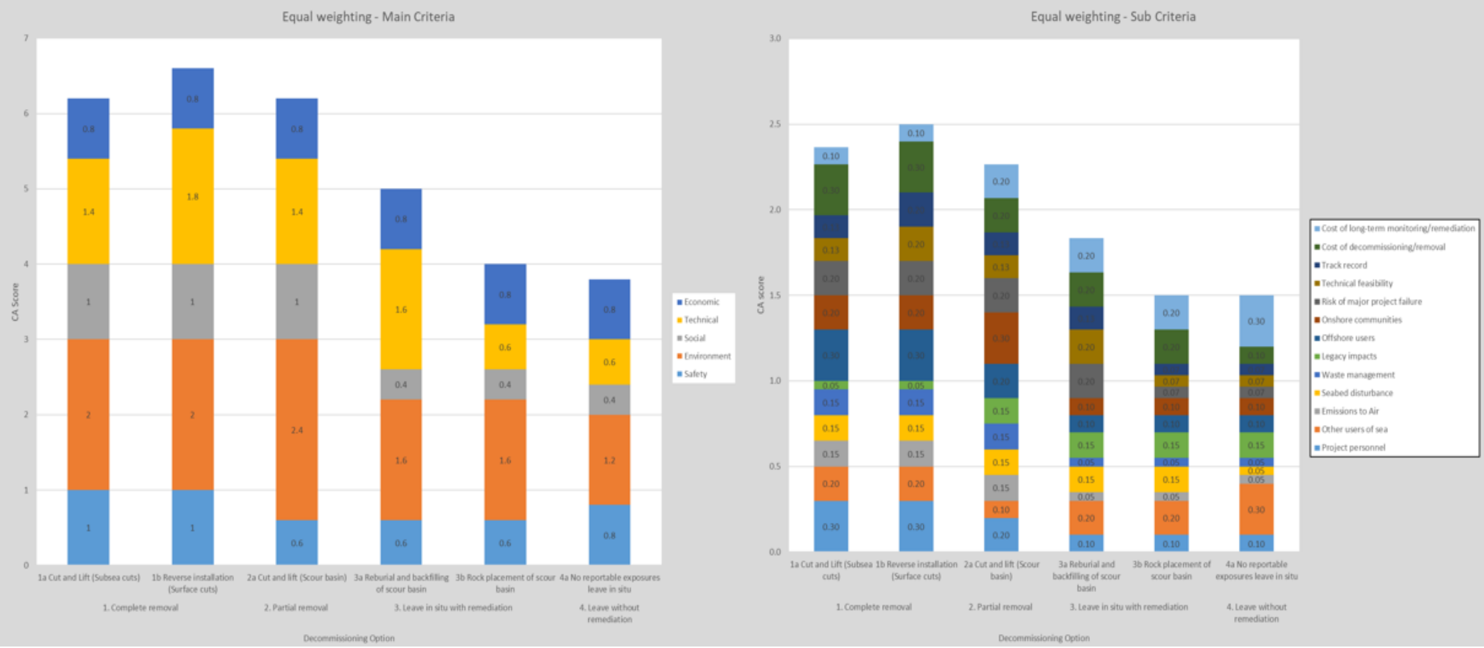
Full details of the CA process and result are presented in the CA report [93] and associated documents.

As a result, the following EA has been prepared based on the preferred option.

Table 4.4: Selected Decommissioning options as a result of the CA

Infrastructure	Decommissioning option
c.52m of PL 1220 within Tyne 500m zone (scour basin)	Left in situ under rock placement
c.52m of PL 1221 within Tyne 500m zone (scour basin)	Left in situ under rock placement
PL 1220 within Trent 500m zone	To be considered in Trent DP
PL 1221 within Trent 500m zone	To be considered in Trent DP
PL 1220 Remaining section	Left in situ
PL 1221 Remaining section	Left in situ
Exposed Concrete Mattress over pipelines	Left in situ
Exposed Concrete Mattress displaced from pipeline	Left in situ
Historic Rock placement	Left in situ

Figure 4-1: CA output on selected decommissioning options



4.2.1 Schedule

Table 4.5: Schedule of Tyne topside and pipelines Decommissioning activities

Year	2015				2016				2017				2018				2019				2020				2021				2022				2023				2024			
Quarter (Q)	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Approval of Installation DP														Performed																										
Approval of CoP				Performed																																				
Clean export lines to Trent						Performed																																		
Plug and Abandon							Performed																																	
Verify HCF							Performed																																	
Topsides and Jacket Removal																				Performed																				
Pipeline DP																																								
Pre-decom surveys										Performed																														
Submission of DP																																			Earliest	Latest				
Consultation																																				Earliest	Latest			
Approval of DP																																					Earliest	Latest		
Post-decommissioning Activities and Surveys																																								
Post-decom surveys																														Performed										
Remediation (if required)																																						Earliest	Latest	
Overtrawl - Clear Seabed Certificate																																						Earliest	Latest	
Close out report																																							Earliest	Latest

Legend

- Earliest date task commences (dark blue)
- Latest task should be completed (light blue)
- Date tasks were performed (bright blue)

5 Environmental and Societal Baseline

5.1 Introduction

As part of the EA process, it is important that the main physical, biological and societal sensitivities of the receiving environment are well understood. As such, this section describes the main characteristics of the physical and biological environment, identifies the other users of the sea present in and around the Tyne development, and highlights any key sensitivities therein.

This environmental baseline description draws upon a number of data sources including published papers on scientific research in the area, industry wide surveys (for example (e.g.) the OSEA3 and OSEA4 programmes) and site-specific investigations commissioned as part of the exploration and development processes and pre- and post-decommissioning survey work carried out at Tyne.

5.1.1 Tyne Pre-Decommissioning Surveys

In 2016 PUK commissioned a pre-decommissioning Environmental Baseline Survey (EBS), undertaken by Benthic Solutions ltd (BSL) supported by Bibby HydroMap on board the MV Bibby Tethra. The survey area included a 1km^2 area, centred on the Tyne platform, and an approximately 250m wide corridor along the export pipeline and MEG line (PL 1220/ PL 1221) to Trent. The survey comprised side scan sonar (SSS), single beam and multi-beam echo sounders (MBES), drop-down camera work and seabed grab samples, with the samples subject to both physio-chemical analyses such as Particle Size Distribution (PSD), Total Organic Carbon (TOC), hydrocarbon and Heavy Metals (HM) concentrations and faunal analysis. The key objectives of the survey were to:

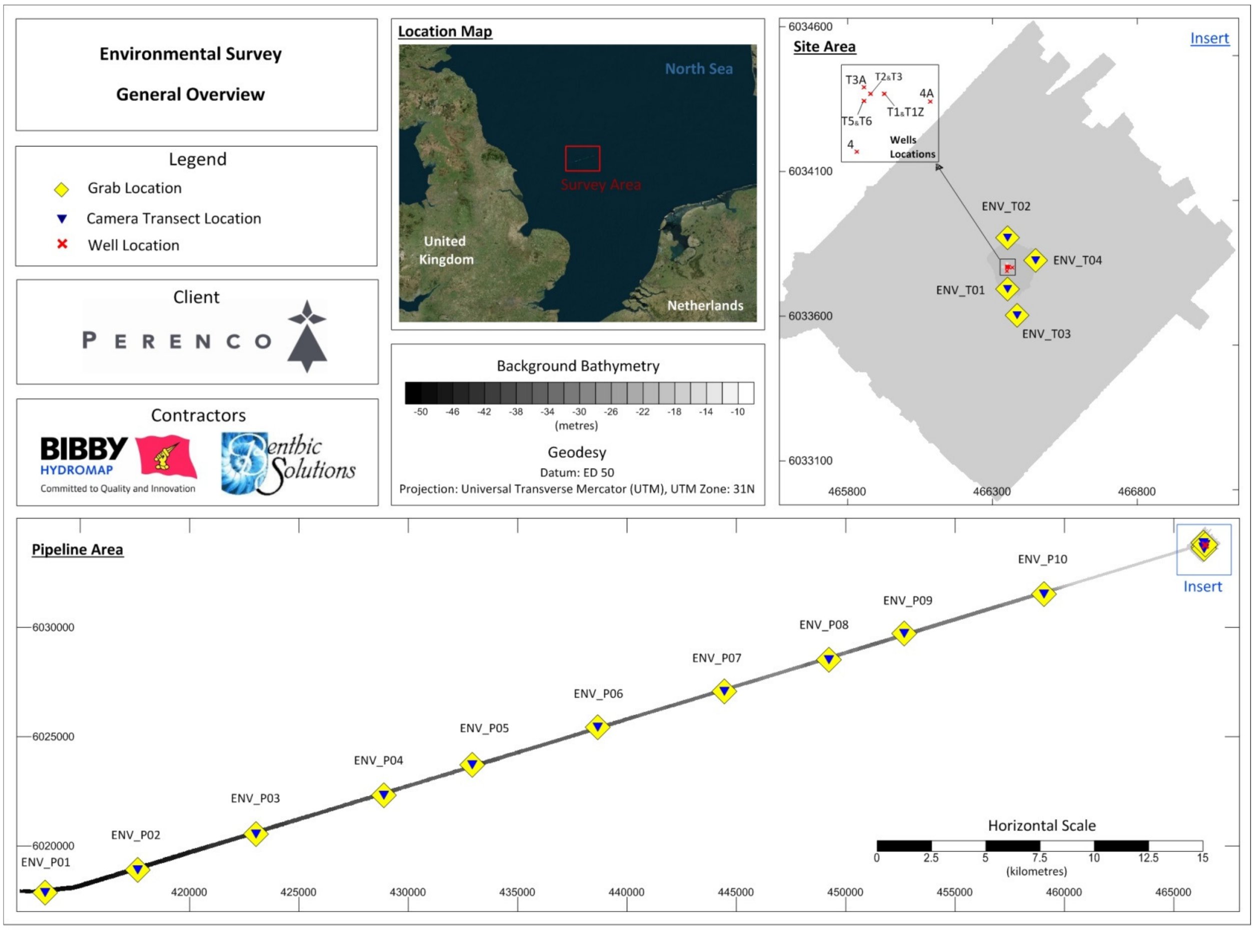
- Assess the status/diversity of benthic habitats in the vicinity of the Tyne platform and along the Trent/Tyne export pipeline and MEG line route;
- Provide sufficient benthic data to adequately assess the environmental impact of the decommissioning operations as part of the EIA process;
- Identify any potential features within the Dogger Bank (Annex I Habitat) as described under the European Union (EU) Habitats Directive and associated regulations;
- Provide data on the chemical and physical properties of the sediments in the vicinity of the Tyne Platform and the export pipeline and MEG line route.

Acoustic data was acquired over the survey area to provide an overview of the sediment habitat types present. Sampling stations were then selected to acquire data in the vicinity of the platform and evenly throughout the entire route corridor, while targeting areas of potential sensitivity. Of particular interest were clear bathymetric features and, if recorded, potential Annex I habitats (EU Habitats Directive). In total, 14 sampling station locations were selected (Figure 5-1), four of which were positioned in the vicinity of the Tyne platform (ENV_T01 to ENV_T04). The remaining ten stations were selected to provide adequate coverage of background sediments, high reflective patches observed on the SSS data, areas of suspected sediment change and spatial variation along the length of the pipeline route (ENV_P01 to ENV_P10). Only sampling stations ENV_P01, ENV_P02 and ENV_P03 were located outside of the Dogger Bank Special Area of Conservation (SAC).

Seabed photography using BSL's MOD4 camera system was used to ground truth all key seabed habitats identified from the acoustic datasets. High-resolution digital photographs were acquired along a short transect at each sampling station location, accompanied by video footage covering a larger seabed area. In addition, seabed grab samples were collected using a 0.1m^2 area day grab, with each of the 14 sample station locations sampled three times. Two of these samples were acquired for faunal analysis and one sample was acquired for physio-chemical analysis (PSD, TOC, hydrocarbon, and HM analysis). The results from the survey are included where relevant throughout this section of the EA.

The full sampling methodology and laboratory treatments and techniques are provided in the full survey report [6].

Figure 5-1: Overview of 2016 pre-decommissioning survey



5.1.2 Post Platform Decommissioning Surveys

In 2022 Ocean Ecology Limited were commissioned by N-Sea on behalf of PUK to conduct a post-decommissioning environmental assessment survey of the seabed in the vicinity of the Tyne field [86]. The scope of work at the Tyne area consisted of MBES surveys covering 1 x 1km platform box-in and a 100m wide pipeline corridor.

A total of 21 locations were sampled across the Tyne field: 11 stations located along a cruciform centred at the decommissioned platform and 10 along pipeline PL 1220/ PL 1221. These were selected to collect sediment samples for both physio-chemical and macrobenthic analyses. The same locations were also targeted with Drop-Down Camera (DDC) to collect still images and video footage prior to collection of grab samples to ensure no obstacles or designated features (e.g., *Sabellaria spinulosa* reef) were present.

The report presents the results of the DDC survey and macrobenthic and sediment physio-chemical analyses of samples collected during the 2022 post-decommissioning survey with the aim of establishing the environmental conditions following the decommissioning of the Tyne field as well as providing a comparison to pre-decommissioning datasets.

The main objectives of the post-decommissioning survey were to:

a) Establish temporal changes from decommissioning activities;

b) Measure and confirm the extent of any contamination resulting from decommissioning operations;

c) Measure the physical characteristics and chemical composition (e.g. Total Hydrocarbons Content (THC), polycyclic aromatic hydrocarbons, metals,) of the sediment including reference stations to determine temporal and spatial changes of these parameters;

d) Describe the biological characteristics of the surrounding sediment and reference stations;

e) Establish the environmental baseline for the surrounding area, and assess the gradients of physical, chemical, and biological perturbation with proximity to the platform; and

f) Establish the presence or absence of any Habitat of Conservation Importance (HOCI) across the survey area including habitats protected under:

  - EU Habitats Directive (92/43/EEC).
  - Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.
  - Conservation of Habitats and Species Regulations 2017 (as amended).
  - Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended).
  - Threatened and/or declining species and habitats (OSPAR 2008) or species listed on the International Union for the Conservation of Nature (IUCN) Red List.

A summary of the historical surveys carried out at Tyne installations is presented in Table 5.1. Data acquired from these surveys supplemented by data from other published sources has been used in the preparation of this baseline study.

Table 5.1: List of historical surveys carried out at Tyne

Year	Surveys
2005	General Inspection Pipeline Survey
2008	General Inspection Pipeline Survey
2011	General Inspection Pipeline Survey
2014	General Inspection Pipeline Survey
2015	Remotely Operated Vehicle (ROV) Survey
2016	Pre-Decommissioning Survey
2016	Depth of Burial Survey
2020	General Inspection Pipeline Survey
2022	Post-decommissioning Survey

5.2 Physical Environment

5.2.1 Bathymetry

The SNS extends from the Flamborough front in the south to north of the Dover Strait in the south, with a transition from North Sea water to Atlantic water. This region is shallow (generally 0-50m), with a predominantly sandy seabed [16]. Mapped information [54] indicates that the SNS generally comprises of sand and muddy sand with significant areas of coarse sediment, especially closer to shore.

The SNS has many extensive sandbanks features present at less than 25m depth; these include areas which have been designated under the EU Habitats Directive (92/43/EEC) such as Dogger Bank SAC and the North Norfolk Sandbanks SAC [16].

The water depth at the Tyne platform location is 17m Lowest Astronomical Tide (LAT) [6]. The seabed gently slopes in a south-westerly direction from the Tyne platform along the route of the Tyne export pipeline and MEG line. The water depth in the vicinity of the Tyne development ranges from 14m LAT near to the Tyne platform, to 57m LAT to the northwest of the Trent platform [35].

During the latest post-decommissioning MBES and environmental survey [72], the seabed within the Tyne platform was observed to be generally flat. Water depths at the Tyne platform area range from 18.0m to 19.1m LAT, with average water depth of approximately 18.4m LAT. A large scour area was recorded adjacent to the previous Tyne platform location, mainly to the south. Three remnant spudcan depressions were observed to SE of the platform. Two of those contained a single boulder of a significant size.

The PL 1220/ PL 1221 pipeline route was surveyed from Kilometre Point (KP) 0.0 at the previous Tyne platform to KP 55.723 at the Trent platform. Overall, the seabed level ranges from 17.9m to 50.8m LAT. At Tyne platform, the water depth is 17.9m. For the first 5km the seabed remains relatively flat, reaching 18.0m LAT at KP 5.733. From this point onwards, the water depth gradually increases along the route, undulating slightly due to seabed morphology (sand waves, megaripples), reaching maximum of approximately 50.8m LAT at KP 54.456. Over the last few hundred metres of the route, the seabed gently rises towards Trent structure, reaching 48.9m LAT at the Trent location (KP 55.723).

Figure 5-2: Overview of the Tyne platform bathymetry 2022

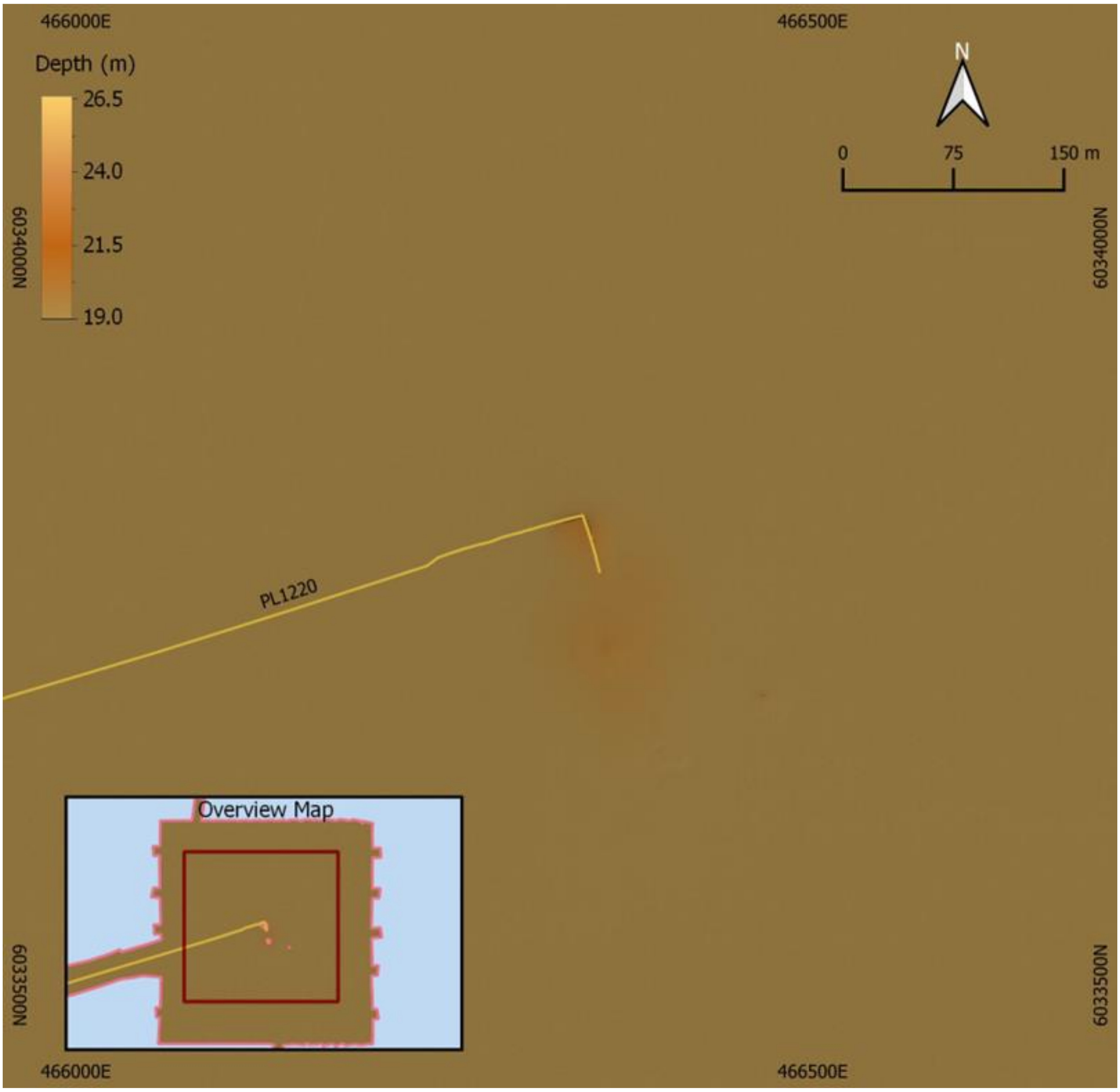
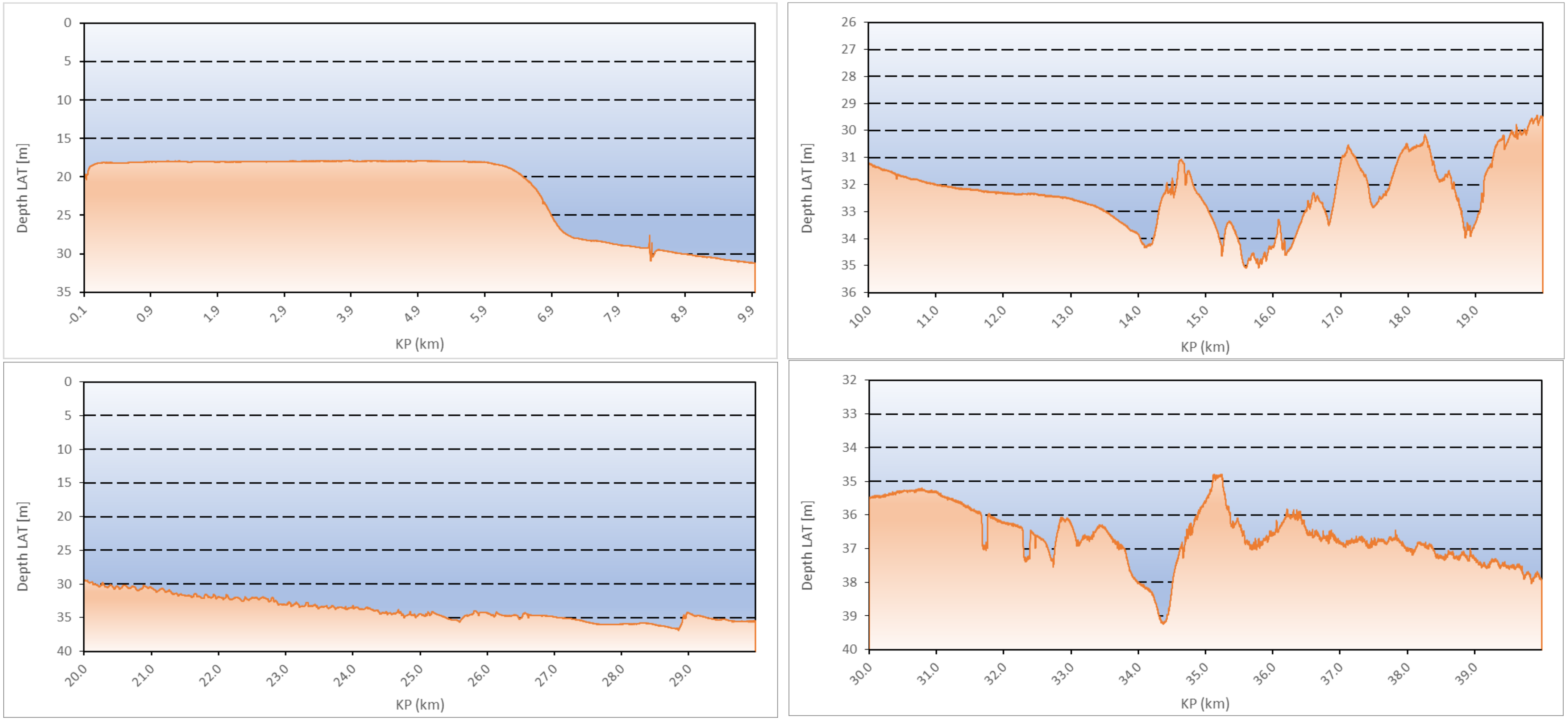


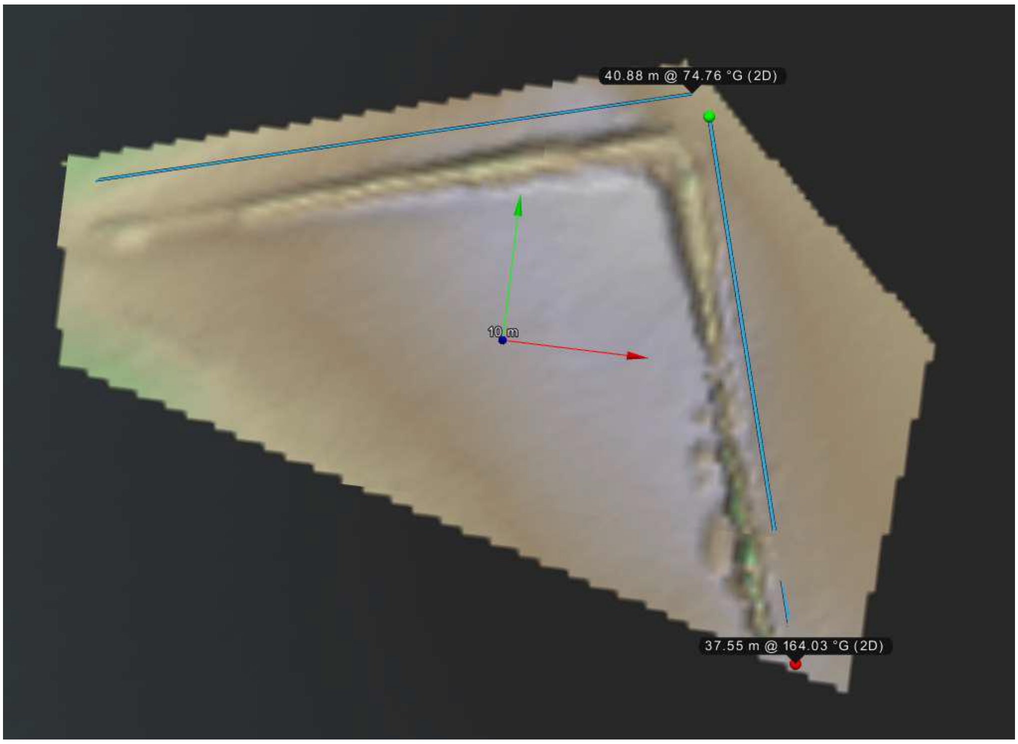
Figure 5-3: PL 1220/ PL 1221 route seabed profile 2022



Additional geophysical assessment of the Tyne 500m exclusion zone scour basin identified that infill of the scour basin had not progressed as originally assumed, resulting in the exposure of approximately 23m and 29m of the tie in spools on PL 1220 and PL 1221. These currently remain exposed above the seabed covered by concrete mattresses of varying condition.

Bathymetry data spanning from 2012 to 2022 was overlaid using NAVIMODEL software (a point cloud data system used to analyse geophysical survey data for all of PUK subsea assets) to compare the seabed movements over a 10-year period. The bathymetry data that has been analysed over the 10-year period focuses on a 2,000m^2 area around the previous existing Tyne jacket. Figure 5-4 shows the extension of the scour basin, with an approximately area of 41m in length by 38m wide [87].

Figure 5-4: NAVIMODEL extract with linear dimensions of scour basin



5.2.2 Seabed Sediments

The following European Nature Information System (EUNIS) seabed classifications have been identified in the vicinity of the PL 1220/ PL 1221 [12; 16; 86].

- A5.14: Circalittoral coarse sediment;
- A5:15: Infralittoral coarse sediment;
- A5.23: Infralittoral fine sand;
- A5.24: Infralittoral muddy sand;
- A5.25: Circalittoral fine sand;
- A5.26: Circalittoral muddy sand;
- A5.43: Infralittoral mixed sediments;
- A5.44: Circalittoral mixed sediments.

A5.14 Circalittoral coarse sediment - Tide-swept circalittoral coarse sands, gravel, and shingle generally in depths of over 15-20m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves. Certain species of sea cucumber (e.g. *Neopentadactyla*) may also be prevalent in these areas along with the lancelet (*Branchiostoma lanceolatum)*.

A5:15: Offshore circalittoral course sediment - Offshore (deep) circalittoral habitats with coarse sands and gravel or shell. Such habitats are quite diverse compared to shallower versions of this habitat and generally characterised by robust infaunal polychaete and bivalve species. Animal communities in this habitat are closely related to offshore mixed sediments and in some area's settlement of *Modiolus modiolus* larvae may occur and consequently these habitats may occasionally have large numbers of juvenile *M. modiolus.* In areas where the mussels reach maturity their byssus threads bind the sediment together, increasing stability and allowing an increased deposition of silt leading to the development of the biotope *Modiolus modiolus* beds with *Chlamys varia*, sponges, hydroids, and bryozoans on slightly tide-swept very sheltered Atlantic circalittoral mixed substrata

A5:23/A5:24: Infralittoral sand - Clean medium to fine sands or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets. Such habitats are often subject to a degree of wave action or tidal currents which restrict the silt and clay content to less than 15%. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs, and amphipod crustacea.

A5.25/A5.26 Circalittoral sand - Circalittoral clean fine sands with less than 5% silt/clay in deeper water, or either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20m or non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20% generally found in water depths of over 15-20m. This habitat is generally more stable than shallower, infralittoral sands and consequently supports a more diverse community. This habitat extends offshore, while very little information is available on these, they are likely to be more stable than their shallower counterparts. This habitat is characterised by a range of taxa including polychaetes, bivalve molluscs, and amphipod crustacea.

A5.43: Infralittoral mixed sediments - Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand, or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms, and burrowing anemones such as *Cerianthus lloydii* are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as Nemertesia species (spp) and *Hydrallmania falcata*. The combination of epifauna and infauna can lead to species rich communities. Coarser mixed sediment communities may show a strong resemblance, in terms of infauna, to biotopes within the A5.1. However, infaunal data for this habitat type is limited to that described under the biotope A5.443, and so are not representative of the infaunal component of this habitat type.

A5.44: Circalittoral mixed sediments - Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand, or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms, and burrowing anemones such as *Cerianthus lloydii* are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as Nemertesia spp and *Hydrallmania falcata*. The combination of epifauna and infauna can lead to species rich communities. Coarser mixed sediment communities may show a strong resemblance, in terms of infauna, to biotopes within the A5.1. However, infaunal data for this habitat type is limited to that described under the biotope A5.43, and so are not representative of the infaunal component of this habitat type.

Sediment samples for chemical analysis were collected from 14 grab stations sampled across the Tyne field for the 2016 pre-decommissioning survey. The environmental survey data revealed a relatively homogeneous seabed, comprising sand with varying amounts of gravel and shell material and areas of regular bedforms, such as sand ripples. Review of the seabed photography data indicated sand-dominated sediments throughout the survey area but with ripples evident in the shallower, more mobile sediments around the previous Tyne platform in the east.

Additional comparison of the full PSD was carried out for the 14 samples collected. The mean proportions of fines, sands and gravels were as follows:

- Fines: mean 3.9% ± 3.71 Standard Deviation (SD);
- Sands: mean 83.2% ± 11.05SD;
- Gravels: mean 12.9% ± 10.12SD.

The majority of samples indicated a broad distribution dominated by the sand fractions (average 83.2% sand), with stations ENV_T02 recording almost 98% sand. Gravels were more prevalent at stations ENV_P04 and ENV_P07 with on average over 26% of the PSD accounted for by particles over 2mm in size. Conversely, stations ENV_P01, ENV_P02, ENV_P06 and ENV_P09 showed the highest proportion of fines (<63µm) with an average of 9%.

21 samples were collected across the Tyne field as a part of the 2022 post-platform decommissioning surveys (Figure 5-5, Figure 5-6), 11 in proximity of the decommissioned platform, and 10 along the pipeline. Nine out of 11 stations located at the decommissioned platform were classified as Slightly Gravelly Sand ((g)S) belonging to EUNIS Broad Scale Habitat (BSH) A5.2 (Sand and muddy sand). Conversely stations TY_03 and TY_10 classified as Gravelly Sand (gS) and fell under BSH A5.1 (Coarse sediment). Greater variability in sediment type was observed along the pipeline. This resulted in 5 stations being interpreted as BSH A5.4, four stations falling under BSH A5.2 and one under BSH A5.1.

In addition, a seabed imagery analysis of a total of 21 DDC stations were sampled during the Tyne post-decommissioning survey, resulting in the collection of 66 still images at the decommissioned platform stations and 51 along the pipeline. A homogeneous substrate characterised the Tyne survey area with most stations being classified as EUNIS classifications A5.44 'Circalittoral mixed sediment' and A5.26 'Circalittoral muddy sand'. These types of sediment are among the most common habitats found in subtidal settings throughout the UK coastal and offshore regions with EUNIS classification A5.26 corresponding to HOCI 'Subtidal sands and gravels'.

When comparing the PSD across the samples, sand dominated in all stations but pipeline station ENV_P08 where gravel dominated. The mean (± SE) proportion of sand across all survey stations was 83.06 ± 4.37%, mean (± SE) gravel content was 12.11 ± 3.87% and mean (± SE) mud content was 4.83 ± 1.25%.

Figure 5-5: Examples photographs of sediment samples collected during the Tyne post-decommissioning survey 2022.

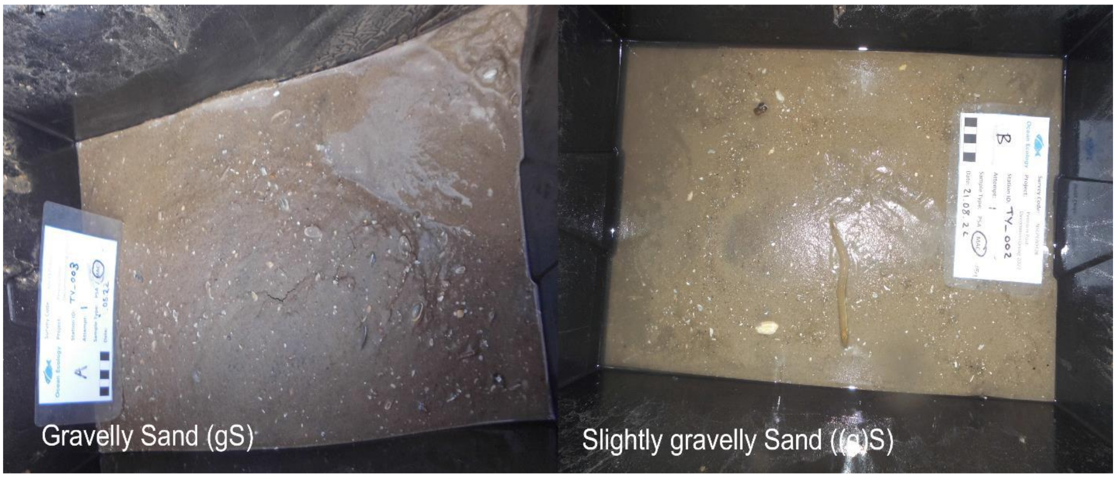
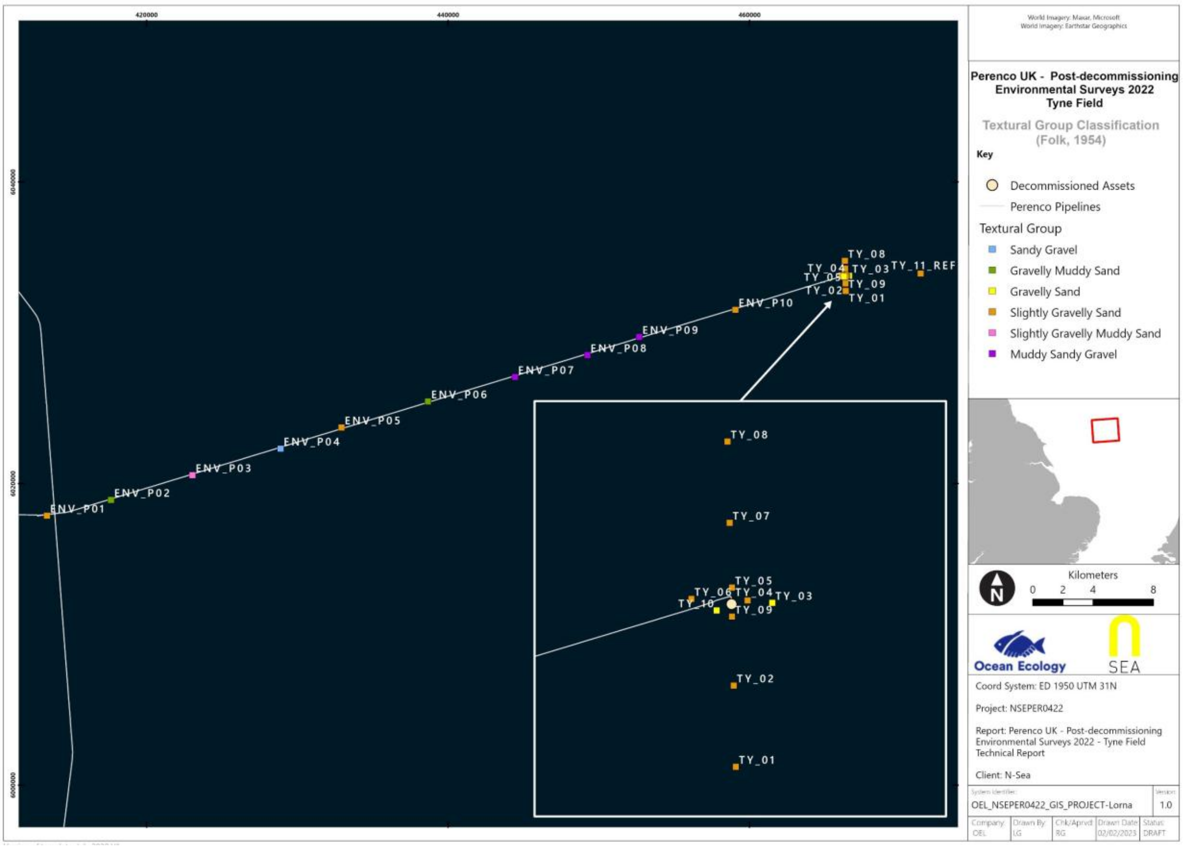


Figure 5-6: Sediment types as determined from PSD analysis of samples acquired across the Tyne post-platform decommissioning survey area. White lines indicate pipelines



Key sediment characteristics were compared between samples collected during the 2016 and 2022 post-decommissioning surveys. Table 5.2 summarises the changes in mean grain size at each station surveyed in both 2016 and 2022. Overall, six stations saw a shift to a finer sediment type whilst seven stations shifted to a coarser sediment type.

Across the 10 stations along the pipeline, average mean grain size for the region (± SE) was higher post-decommission at 805.4μm (± 242.4) compared to 540.4μm (± 114.8) pre-decommission. The greater standard error in data from 2022 data implies a greater variation in sediment type.

Table 5.2: Mean grain size (µm) comparison of sediment in 2016 and 2022 decommissioning surveys at Tyne field.

Station	Areas	Mean Grain Size (µm)		Change
		2016	2022	(+ / -)
TY_04 (ENV_T04)	Platform	530.0	233.9	-
TY_05 (ENV_T02)	Platform	222.0	251.3	+
TY_09 (ENV_T01)	Platform	547.0	254.5	-
ENV_P01	Pipeline	230.0	234.0	+
ENV_P02	Pipeline	310.0	139.7	-
ENV_P03	Pipeline	334.0	189.4	-
ENV_P04	Pipeline	767.0	1592.3	+
ENV_P05	Pipeline	514.0	288.3	-
ENV_P06	Pipeline	386.0	783.1	+
ENV_P07	Pipeline	316.0	981.2	+
ENV_P08	Pipeline	380.0	2438.1	+
ENV_P09	Pipeline	963.0	1220.6	+
ENV_P10	Pipeline	204.0	186.8	-

Results of one-way ANOSIM test performed on mean grain size data collected at each station for 2016 and 2022 decommissioning revealed that there was no significant change in mean grain size across the Tyne field over time (Table 5.3).

Table 5.3: ANOSIM results for comparison of sediment mean grain size collected for Tyne pre- and post-decommissioning surveys.

	R Statistic	Significance Level (p)
Global	-0.006	0.390

Based on post-decommissioning data only, some variations in sediment type and composition were observed across the Tyne field with finer sediments within the decommissioned platform stations compared to pipeline stations. However, the majority of stations (13 stations in total) belonged to BSH A5.2, followed by 5 stations falling into BSH A5.4 and three stations into BSH A5.1. These are among the most common habitats found in offshore settings across the UK coast and BSH A5.1 and A5.2 are considered a component of the HOCI 'Subtidal sands and gravels'.

Differences in sediment type and composition were also observed between pre- and post-decommissioning surveys with finer sediment sampled during the pre-decommissioning survey (Table 5.2). Nevertheless, most stations were dominated by sand during both surveys and no statistically significant differences were found between pre- and post-decommissioning surveys (Table 5.3).

European Council (EC) Habitats Directive Annex I habitats

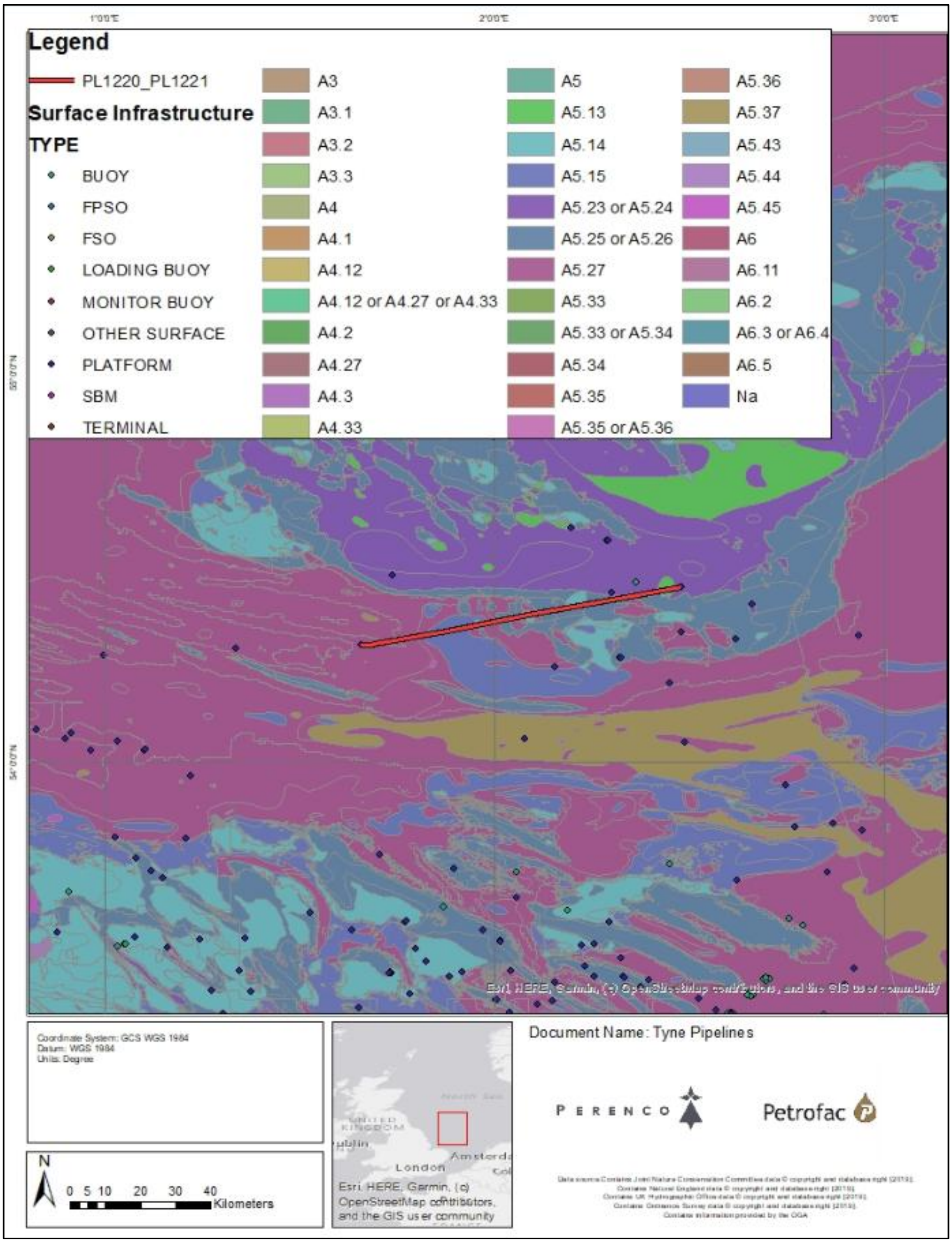
In addition to the Annex I habitat ‘Sandbanks which are slightly covered by sea water all the time (1110)’, which is an interest feature of the Dogger Bank SAC (*see* section 7.3.2.2), there is also the potential for Annex I habitat biogenic ‘reefs’ (1170) to be present in this area of the SNS.

Biogenic reefs, created by the ross worm *Sabellaria spinulosa*, comprise of dense subtidal aggregations of this small, tube-building polychaete worm. The *S. spinulosa* reef habitats of greatest nature conservation significance occur on predominantly sediment or mixed sediment areas allowing the settlement and growth of other biota on the reef surface.

There are no noted reefs or potential reefs within the Dogger Bank area; however, biogenic reefs have been known to form on exposed sections of pipelines, taking advantage of the presence of hard substrate.

An investigation into the presence of potential Annex I habitats within the vicinity of the Tyne infrastructure was included in the scope of the 2016 pre-decommissioning EBS and 2022 post-decommissioning EBS and a full reef habitat assessment was conducted on all DDC imagery. No Annex I habitats or other protected habitats/ species were encountered during the Tyne pre- and post-decommissioning surveys.

Figure 5-7: Seabed EUNIS broad-scale seabed classification



5.2.3 Seabed Chemistry

5.2.3.1 TOC

Sediment samples were analysed for TOC and moisture content. TOC represents the proportion of biological material and organic detritus within the substrate. This method is less susceptible to the interference sometimes seen using crude combustion techniques, such as analysing Total Organic Matter (TOM) by loss on ignition. TOC in surface sediments is an important source of food for benthic fauna [80], although an overabundance may lead to reductions in species richness and number of individuals due to oxygen depletion. Increases in TOC may also reflect increases in both, physical factors (i.e. fines) and common co-varying environmental factors through elevated adsorption on increased sediment surface areas [84].

The TOC results in the pre-decommissioning survey were relatively low and consistent throughout the Tyne environmental survey, ranging from <0.10% to 0.88% with a mean of 0.21% (+0.26SD) generally reflecting an organically deprived environment. Higher levels of TOC were recorded during this survey, however tended to coincide with those stations showing the highest percentage of gravel ($r(12)=0.912$; $p<0.01$) (see Table 5.4).

Terrestrially derived carbon from runoff and fluvial systems, combined with primary production from sources such as phytoplankton blooms, contribute to the TOM levels recorded in sediments. While both allochthonous and autochthonous sources will be present throughout the Tyne pre-decommissioning environmental survey, a general lack of fine material and therefore reduced surface area for adsorption means that overall, TOC levels within the sediment are low. This may in turn affect the richness and abundance of deposit-feeding organisms within the sediment.

In addition to TOC, the sediments were also analysed for moisture content. The results were consistent at all sampling stations (mean 16.99±2.66SD), indicative of similar texture and consolidation throughout. As would be expected, the lowest moisture levels were typically found at those stations recording the highest percentages of gravel.

Chemical analysis of TOC was also tested at the post platform decommissioning seabed samples. Concentrations around the Tyne platform ranged from 0.04% at station TY_06 to 0.08% at station TY_10 with an average value (± SE) of 0.06 ± 0.003% across the Tyne platform. Along the Tyne pipeline, TOC concentrations ranged from 0.08% at station ENV_P05 to 0.25% at station ENV_P02 with an average value (± SE) across the pipeline of 17 ± 0.017% (Figure 5-9).

The sediments were also analysed for moisture content, varying between 19.60% and 27.0% with an average value (± SE) of 24.15% ± 0.73% at the Tyne platform location, and between 12.90% at station ENV_P09 and 27.50% at station ENV_P10 with an average value (± SE) of 21.08% ±1.65% along the pipelines. In general, the samples reflected a more homogeneous sediment texture and consolidation across the Tyne platform sediments than across the pipelines sediments.

No trend was observed between mud content in the sediment and percentage contribution of TOC or moisture content.

Table 5.4: Summary of Total Organic Carbon and Moisture Content pre-decommissioning survey

Station	Moisture Content (% wet weight (w/w))	Total Organic Carbon (% w/w)
ENV_T01	15.30	<0.10
ENV_T02	19.20	<0.10
ENV_T03	16.50	<0.10
ENV_T04	15.10	<0.10
ENV_P01	19.20	<0.10
ENV_P02	16.90	0.14
ENV_P03	20.90	0.13
ENV_P04	15.90	0.69
ENV_P05	17.60	0.14
ENV_P06	19.30	0.25
ENV_P07	11.50	0.36
ENV_P08	19.40	<0.10
ENV_P09	13.00	0.88
Mean	16.99	0.21
St Dev	2.66	0.26
Variance (%)	15.6	125.2

Figure 5-8: TOC pre-decommissioning environmental survey

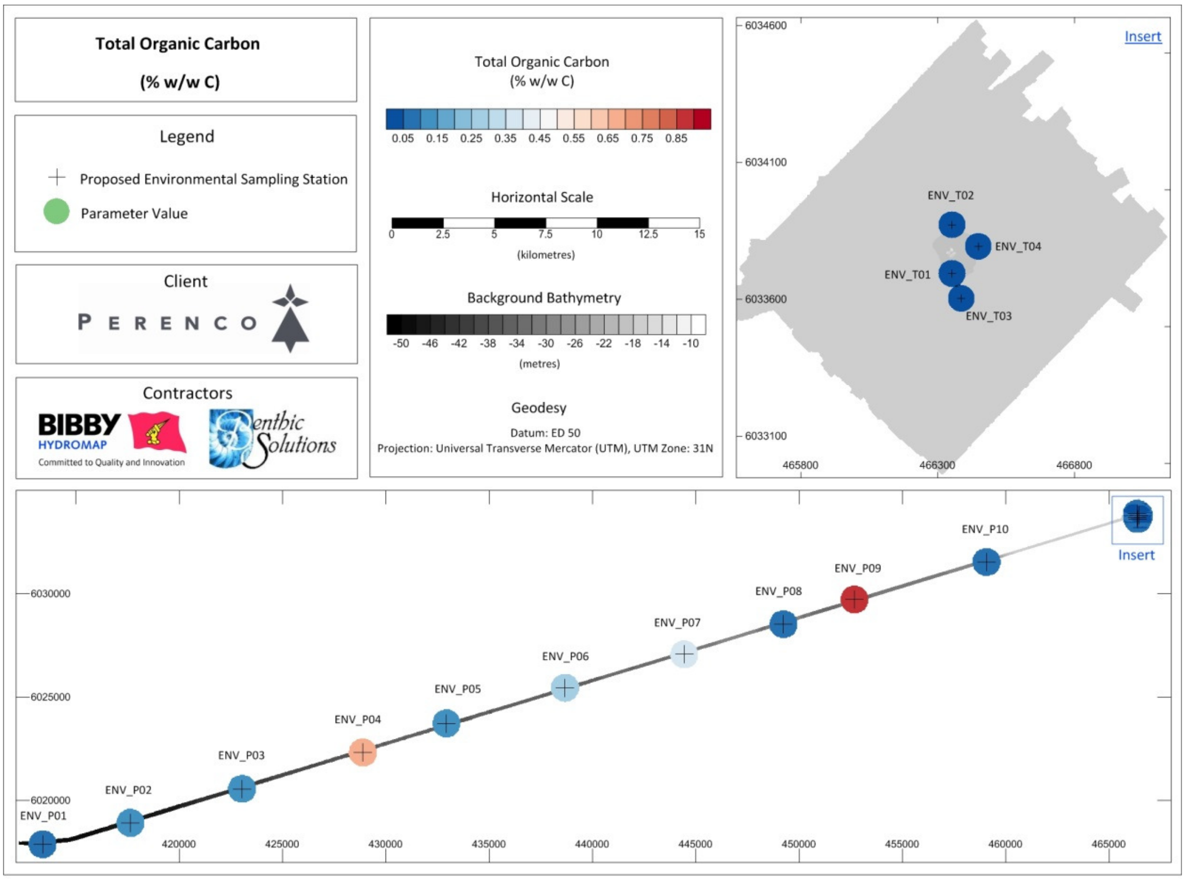
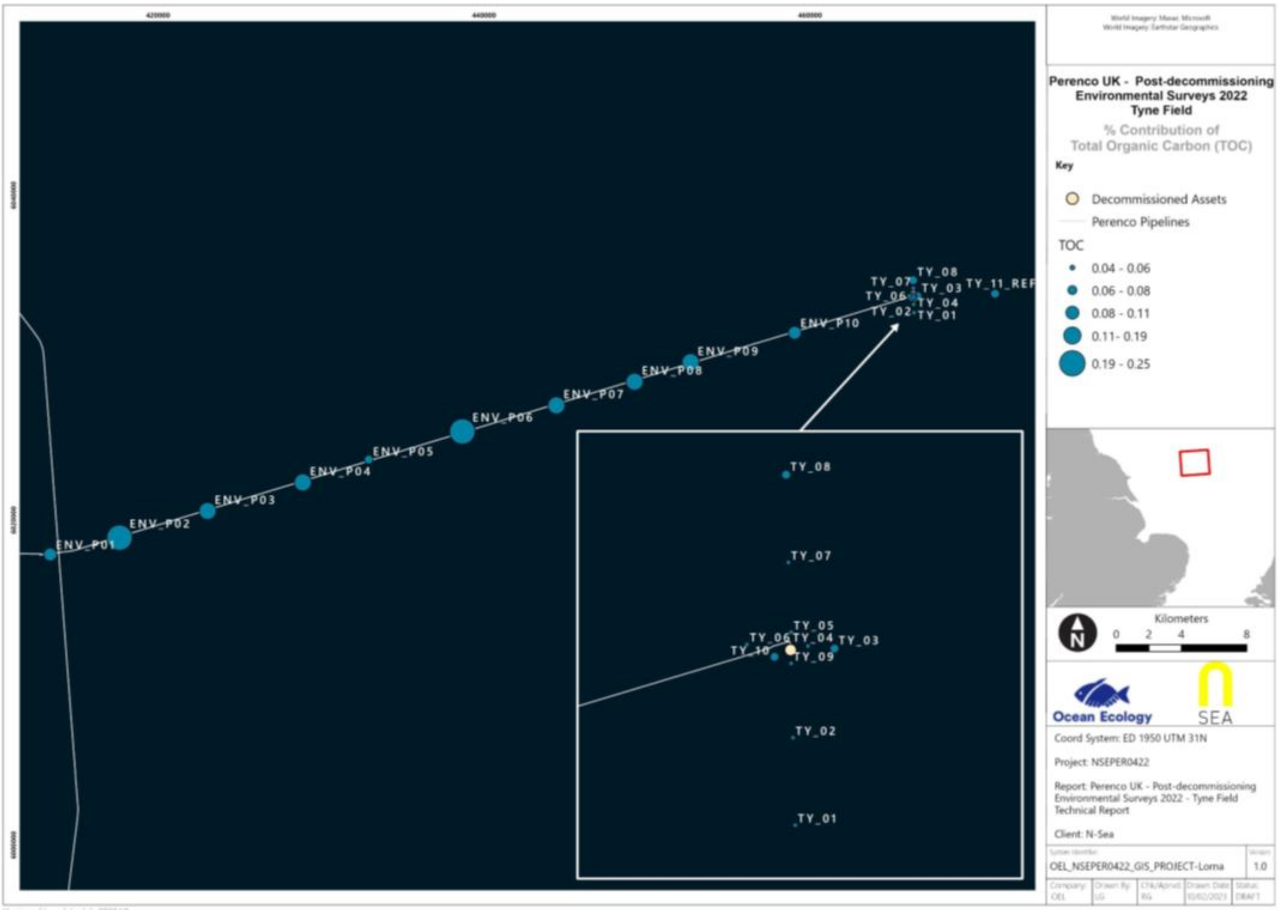


Figure 5-9: Percentage contribution of TOC at each sampling station sampled across the Tyne post-decommissioning survey area. White lines indicate pipelines



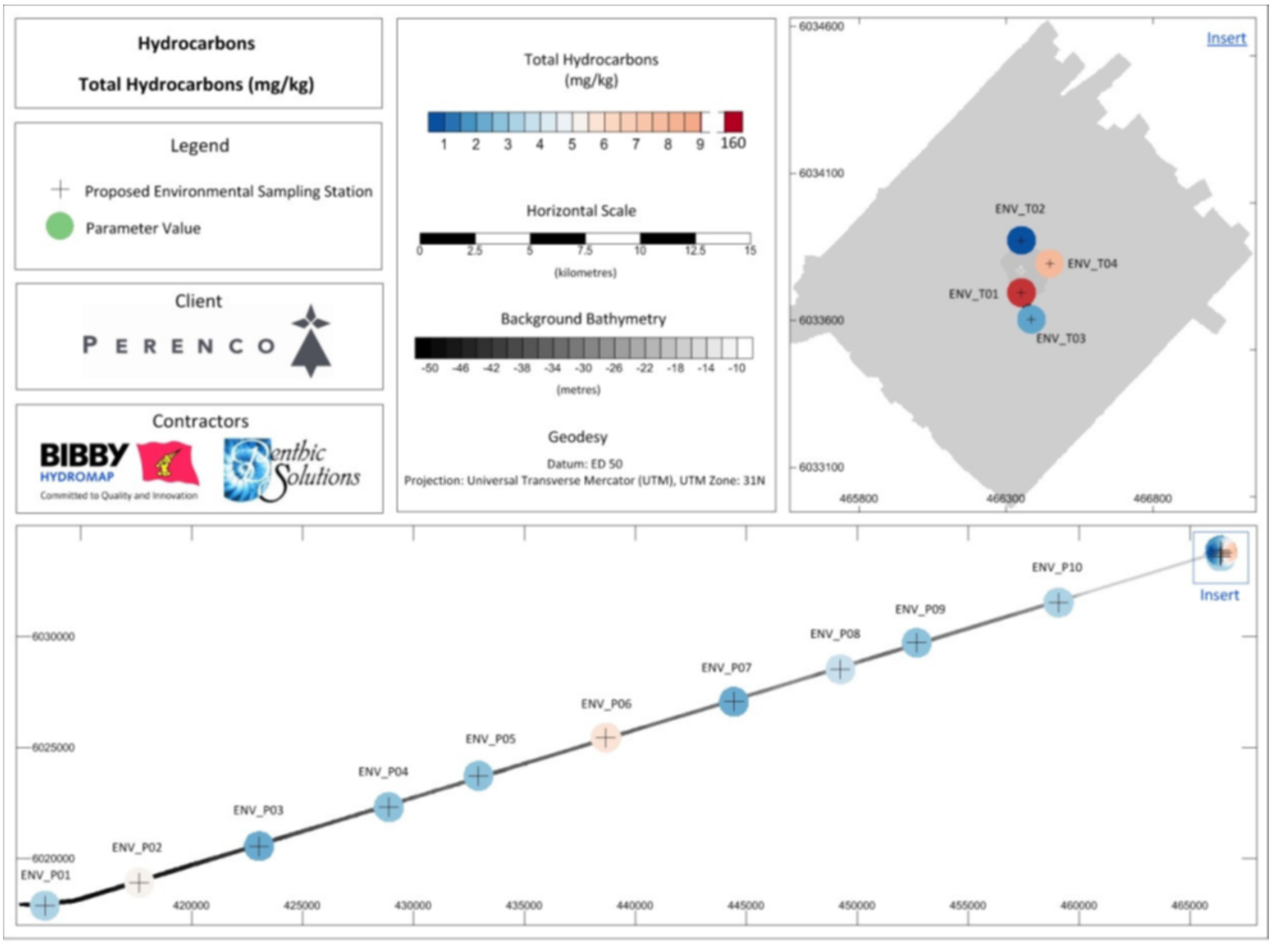
5.2.3.2 THC

The THC of the sediments was measured by integration of all nonpolarized components within the Gas Chromatography (GC) trace. The 2016 pre-decommissioning survey results showed generally low levels ranging from 2.1mg.kg^{-1} to 8.9mg.kg^{-1}, with an elevated concentration of 166.4mg.kg^{-1} recorded at station ENV_T01. Excluding the elevated level at station ENV_T01, the mean THC for the Tyne survey was 3.61mg.kg^{-1} (±1.91SD), and the variability between stations was relatively marked, with a percentage variance (SD over the mean) of 53.0%. The elevated level found at station ENV_T01 and the corresponding GC-trace for this station indicated potential low toxicity oil-based mud input from drilling activities around the Tyne platform.

No significant statistical correlation was found between THC and the mean sediment grain size. Mean background THC levels for surface sediments from the SNS were estimated by the United Kingdom Offshore Operators Association (UKOOA) [89] to be 4.34mg.kg^{-1}, with an upper 95th percentile concentration of 11.39mg.kg^{-1} for stations located over 5km from oil and gas platforms. Higher concentrations of between 10mg.kg^{-1} and 450mg.kg^{-1} have been reported around oil and gas installations. Thus, while the THC concentration at station ENV_T01 was elevated above typical background levels for the SNS, it was consistent with expected levels around offshore platforms. Moreover, surveys of cuttings piles around offshore platforms in the central and Northern North Sea (NNS) recorded maximum THC concentrations significantly higher than seen during this survey, ranging between 30,000mg.kg^{-1} and 150,000mg.kg^{-1}.

Only one station (ENV_T01) recorded THC levels above the OSPAR (2009a) 50mg.kg^{-1} threshold above which adverse effects on seabed invertebrates may be noted. Based on the location of station ENV_T01, 50m downstream (south) of the Tyne platform, and other Tyne sampling stations, it is likely that the footprint of seabed contamination above the 50mg.kg^{-1} threshold is limited to less than 50m north, east and west of the platform, and between 50m and 170m south of the platform.

Figure 5-10: Summary of hydrocarbon concentrations in 2016 pre-decommissioning survey



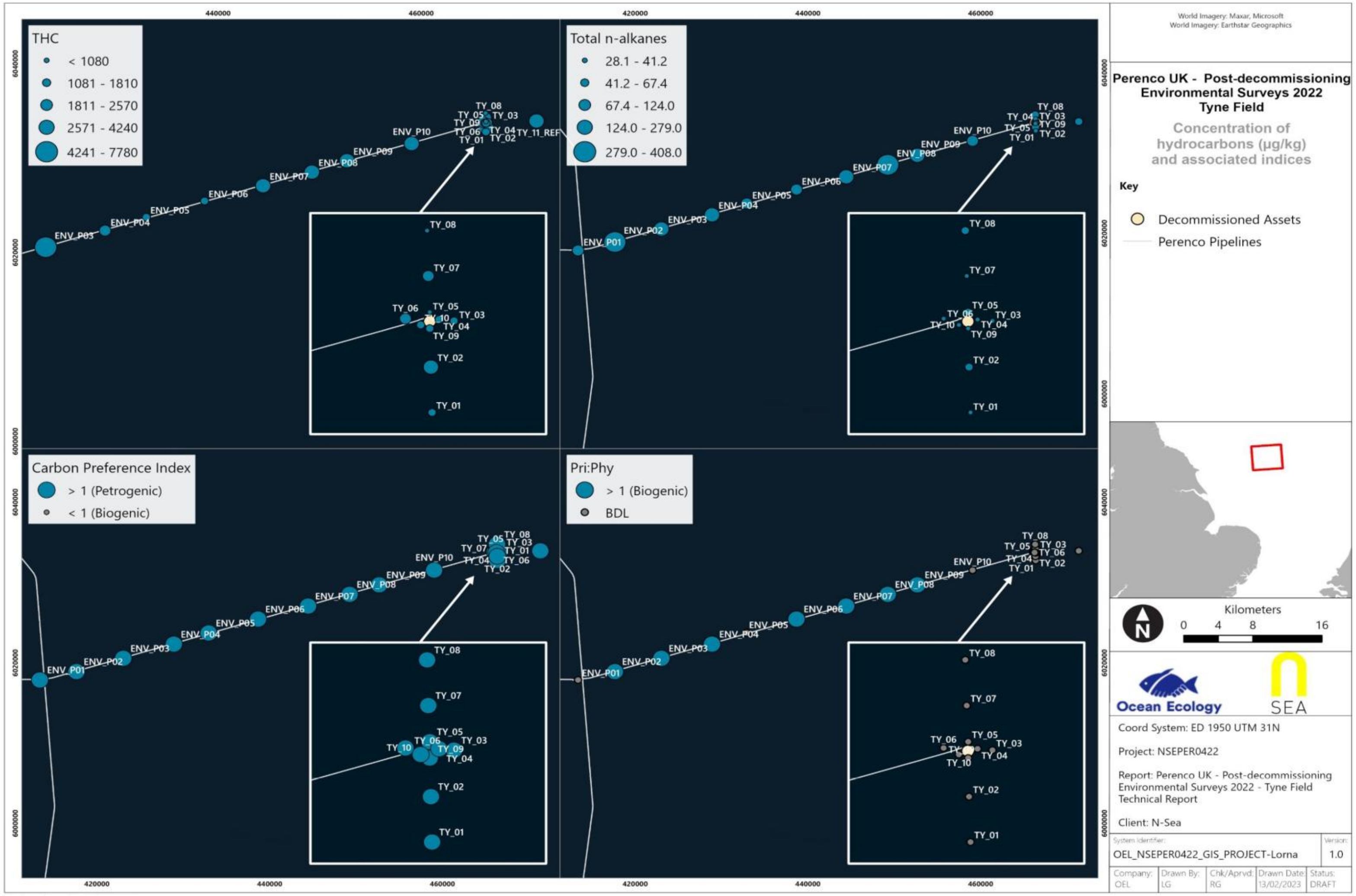
The THC in 2022 post-decommissioning sediment samples collected around the Tyne platform ranged from 1,080µg.kg^{-1} at station TY_08 to 3,260µg.kg^{-1} at station TY_11_REF with the highest concentration found at the reference station suggesting that this relatively high THC cannot be the result of decommissioning activities. No pattern emerged when comparing THCs with the corresponding TOC or mud content which could have been related to transportation and deposition of hydrocarbons across the survey area.

The THC concentrations along the pipeline ranged from 1,550µg.kg^{-1} at station ENV_P06 to 7,780µg.kg^{-1} at station ENV_P02. No pattern emerged when comparing THCs with the corresponding TOC or mud content which could have been related to transportation and deposition of hydrocarbons across the survey area.

The current mean THC recorded across the Tyne cruciform of 1,888.18 ± 209.34µg.kg^{-1} and along the pipeline of 3,524µg.kg^{-1} ± 613.2µg.kg^{-1} are lower than the background levels from UKOOA dataset [89].

To determine whether the decommissioning of the Tyne field has had a significant impact on the hydrocarbon content of sediments, the THC and Carbon Preference Index (CPI) of sediments were compared between decommissioning surveys. Values between pre- and post-decommissioning surveys show no statistically significant differences over time, suggesting that decommissioning activities across the Tyne field resulted in no measurable impact on the local environment.

Figure 5-11: Concentration of key hydrocarbons and relative indices (CPI) and ratios (Pristane/Phytane) 2022 post-decommissioning survey



5.2.3.3 Heavy metals (HM)

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Some are essential to marine life while others may be toxic to numerous organisms [69]. Rivers, coastal discharges, and the atmosphere are the principal modes of entry for most metals into the marine environment [77], with anthropogenic inputs occurring primarily as components of industrial and municipal wastes. Historically, several heavy and trace metals are found in elevated concentrations where drilling fluids or produced waters have been discharged by oil and gas installations. These include intentional additives (such as metal-based salts and organo-metallic compounds in the fluids) as well as impurities within the drilling mud systems such as clays (e.g. bentonites; a gelling and viscosifying agent) and metal lignosulphates (a viscosity controller). The metals most characteristic for offshore contamination of marine sediments from oil and gas activities are barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn) [59], although these may vary greatly dependent upon the constituents used.

Trace metal contaminants in the marine environment tend to form associations with the non-residual phases of mineral matter, such as iron (Fe) and manganese oxides and hydroxides, metal sulphides, organics, and carbonates. Metals associated with these non-residual phases are prone to various environmental interactions and transformations (physical, chemical, and biological), potentially increasing their biological availability. Residual trace metals are defined as those which are part of the silicate matrix of the sediment and that are located mainly in the lattice structures of the component minerals. Non-residual trace metals are not part of the silicate matrix and have been incorporated into the sediment from aqueous solution by processes such as adsorption and organic complexes and may include trace metals originating from sources of pollution. Therefore, in monitoring trace metal contamination of the marine environment, it is important to distinguish these more mobile metals from the residual metals held tightly in the sediment lattice [8], which are of comparatively little environmental significance.

Of particular relevance to the offshore oil and gas industry are metals associated with drilling related discharges. These can contain substantial amounts of barium sulphate (barites) as a weighting agent and Ba is frequently used to detect the deposition of drilling fluids around offshore installations. Barites also contain measurable concentrations of HM as impurities, including Cadmium (Cd), Cr, Copper (Cu), Pb, Mercury (Hg), and Zn. HM, either as impurities or additives are also present in other mud components.

Table 5.5 displays the results of HM analysis from 2016 pre-decommissioning activities.

Table 5.5: Total heavy and trace metal concentrations (mg.kg^{-1}) in 2016 pre-decommissioning survey

Station	Arsenic (HF-MS)	Cadmium (HFMS)*	Chromium (HFMS)	Copper (HF-MS)	Lead (HF-MS)	Mercury (Tot.MS)*	Nickel (HF-MS)	Tin (HF-MS)*	Vanadium (HFMS)	Zinc (HF-MS)	Aluminium (Sediments HFOES)	Barium (Sediments HFOES)	Barium (Sediments - Fusion)	Iron (Sediments HF-OES
ENV_T01	4.7	<0.1	9.1	4.5	5.1	0.02	7.2	0.6	16.9	16	3,270	175	225	9,040
ENV_T02	3.2	<0.1	9.9	3.2	3.8	0.01	4.7	0.5	19.2	11.3	2,140	28	120	9,740
ENV_T03	5.4	<0.1	6.3	2.7	2.6	0.01	5	<0.5	13.3	13	1,610	73	164	6,330
ENV_T04	5.1	<0.1	5.8	2.5	1.9	<0.01	4.3	<0.5	12.6	7.8	1,250	59	117	5,900
ENV_P01	6.8	<0.1	10.6	3.4	4.9	0.61	5.5	<0.5	20	14.7	2,160	26	-	8,630
ENV_P02	20	0.11	16.6	5	9.7	0.03	11	<0.5	42.5	28.2	4,740	56	-	16,700
ENV_P03	25.3	<0.1	13.4	3.9	10.7	0.01	8.4	<0.5	49	20.8	2,980	32	-	16,600
ENV_P04	21.2	0.13	16.9	5.8	8.5	0.01	15.1	<0.5	47.4	33.3	5,520	63	-	20,800
ENV_P05	22.2	<0.1	14.2	4.7	7.3	0.01	10.3	<0.5	43.3	23.2	4,180	31	-	16,900
ENV_P06	14.8	<0.1	12	3.9	6.5	0.01	9	<0.5	30.5	21.8	3,810	27	-	12,600
ENV_P07	24.7	0.14	19.5	7.2	7.8	0.01	20.3	<0.5	55	43.2	6,910	50	-	25,300
ENV_P08	13.9	0.1	10.4	4.1	4.8	0.01	8.4	<0.5	28.8	19	2,770	29	-	12,400
ENV_P09	26.7	0.15	18.8	7.1	8.5	0.02	17.6	0.5	55	37.9	6,690	68	-	27,300
ENV_P10	3.4	<0.1	6.5	2.6	2.8	0.01	4	<0.5	10.6	7.9	1,680	19	-	5,180
Mean	14.1	0.08	12.14	4.33	6.06	0.06	9.34	0.31	31.72	21.29	3,550.71	52.52	156.5	13,815.71
SD	9.11	0.04	4.58	1.53	2.78	0.16	5.12	0.12	16.53	10.95	1,847.93	39.53	50.47	7,077.28
Variance %	64.6	51.2	37.7	35.2	45.8	288.6	54.8	39.5	52.1	51.4	52	75.3	32.2	51.2
ERL*	8.2	1.2	81	34	47	0.1	21	n.a.	n.a.	150	n.a.	n.a.	n.a.	n.a.

n.a: not available
Note: where levels were below the detection limit, a value of half the detection limit was applied in the calculations.
**Lowest concentration of metal that can produce a harmful effect*

Although not directly related to the oil and gas industry, Cd levels consistently gave low concentrations in all samples with a mean concentration of 0.08mg.kg-1 (±0.04SD). Hg remained at trace concentrations of between <0.01mg.kg^{-1} to 0.61mg.kg^{-1} using Inductively coupled plasma - mass spectrometry at all stations sampled (mean 0.06±0.16SD). Moderate but variable concentrations of Pb were recorded, ranging from 1.9mg.kg^{-1} to 10.7mg.kg^{-1} (mean 6.1±2.8SD). As expected, lead indicated a significant positive correlation with percentage fines, (r(12)=0.632, p<0.05).

Natural Ba levels were moderately low along the interconnector pipeline route ranging from 19mg.kg^{-1} to 73mg.kg^{-1} (mean 43.1mg.kg^{-1}±18.6SD). The platform stations however recorded a mean of 83.8mg.kg^{-1} (±63.6SD) with the highest level of 175mg.kg^{-1} measured at station ENV_T01. A further fusion technique was applied to those platform stations in order to analyse insoluble Ba, revealing a mean value of 156.5mg.kg^{-1} (±50.5SD). Measurements of Ba revealed a trend of increasing levels from the SNS to the NNS, similar to the concentration of THC, closely linked to the spatial distribution of sediment types from a sandy to muddy environment. Mean levels of bioavailable Ba (1754.7mg.kg^{-1}) and total Ba (33562.1mg.kg^{-1}) within 500m from active platforms [89] were both far higher than recorded during the Tyne environmental survey. There was no obvious geographical pattern observable for the distribution of Ba although a highly significant correlation with physical sediment parameters, i.e. percentage fines, was confirmed (r(12)=0.905; p<0.01).

Of the other metals, Cr, Nickel (Ni), Cu, vanadium (V) and zinc (Zn) all gave relatively low concentrations with respective means of 12.1mg.kg^{-1}, 9.34mg.kg^{-1}, 4.33mg.kg^{-1}, 31.72mg.kg^{-1} and 21.29mg.kg^{-1}. Vanadium is often associated with the oil and gas industry as it is present in relatively high concentrations in most crude oils [45]. Most vanadium enters seawater in suspension or colloidal form, passing quickly out of the water column and into silt deposition [10]. Consequently, as the natural background levels in this region were relatively low, possible impacts from anthropogenic activities are likely to be detected from future surveys.

The crustal or matrix metals Al and Fe both gave very consistent results with means of 3.55g.kg^{-1} (±1.85SD) and 13.82g.kg^{-1} (±7.01SD) respectively.

The concentration of Arsenic (As) was consistently low around the platform stations (mean 4.6mg.kg^{-1}±1.0SD), with the majority of elevated levels occurring along the interconnector route (17.9mg.kg^{-1}±8.0SD).

Table 5.6 displays HM analysis results from the 2022 post-decommissioning surveys.

Table 5.6: Heavy and trace metals (mg.kg^{-1}) in sediments post-platform decommissioning surveys.

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Ba	Barium by Fusion
TY_01	3	<0.04	5.3	2.7	2.7	<0.01	3.5	11.5	14.7	200
TY_02	2.7	<0.04	5.6	2.9	2.5	<0.01	3.1	12.6	34.2	300
TY_03	3	<0.04	6	1.7	2.7	<0.01	2.8	9.1	8	200
TY_04	2.9	<0.04	5.4	3.4	2.8	<0.01	3.9	12.4	10.1	200
TY_05	3.1	<0.04	5.2	2	2.8	<0.01	3.1	8.9	7.2	200
TY_06	2.9	<0.04	6.7	3.2	3.1	<0.01	4.5	20.4	22	200
TY_07	2.7	<0.04	6.1	4.6	2.9	<0.01	3.7	19	6.7	200
TY_08	3.6	<0.04	9.5	3.3	3.6	<0.01	4.3	16.9	8.2	200
TY_09	2.4	<0.04	4	4.2	1.8	<0.01	2.8	13.2	27.8	300
TY_10	3.1	<0.04	6.9	3.2	3.2	<0.01	3.1	11.9	48.8	200
TY_11_REF	1.8	<0.04	4.4	3.1	2.2	<0.01	2.6	9	7.7	300
ENV_P01	7.2	<0.04	8.3	3.4	4.5	<0.01	5.1	16	15.5	300
ENV_P02	13.9	<0.04	13.9	6.1	9	0.03	10.7	45	51.7	300
ENV_P03	19.2	<0.04	10.8	4.5	8.5	0.01	7.5	23.4	30.9	300
ENV_P04	26.2	0.09	17.2	7.3	7.9	0.01	18	40.3	91.6	400
ENV_P05	12.5	<0.04	8.1	2.9	4.8	<0.01	5.9	17.4	22.4	300
ENV_P06	27.4	0.06	14.4	6.6	8.1	<0.01	13.8	35.6	38.7	300
ENV_P07	23.2	<0.04	17.7	6.4	6.9	0.03	18.9	40	81	300
ENV_P08	19.9	<0.04	13.1	6.7	5.9	<0.01	13	30.7	30.6	300
ENV_P09	26.6	0.07	18	7.3	7.4	0.03	18	44.8	44.8	300
ENV_P10	2.4	<0.04	4.8	1.6	2.2	<0.01	2.8	9	7.8	300
Min	1.8	BDL	4	1.6	1.8	BDL	2.6	8.9	6.7	20BDL
Max	27.4	0.09	18	7.3	9	0.03	18.9	45	91.6	40BDL
Mean	9.99	0.07	9.11	4.15	4.55	0.02	7.2	21.29	29.06	266.67
SD	9.62	0.02	4.7	1.85	2.43	0.01	5.69	12.65	23.98	57.74
SE	2.1	0.01	1.03	0.4	0.53	BDL	1.24	2.76	5.23	12.6
CEFAS AL1	**20**	**0.4**	**40**	**40**	**50**	**0.3**	**20**	**130**	**-**	**-**
CEFAS AL2	**100**	**5**	**400**	**400**	**500**	**3**	**200**	**800**	**-**	**-**
OSPAR BAC	**25**	**0.31**	**81**	**27**	**38**	**0.07**	**36**	**122**	**-**	**-**
OSPAR ERL	**8.2***	**1.2**	**81**	**34**	**47**	**0.15**	**21***	**150**	**-**	**-**
TEL	**7.24**	**0.7**	**52.3**	**18.7**	**30.2**	**0.13**	**-**	**124**	**-**	**-**
PEL	**41.6**	**4.2**	**160**	**108**	**112**	**0.7**	**-**	**271**	**-**	**-**

*The ERLs for As and Ni are below the BACs therefore As and Ni concentrations are usually assessed only against the BAC.
Red shading indicates values above CEFAS AL1

None of the main heavy and trace metals exceeded reference levels at any of the 21 sampling stations with the exception of As which was above CEFAS AL 1 at four stations, OSPAR Background Ambiental Concentration (BAC) at three stations and Effects Range Low (ERL) and Threshold Effect Level (TEL) at eight stations.

Cd concentrations were found at levels below the limit of detection at most stations except for ENV_P04, ENV_P6 and ENV_P09 where levels were detectable but below guideline levels. Hg concentrations were also below the limit of detection and did not exceed guideline limits where detectable along the pipeline stations. Pb levels ranged from 2.2mg.kg-1 to 9.0mg.kg^{-1} and did not exceed guideline limits where detectable. Ba levels varied between 6.7mg kg^{-1} to 91.6mg.kg^{-1}, while Barium by Fusion (Tba) concentration was 300mg.kg^{-1} at all stations except for station ENV_P04 where TBa concentrations were measured at 400mg.kg^{-1}.

No correlation between any of the metals and either mud or TOC content was found along the pipeline due to the very narrow range of TOC in the sediments and the predominance of sandy sediments across the survey area.

Table 5.7: Number of stations across the Tyne pipeline area exhibiting elevated heavy and trace metals levels in comparison with OSPAR, CEFAS and Canadian Sediment Quality Guidelines (CSQG) post-decommissioning survey (red highlight indicates exceedance)

Metal	CEFAS		OSPAR BAC		CSQG	
	AL1	AL2	BAC	ERL	TEL	PEL
As	4	0	3	8	8	0
Cd	0	0	0	0	0	0
Cr	0	0	0	0	0	0
Cu	0	0	0	0	0	0
Pb	0	0	0	0	0	0
Hg	0	0	0	0	0	0
Ni	0	0	0	0	0	0
Zn	0	0	0	0	0	0

The post-decommissioning survey in 2022 confirmed the negligible impact of the HM and trace metal concentrations within the sediments at the Tyne platform and pipelines. Among all metals measured during the post-decommissioning survey, only As exceeded reference levels at few stations (Table 5.7). Arsenic may be linked to Barite, a common additive in oil-based drilling muds, which contains heavy metals like Hg, As, Pb, Cd, and others. While elevated As levels were observed near the Tyne former platform, the low concentrations of other metals suggest these levels are not related to oil-based drill mud discharge. High concentrations of As in the western part of the SNS are a common finding in offshore environmental surveys [91], indicating that As and other metals have been influenced by both the Humber plume and the disturbance of metal-rich shales due to historic regional offshore drilling activities. It is unlikely that geological inputs or historical coastal industrial discharges have had an impact on As levels due to the distance to the nearest coastal area. Production chemicals or the mobilisation of naturally occurring metal-rich shales by offshore drilling activities might explain these elevated levels.

Cd and Hg concentrations were below detection limits at most stations during both surveys hindering a temporal comparison between the two. Conversely, TBa was not measured during pre-decommissioning survey and spatial comparison is not possible.

When comparing the concentrations of key metals with pre-decommissioning data, no statistically significant differences were found between the concentrations of As, Pb and Ba over time further suggesting that contamination resulting from the decommissioning of the Tyne field was minimal and resulted in no measurable impact on the local environment [86].

The question of bioavailability of metals to marine organisms is a complex, as sediment granulometry and the interface between water and sediment all affect bioavailability and subsequently toxicity. Therefore, even if a metal is found in higher concentrations it does not necessarily conclude a detrimental effect on the environment, if present in an insoluble state.

5.2.4 Waves

Waves are the result of energy being transferred between two fluids moving at different rates [19]. They are caused at sea by the differential motion of the air (wind) and the seawater. The height of a wave is the distance from the crest to trough, but as the waves at any one time are not of equal size, the significant wave height is taken and corresponds approximately to the mean height of the highest third of the waves. The wave period is the (mean) time between two wave crests, called the zero up-crossing period and is given in seconds. The wave climate of the area provides information on the physical energy acting on structures and dictates the structural design requirements.

The worst-case height in the vicinity of the blocks of interest exceed 2.5m for 10% of the year (Table 5.8). However, there is considerable seasonal variation between sea states, with waves in excess of 2m recorded for 25% of the time in autumn and winter, but only 2% of the time in summer [79]. Wave direction is variable throughout the year.

Table 5.8: Average wave heights in the vicinity of the blocks of interest

Average wave height (m)			
Spring	Summer	Autumn	Winter
1.51 to 1.75	1.01 to 1.50	1.76 to 2.00	2.01 to 2.50

5.2.5 Water Circulation and tides

The general circulation of near-surface water masses in the North Sea is cyclonic, mostly driven by the ingression of Atlantic surface water in the western inlets of the NNS. As a result, residual water currents near the sea surface tend to move in a south-easterly direction along the coast towards the English Channel [62][16].

In addition, counter currents occur towards the English/ Dutch sector median line, flowing northeast towards Denmark (Figure 5-12). The effect of this counter current in the vicinity of the blocks of interest pushes the near-surface water movement towards a more southerly and easterly direction.

Tides in the SNS are predominately semi-diurnal and tidal waters offshore in this area flood southwards and ebb northwards. Maximum tidal rates in the region of the blocks of interest are 0.46 and 0.26m/s respectively for spring and neap tides (Figure 5-13). Tidal streams were generally fastest for a period of one hour up to six hours prior to and after high water during both spring and neap tides [35].

Figure 5-12: Major Current flows around the UK [16]

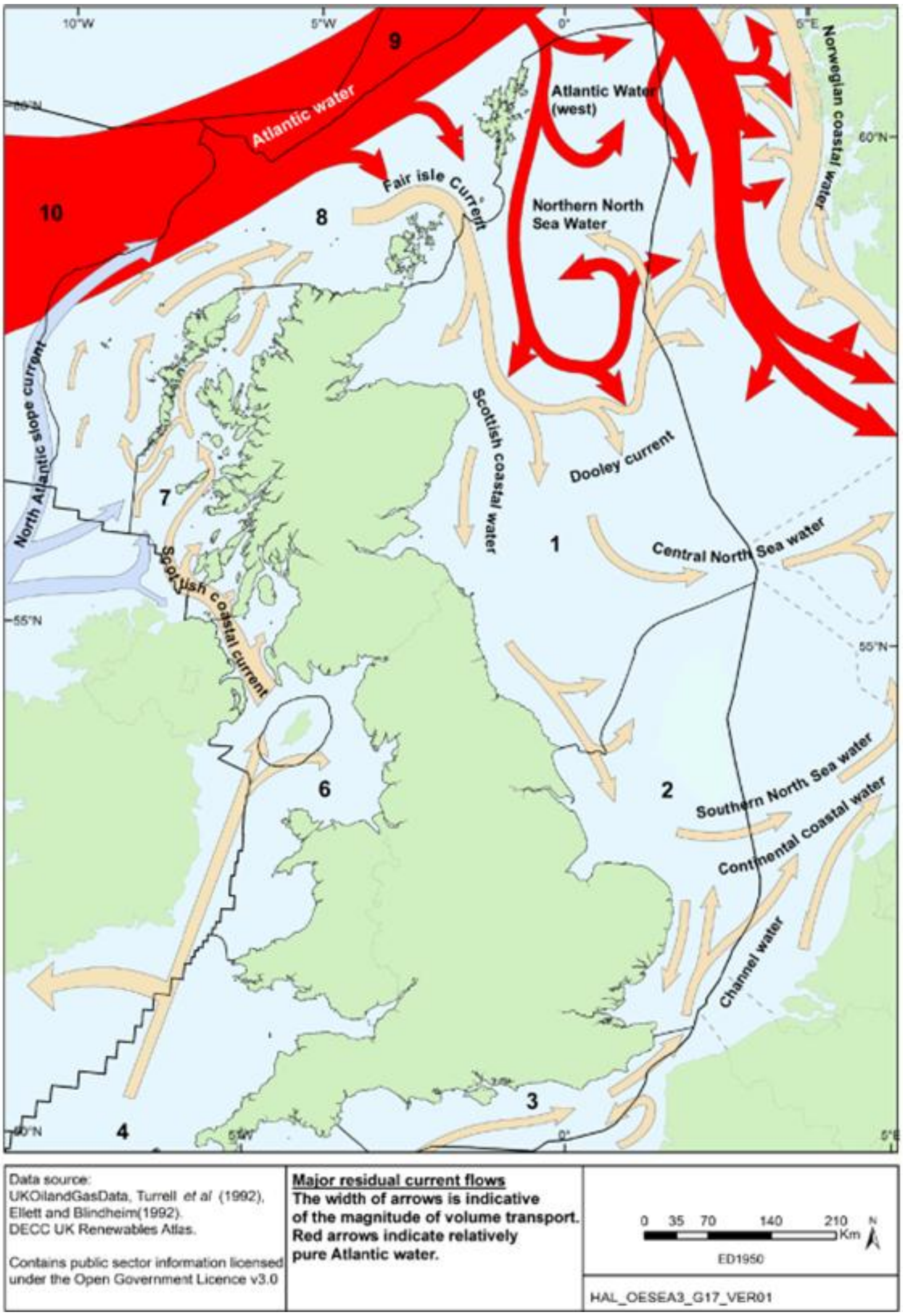
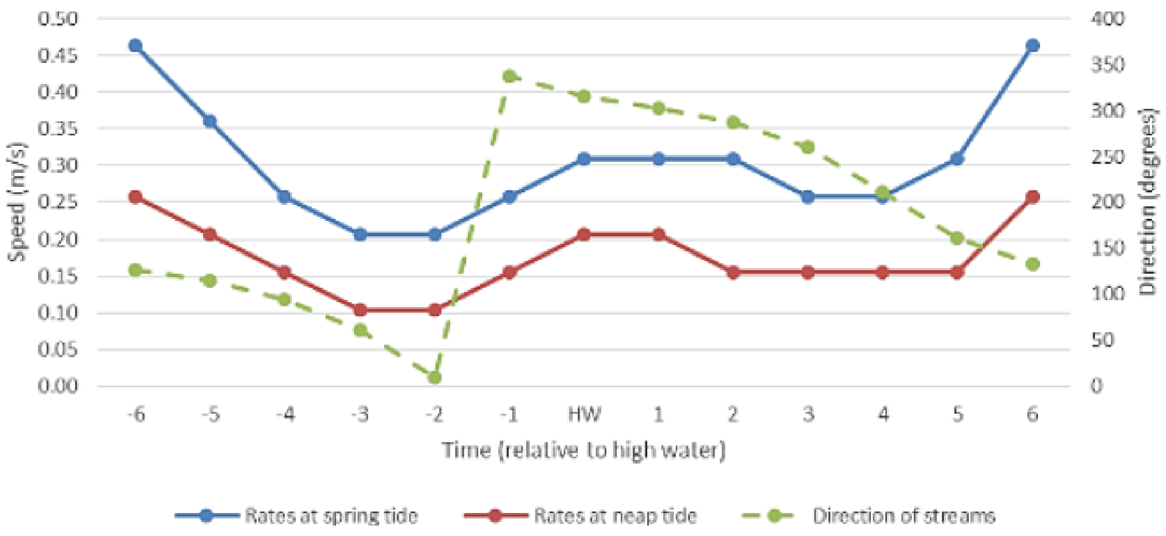


Figure 5-13: Tidal current speeds and direction measured in the region of the blocks of interest [35]



5.2.6 Temperature & Salinity

Winter water temperatures in the SNS are in the range of 4 – 8ºC, while summer water surface temperatures are in the range of 16ºC – 19ºC, with little variation, either down the water column or from near shore to offshore waters [24]. Salinities decrease both towards the south and towards the coastline, reflecting the influence of freshwater inputs from the adjacent landmasses.

The salinity in the region of the blocks of interest remains relatively stable throughout the year. The mean annual salinity of the sea surface varies between a winter mean of 34.69 parts per thousand (ppt) and a summer mean of 34.67ppt. While the mean salinity of the bottom is 34.67ppt in winter and 34.68ppt in summer [61].

5.3 Biological Environment

5.3.1 Benthic Biodiversity

Benthic faunal communities were assessed during the Tyne pre-decommissioning survey. Communities in the vicinity of PL 1220/ PL 1221 showed minor variation in terms of individual abundance, species richness and species composition; as would be expected given the homogeneity of the sediment, energetic environment, and depth within the area. The infaunal community was dominated by both annelids and echinoderms in terms of individual abundance and by annelids and molluscs regarding species richness, including *Goniada maculate*, *Ophelia limacine*, *Nemertea unid*., *Diplocirrus glaucus* and *Echinocyamus pusillus* (Table 5.9, Figure 5-14, Figure 5-15).

Annelida

Within the polychaete species, no rare or unusual specimens were recorded. *Glycera lapidum, Nephthys* spp, *Scoloplos armiger, Spiophanes* spp*, Magelona mirabilis* and *Owenia fusiformis* are typical annelids that inhabit clean sandy, shelly, and gravelly sediments whereas *Ophelia limacina* usually prefers highly mobile sediments.

Mollusca

Similar to the polychaete community, no rare species were found during the Tyne 2016 environmental survey. However, the presence of the bivalve *Glycymeris glycymeris* was unusual, as this species is normally absent in the SNS. Its southern limit is not well defined and is usually found in highly dynamic mobile sediments. Only one specimen was found at station ENV_P04. Five individuals of the predatory gastropod *Euspira nitida* were recorded.

Arthropoda

The species recorded are typical for clean sandy sediments. Of interest was the record of *Upogebia* spp at stations ENV_P02 and ENV_P07. The presence of this species indicates a firm underlying sediment of sand or clay under a highly mobile substrates that support the extensive burrows of these species. These crustaceans can make large burrows down to 40cm in depth and due to this fact, their real numbers might be underestimated as a common Day grab would not achieve this penetration. Ten to twelve adults per m^2 have been observed in the past to live within such burrows utilising a suction sampler for the excavation of these animals.

Echinodermata

The species found during the survey were generally species one would expect for this area. The sudden high abundance of *Amphiura filiformis* at station ENV_ P02 (161 out of 193 individuals in total) could be attributed to an increase in organic matter and/or higher amount of fine sediment which would match with the highest proportion of percentage fines (~10%) measured at this station.

Vertebrata

The lancelet fish *Branchiostoma lanceolatum* was recorded as one typical member of the infauna for highly mobile sediment.

Overall, the macrofauna community was composed of species commonly found in this area, with some species variations due to varying levels of sand residues and possibly historic shell material in the grab samples.

Table 5.9: Overall species ranking (top 15 species) 2016 pre-decommissioning survey

Overall Top 15 Rank	*Species/Taxon*	Total rank score (out of 140)	Numerical Abundance (2 replicates)	Numerical Top 15 rank
1	*Goniada maculata*	57	19	6
2	*Ophelia limacina*	44	18	8
3	*Nemertea unid.*	40	17	10
4	*Diplocirrus glaucus*	39	16	13
5	*Echinocyamus pusillus*	39	17	10
6	*Amphiura filiformis*	37	193	1
7	*Nephthys cirrosa*	34	9	21
8	*Notomastus latericeus*	34	28	2
9	*Pholoe inornata*	30	16	13
10	*Glycera fallax*	28	17	10
11	*Urothoe elegans*	27	22	3
12	*Nephthys hombergii*	26	7	27
13	*Magelona mirabilis*	26	15	15
14	*Owenia fusiformis*	26	6	31
15	*Dexamine spinosa*	26	19	6

Figure 5-14: Proportion of individual abundance by main taxonomic group for each station, pre-decommissioning survey, 2016

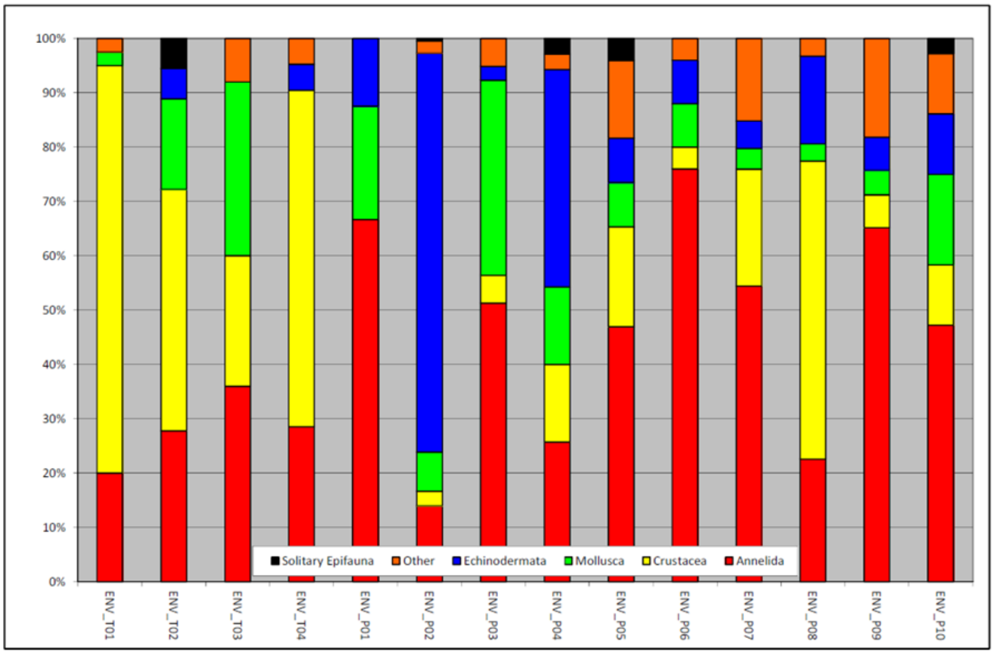
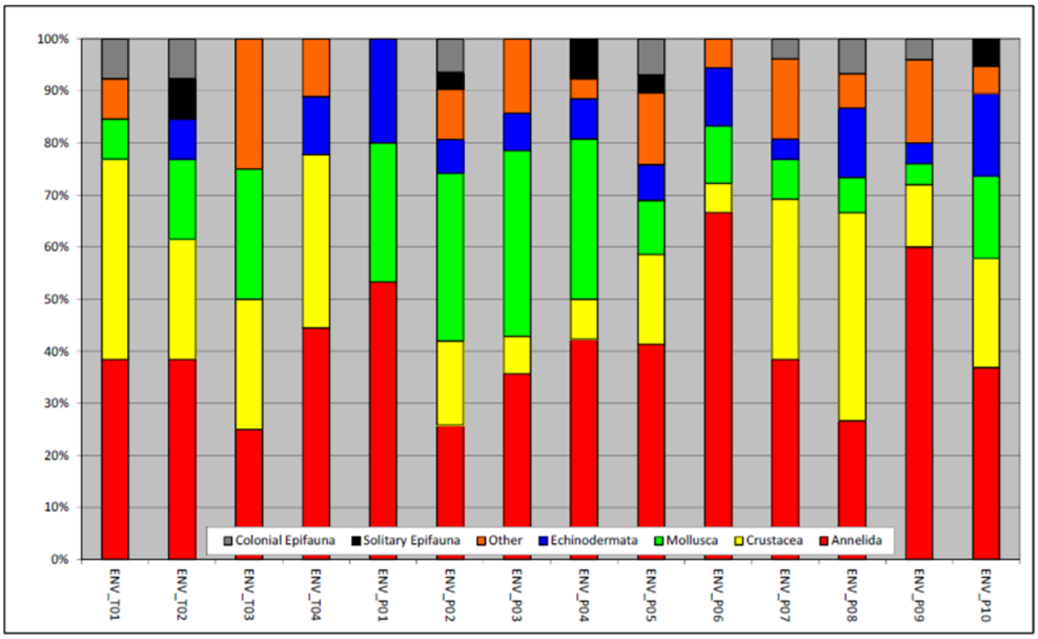


Figure 5-15: Proportion of individual diversity by main taxonomic group for each station, pre-decommissioning survey, 2016



A further 21 macrofauna samples obtained from the 11 grab sampling stations (two replicates per station) were assessed at the Tyne post-decommissioning survey in 2022. A diverse macrobenthic assemblage was identified across the Tyne field with a total of 8,472 individuals and 266 taxa recorded. Polychaete *Lanice conchilega* was the most abundant taxon sampled accounting for 17.5% of all individuals recorded (see Figure 5-16, Figure 5-17, Table 5.10). It accounted also for the greatest average density per sample. Other key taxa included Nemertea which occurred at 92.9% of stations and *Owenia* which accounted for the maximum abundance in a single sample.

On average, Annelid taxa contributed most to abundance and diversity as they accounted for about 55% of all individuals recorded and 40% of all taxa recorded. In contrast biomass was dominated at times by Mollusca taxa along the pipeline with notable contributions of Echinodermata and Crustacea taxa, while it was dominated by Miscellaneous taxa within the cruciform with notable contributions of Echinodermata taxa.

Figure 5-16: Proportion of individual abundance by major taxonomic group by station, post-platform decommissioning survey

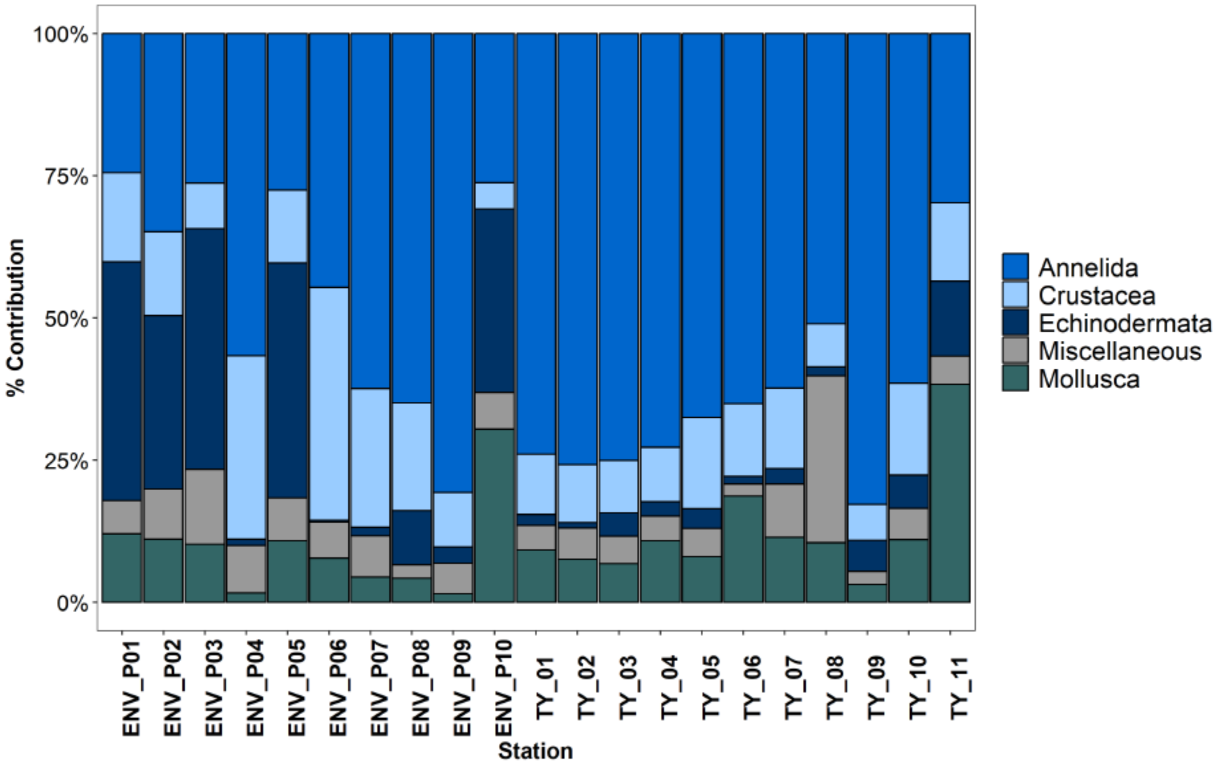


Figure 5-17: Proportion of individual diversity by major taxonomic group by station, post-platform decommissioning survey

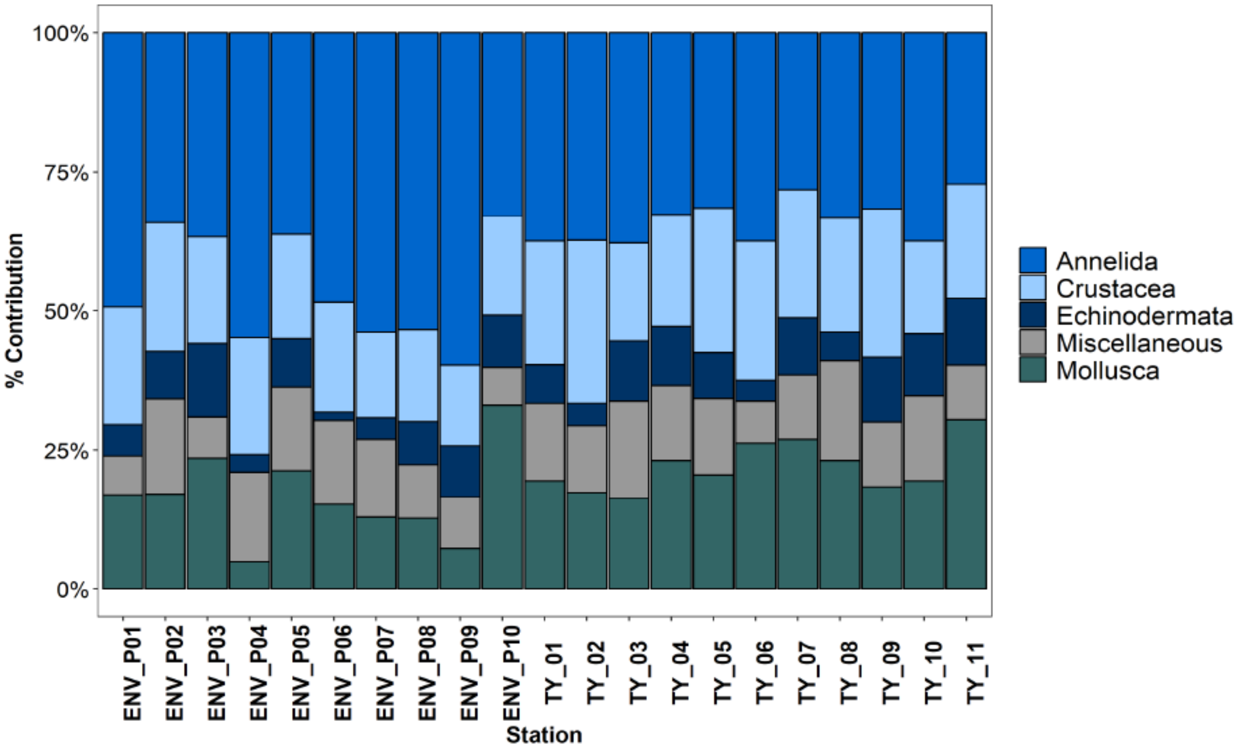


Table 5.10: Percentage contributions of the top 10 macrobenthic taxa to total abundance for post-decommissioning survey

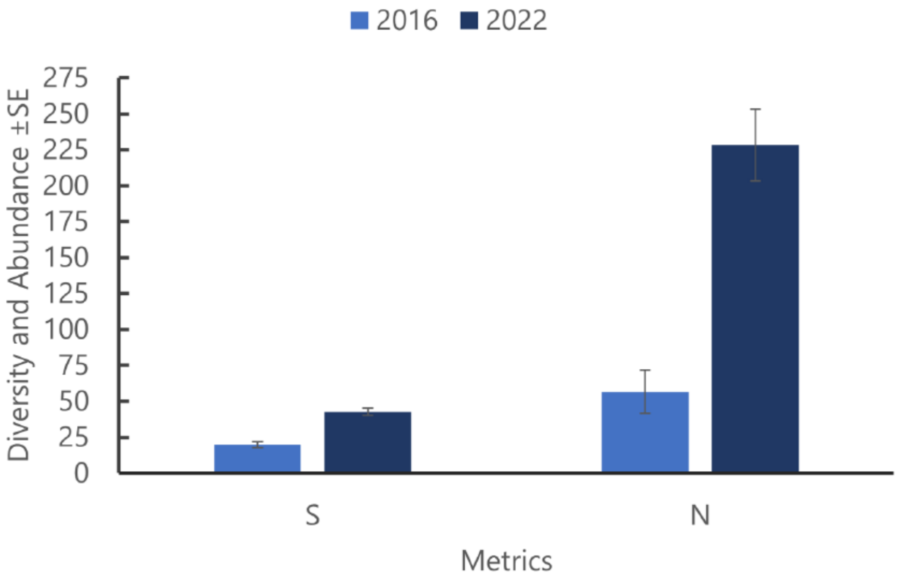
Overall Top 10 Rank	Species/Taxon	Contribution to total abundance (%)
1	*Lanice conchilega*	17.543
2	*Owenia*	8.128
3	*Amphiuridae_Juvenile*	6.273
4	*Upogebia_Juveline*	4.525
5	*Notomastus*	4.017
6	*Spiophanes bombyx*	3.745
7	*Amphiura filiformis*	2.304
8	*Nephtys cirrosa*	2.008
9	*Nemertea*	1.949
10	*Thracioidea Juvenile*	1.855

Macrobenthic communities can be highly heterogenous as they are heavily influenced by ambient environmental conditions such as sediment composition [11], hydrodynamic forces and physical disturbance [32], depth [21], and salinity [83].

Statistically significant differences in macrobenthic compositions were found across the Tyne field between the 2016 and 2022 post-decommissioning surveys based on cluster and SIMPROF analyses. Dominant taxa differed across the area and over time presenting different biotope(s) between the 2016 and 2022 post-decommissioning surveys.

Mean (±SE) diversity across the Tyne field was 19.8 ± 2.1 in 2016 and 42.7 ± 2.6 in 2022. Mean (±SE) abundance was 57 ± 15 in 2016 and 228 ± 25 in 2022. Figure 5-18 illustrates temporal variability of diversity and abundance across the Tyne filed.

Figure 5-18: Mean diversity (S) and abundance (N) of macrobenthic assemblages across the Tyne field during the 2016 and 2022 post-decommissioning surveys



Multivariate analysis was undertaken on the square-root transformed macrobenthic abundance data to identify spatial distribution patterns in macrobenthic assemblages across the Tyne field and identify characterising taxa present [86]. Multivariate analysis led to unique macrobenthic groups being identified between the 2016 and 2022 post-decommissioning surveys. PSD and macrobenthic data clearly indicated the presence of three macrobenthic groups and one outlier station in 2016 and 4 macrobenthic groups and three outlier stations in 2022 across the Tyne survey area.

A change in biotopes from 2016 to 2022 was observed across the survey area (see Figure 5-19). The macrobenthic group dominated in 2016 was characterised by high abundances of *G. maculata*, Nemertea and *Glycera* spp, representative of biotope A5.151. In 2022 macrobenthic two dominant biotopes were identified, A5.145 characterised by *Notomastus* spp, and A5.261 dominated by *A. filiformis*. However, no clear spatial trend emerged between the post-decommissioning surveys and no one biotope from 2016 consistently transition to a biotope in 2022. Biotopes assigned in 2016 did not match or compare with those biotopes assigned in 2022. An overall increase in the number of biotopes present across the survey area was noted between 2016 and 2022. The number of stations classified as outliers also increased in 2022. A significant increase in the abundance and diversity of macrofauna across the survey area was also observed from 2016 to 2022. Therefore, presenting that the overall community across the Tyne survey area has changed between the 2016 and 2022 post-decommissioning surveys.

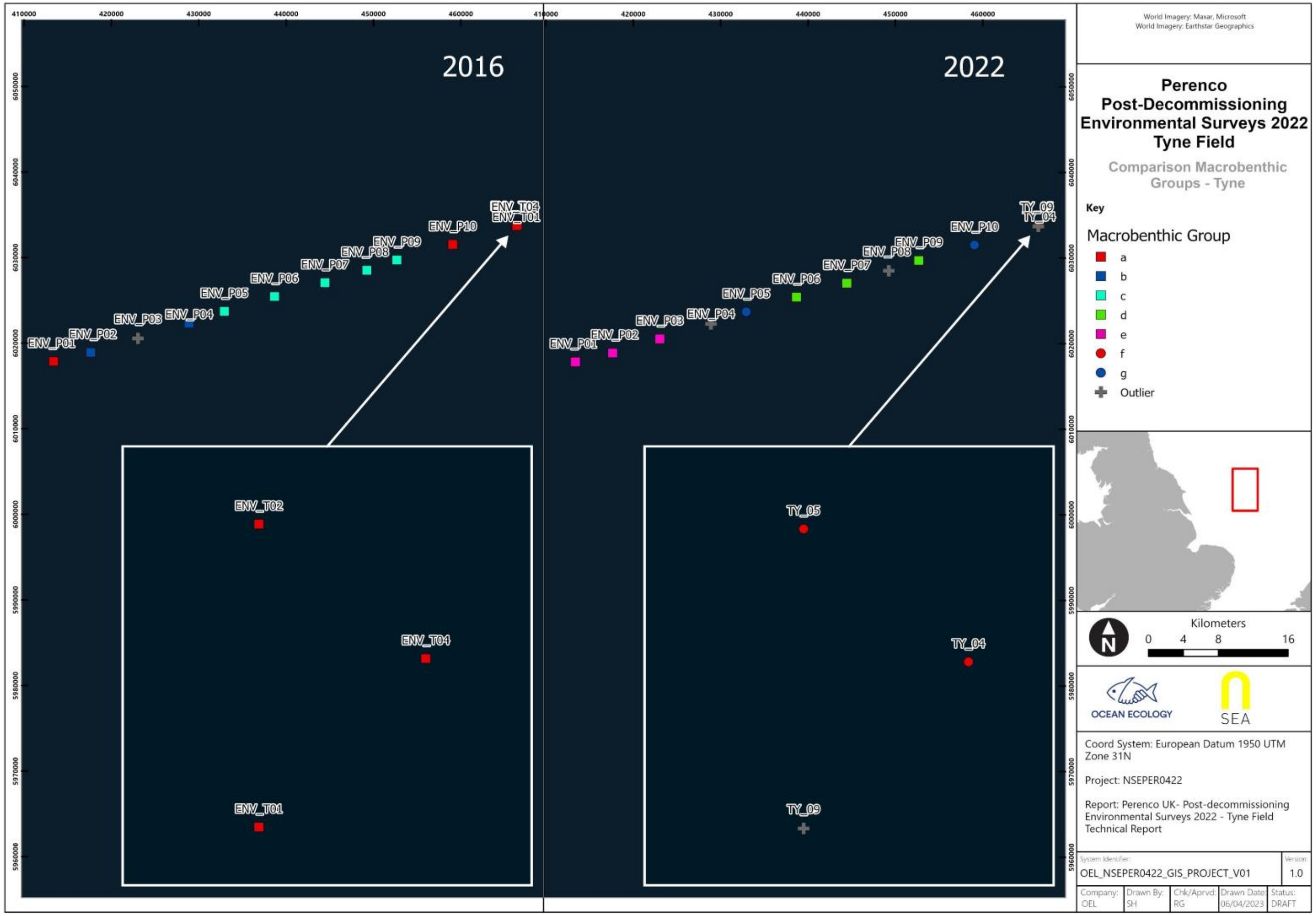
5.3.1.1 Notable taxa

Two Invasive Non-Native Species (INNS) were found across the Tyne field in the Tyne post-decommissioning survey: the Atlantic jack-knife clam (*Ensis leei*) and the crustacean *Monocorophium sextonae*. However, only three individuals of *E. leei* were identified across the survey area with two individuals sampled at station TY_04 and one at station ENV_P08. Only one specimen of *M. sextonae* was recorded across the Tyne field identified at station TY_11_REF.

These INNS clams can form dense colonies and smother native species; potentially changing local habitats [85]. *M. sextonae* is originally from New Zealand and was first introduced to the UK in the 1930's. Effects on the environment due to the presence of this INNS seem negligible; however, *M. sextonae* has been seen competing with native amphipod *Crassicorophium bonellii* [25]. Atlantic jack-knife clams are native to the east coast of America and reportedly accidentally introduced into the UK in ballast water of cargo ships.

In addition, a total of three Ross worm *S. spinulosa* individuals were identified across the Tyne post-decommissioning survey area at stations ENV_P08 and ENV_P09, both located along the Tyne pipeline and outside of the Tyne 500m exclusion zone and with no evidence of reef forming structures observed in the seabed imagery. The Ross worm *S. spinulosa* is a protected species in its reef form under the Habitats Directive and as a threatened and/or declining species in the OSPAR list.

Figure 5-19: Spatial distribution of macrobenthic groups across the Tyne field between the 2016 and 2022 post-decommissioning surveys



5.3.1.2 Sensitivity of benthic fauna

The sensitivity of some of the benthic species found near to the Tyne development during the 2016 EBS were investigated using the Marine Life Information Network sensitivity assessment tool. The assessment rationale involves judging the intolerance of a species to change in an external factor arising from human activities or natural events. The rationale then assesses the likely recoverability of the species following cessation on the human activity or natural event. Intolerance and recoverability are then combined to provide a meaningful assessment of their overall sensitivity to environmental change.

Four benthic species found near to the Tyne development have been assessed for their sensitivity to different criteria (Table 5.11). The polychaete *Magelona mirabilis* and the tubeworm *Owenia fusiformis* are most sensitive to substratum loss, while the brittle star *Amphiura filiformis* is most sensitive to substratum loss and hydrocarbon contamination and the catworm *Nephtys hombergii* is most sensitive to hydrocarbon contamination (Table 5.11). All of these species have no or relatively low sensitivity to smothering, increased turbidity, increased suspended sediment, noise, abrasion and physical disturbance and contamination by HM. Detailed sensitivity analysis was not available for the other species [52]. Generally, polychaetes are known for their ability to be able to adapt to most conditions, while the annelida *Notomastus latericeus* is reported to be intolerant to substratum loss, but tolerant to the presence of hydrocarbons.

Table 5.11: Sensitivity assessment of some benthic species found near to the Tyne development to external factors [52]

External factors	Benthic species			
	Brittlestar *Amphiura filiformis*	Polychaete *Magelona mirabilis*	Catworm *Nephtys hombergii*	Tubeworm *Owenia fusiformis*
Substratum Loss	moderate	moderate	low	moderate
Smothering	very low	not sensitive	not sensitive	low
Increase in Suspended Sediment	very low	not sensitive	not sensitive	not sensitive
Increase in Turbidity	very low	very Low	-	not sensitive
Noise	not sensitive	not sensitive	not sensitive	not sensitive
Abrasion and Physical Disturbance	very low	low	low	low
HM Contamination	low	-	low	not sensitive
Hydrocarbon Contamination	moderate	-	moderate	-
Substratum Loss	moderate	moderate	low	moderate
Smothering	very low	not sensitive	not sensitive	low
Increase in Suspended Sediment	very low	not sensitive	not sensitive	not sensitive

Note: '-' indicates No available information

Priority Marine Features: Amphiura filiformis, polychaetes, Glycera lapidum, Protodorvillea kefersteini, Echinocyamus pusillus, Bathyporeia elegans, Owenia fusiformi.

5.3.2 Plankton

The collective term plankton describes the plants (phytoplankton) and animals (zooplankton) that live freely in the water column and drift passively with the water currents. Typically, in the SNS a phytoplankton bloom occurs every spring, generally followed by a smaller peak in the autumn [16].

The SNS is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variation. The region is largely enclosed by land and as a result the marine environment is highly dynamic with considerable tidal mixing and nutrient-rich run-off from land (eutrophication). Under these conditions, nutrient availability is fairly consistent throughout the year therefore organisms with high nutrient uptake that thrive in dynamic waters, such as diatoms, are particularly successful [48]. The phytoplankton community in the Regional Sea 2 is dominated by the dinoflagellate genus Ceratium (*C. fusus, C. furca, C. lineatum*), along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalochaete* and *Phaeoceros*) than are typically found in the NNS [16].

The zooplankton community is dominated by copepods including *Calanus helgolandicus and C. finmarchicus* as well as *Paracalanus* spp, *Pseudocalanus* spp, *Acartia* spp, *Temora* spp and cladocerans such as *Evadne* spp [16]. The planktonic assemblage in the vicinity of the Tyne pipelines is not considered unusual.

In the sea area surrounding PL 1220/ PL 1221 are likely to be typical for the SNS. The phytoplankton community in the Regional Sea 2 is dominated by the dinoflagellate genus Ceratium (*C. fusus, C. furca, C. lineatum*), along with higher numbers of the diatom, Chaetoceros (subgenera Hyalochaete and Phaeoceros) than are typically found in the NNS. From November to May when mixing is at its greatest, diatoms comprise a greater proportion of the phytoplankton community than dinoflagellates [16].

From November to May when mixing is at its greatest, diatoms comprise a greater proportion of the phytoplankton community than dinoflagellates [16].

5.3.3 Fish & Shellfish

The northeast Atlantic and North Sea is split into a statistical grid called International Council for the Exploration of the Sea (ICES) Rectangles in order to statistically map fisheries information about an area. PL 1220 and PL 1221 are located within ICES Rectangles 37F1 and 37F2. Generally, there is little interaction between fish and offshore developments, although some species congregate around platforms and along pipelines. However, spawning individuals and juveniles can be sensitive to seismic activities, seabed disturbance activities, discharges to sea and, in some cases, accidental spills.

Cefas/Marine Scotland has published data on critical spawning and nursery grounds for selected fish species around the UK [13; 22; 2]. Data is based on historic and more recent ichthyoplankton trawls to identify key spawning, nursery habitats and species of interest. Spawning and nursery grounds are mapped according to ICES statistical rectangles. The Tyne infrastructure straddles two ICES Rectangles: 37F1 and 37F2. For the purpose of this report fish spawning and nursery areas within the blocks of interest have been identified according to whether they overlap with the boundary of ICES rectangles 37F1 and 37F2.

There are potential fish spawning areas in ICES rectangles 37F1 and 37F2 for cod (*Gadus morhua*), herring (*Clupea harengus*), lemon sole (*Microstomus kitt*), mackerel (*Scomber scombrus*), Horse mackerel (*Trachurus trachurus*) Nephrops (*Nephrops norvegicus*), plaice (*Pleuronectes platessa*), sandeels (*Ammodytidae marinus*), sole (*Solea solea*), sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangus*) (Figure 5-20) [13; 22; 2].

A number of species, which have benthic eggs, have a dependency on specific substrata for spawning. For example, sandeels lay their eggs on sandy sediments and therefore may spawn on discreet sandy sediments within the blocks of interest. Such sediments would therefore be considered important for this species [16]. A number of other species, including some demersal species, have pelagic eggs and/or larvae including cod, haddock, Norway pout and saithe and are therefore less reliant on specific sediment types for spawning [16].

In addition to the spawning grounds described above, the waters of ICES rectangles 37F1 and 37F2 also act as nursery areas for anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*) cod (*G. morhua*), European hake (*Merluccius merluccius*), herring (*C. harengus*), mackerel (*S. scombrus*), lemon sole (*M. kitt*), ling (*Molva molva*), Nephrops (*Nephrops norvegicus*), sandeels (*A. marinus*), sprat (*S. sprattus*), spurdog (*Squalus acanthias*), tope shark (*Galeorhinus galeus*) and whiting *(M. merlangus*) [13; 22].

Juvenile fish are vulnerable to predators and harsh conditions in the open water. Therefore, it is typical for juvenile fish to stay in sheltered nursery grounds, which also provide an abundance of food [16].

Of the species that may be present within the blocks of interest at various times throughout the year, the majority are considered to be demersal species, i.e. species that spend most of their time at or near the seabed. These species include anglerfish (monkfish), European hake, lemon sole, ling, plaice, sandeels, sole, spurdog and whiting. However, species such as cod, herring, spurdog, tope shark and whiting can also be regarded as benthopelagic species that move into mid-water periodically and have been known to predate upon midwater species [15]. In addition, sandeels remain buried in sandy sediments during the night and hunt for prey in mid-water during daylight hours and are therefore not a wholly demersal species [16]. Other species such as blue whiting, horse mackerel, mackerel and sprat are considered to be pelagic species i.e. species that spend most of their time in open water, away from the seabed [16].

The 2016 EBS recorded the presence of Soleas spp, Triglops spp, and sandeels in the vicinity of the Tyne development [6].

Table 5.12: Fish and shellfish spawning and nursery areas within ICES Rectangle 37F1 and 37F2 [13] [22]

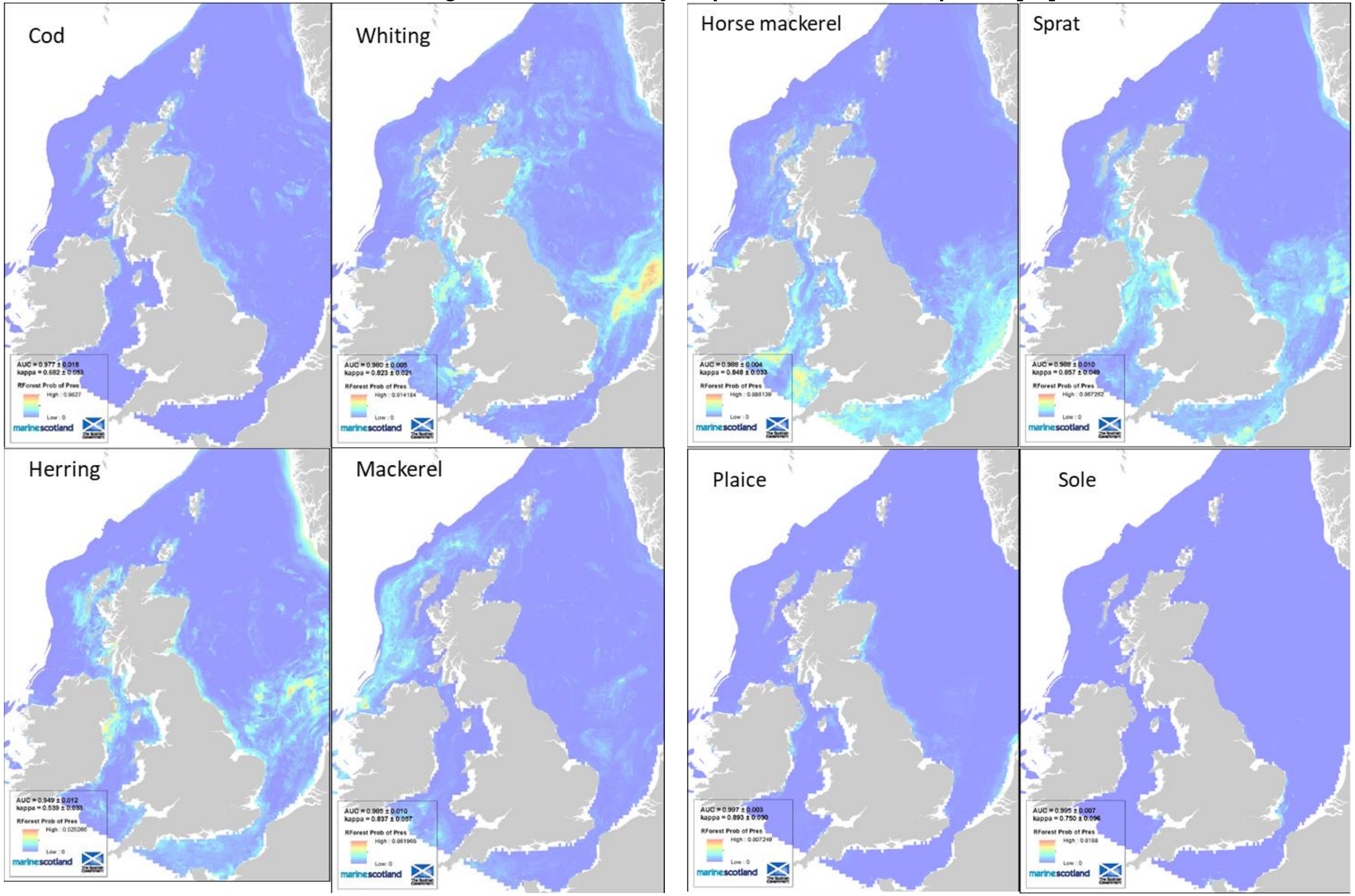
Species	J	F	M	A	M	J	J	A	S	O	N	D
Anglerfish[1]	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	N	N	N	N	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Herrin	N	N	N	N	N	N	N	N	N	N	N	N
Lemon sole	N	N	N	N	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Nephrops	N	N	N	N	N	N	N	N	N	N	N	N
Plaice												

Sandeels	N	N	N	N	N	N	N	N	N	N	N	N
Plaice												
Sole	N	N	N	N	N	N	N	N	N	N	N	N
Sprat	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog[2]	N	N	N	N	N	N	N	N	N	N	N	N
Tope shark[2]	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	N	N	N	N	N	N	N	N	N	N	N
Key		Spawning				Peak Spawning			N	Nursery		

[1] Insufficient data available on spawning grounds [22]

[2] Viviparous species (gravid females can be found all year) [22]

Figure 5-20: Sensitivity maps for selected fish species [13]



Elasmobranch Species

Elasmobranch species (sharks, skates, and rays) are also an important component of the North Sea ecosystem. Elasmobranchs have a low fecundity and slow growth rate, leaving them vulnerable to overfishing pressures and pollution events, and subsequent recovery of populations in response to disturbance events is low. Historically, many elasmobranch species have been fishery targets due to their fins and liver oils [47]. While many species are no longer subjects of targeted fisheries, they are still under threat from commercial pelagic and demersal fishery by-catch.

In a survey of the distribution of elasmobranchs in UK waters was undertaken by Ellis et al. in 2004 a total of 26 elasmobranch species were recorded throughout the North Sea and surrounding waters. Species which have been recorded in the SNS at various times throughout the year and may therefore be present in the vicinity of the blocks of interest, are listed in Table 5.13 [22].

Table 5.13: Elasmobranch Species likely to be found in the Vicinity of the Tyne pipelines

Common Name	Latin Name	Depth Range (m)	Global IUCN Status Note 1
Blonde skate	*Raja brachyura*	10 – 900	Near Threatened
Common smoothhound	*Mustelus mustelus*	5 – 350	Endangered
Cuckoo skate	*Leucoraja naevus*	12 – 290	Least Concern
Small spotted catshark	*Scyliorhinus canicula*	< 400	Least Concern
Spiny dogfish	*Squalus acanthias*	15 – 528	Vulnerable
Spotted skate	*Raja montagui*	< 530	Least Concern
Starry smoothhound	*Mustelus asterias*	0 – 100	Vulnerable
Thornback skate	*Raja clavata*	10 – 300	Near Threatened
Tope shark	*Galeorhinus galeus*	0 – 2000	Critically Endangered
Undulate skate	*Raja undulata*	50 – 200	Endangered

Note 1: Status as of April 2023.

Of these species, blonde skate, common smooth-hound, spiny dogfish, starry smooth-hound, thornback skate and tope shark are of most concern due to their unfavourable conservation status [38]. In addition, spotted skate, thornback skate, and spiny dogfish are listed on the OSPAR list of threatened and/or declining species and habitats [68].

5.3.4 Seabirds

The offshore waters of the SNS are visited by numerous seabirds, mainly for feeding purposes in and around the shallow sandbanks [16]. Regional Sea 2 also includes several areas suitable for cliff nesting seabirds and some of the most important sites for wintering and passage waterbirds in a national and international context, including the Wash and Thames Estuary. Therefore, individuals found offshore in the vicinity of the Tyne location may originate from onshore colonies or be passing migrants. Numbers of seabirds are generally lower in Regional Sea 2 compared to further north [16].

The most common species of seabird found in this area of the SNS include: Northern fulmar (*Fulmarus glacialis*), Great Skua (*Stercorarius skua*), Black legged kittiwake (*Rissa tridactyla*), Great black backed gull (*Larus marinus*), Common gull (*Larus canus*), Lesser black backed gull (*Larus fuscus*), Herring gull (*Larus argentatus*), Common guillemot (*Uria aalge*), Razorbill (*Alca torda*), Little auk (*Alle alle*) and Atlantic puffin (*Fratercula arctica*) [46].

Fulmars are present in highest numbers during the early and late breeding seasons, leading to peak densities in September. Kittiwakes are widely distributed throughout the year. Lesser black-backed gull are mainly summer visitors, while in contrast guillemot numbers are greatest during winter months. In addition, substantial numbers of terns migrate northwards through the offshore North Sea area in April and May, with return passage from July to September [16].

5.3.4.1 Seabird Vulnerability to Oil Pollution

Seabird populations are particularly vulnerable to surface pollution. The vulnerability of bird species to oil pollution varies considerably throughout the year and is dependent on a variety of factors, including time spent on the water, total biogeographical population, reliance on the marine environment and potential rate of population recovery. Species considered most vulnerable to sea surface pollution are those which spend a great deal of time on the sea surface, for example, puffin, guillemot, and razorbill. Species considered to be at lower risk due to spending less time on the sea surface include gannet, cormorant, and kittiwake.

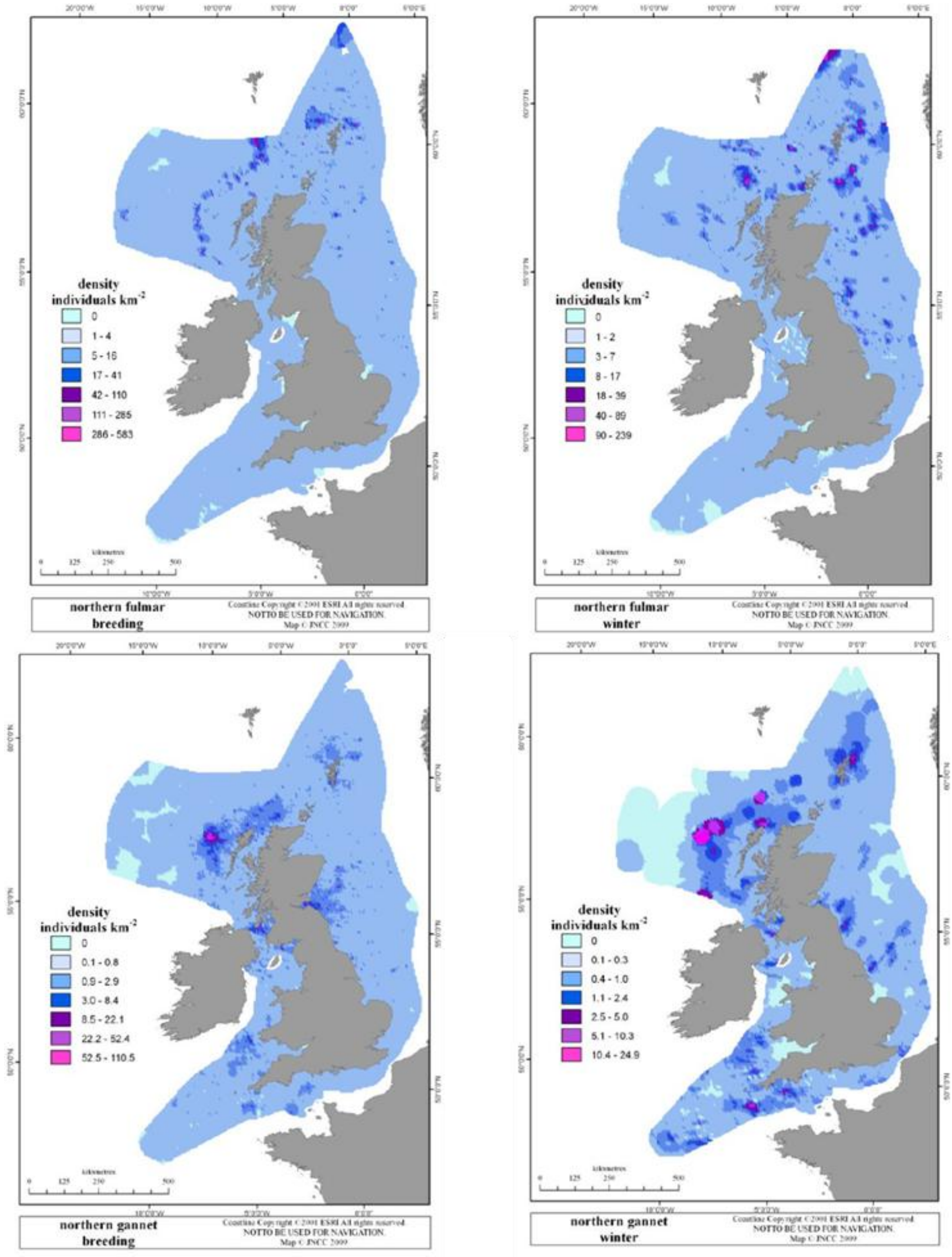
The Seabird Oil Sensitivity Index (SOSI) has been developed to identify areas where seabirds are likely to be most sensitive to oil pollution [92]. The SOSI combines seabird data collected between 1995 and 2015 and individual seabird species sensitivity index values to create a single measure of seabird sensitivity to oil pollution. The SOSI score for each UKCS Block can be ranked into sensitivity categories, from 1 (extremely high sensitivity) to 5 (low sensitivity) (Table 5.14). An assessment of the median SOSI scores indicates that the sensitivity of seabirds to oil pollution in UKCS blocks 43/24, 43/25, 43/20, 44/16, 44/17 and 44/18 is 'very high' during November and 'high' during October, December, and March (Table 5.14).

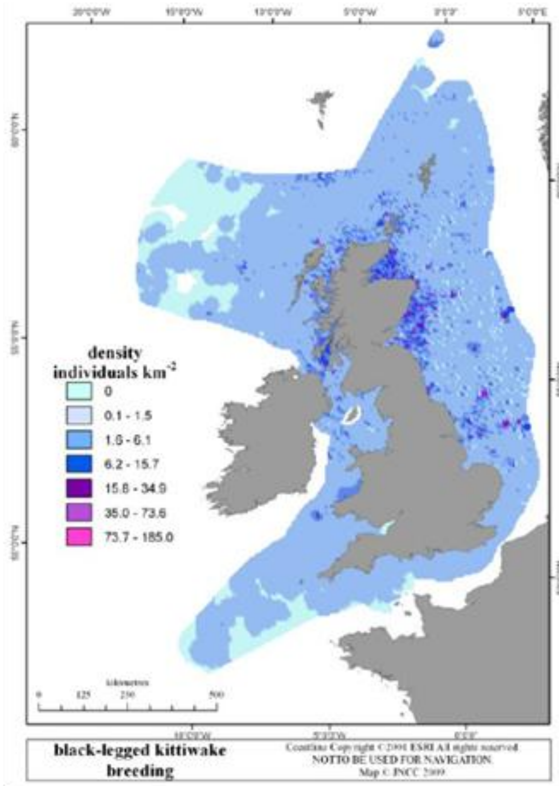
Table 5.14: SOSI scores generalised for UKCS blocks 43/24, 43/25, 43/20, 44/16, 44/17 and 44/18 [92]

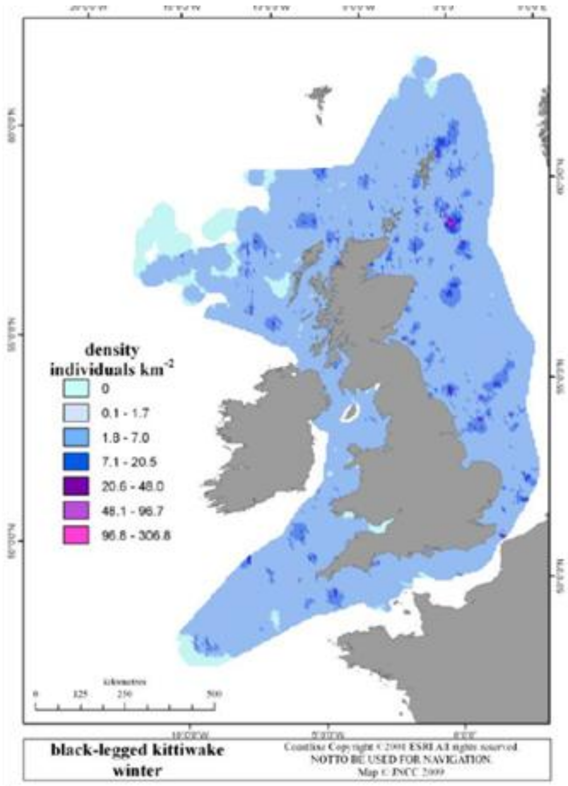
Month	January	February	March	April	May	June	July	August	September	October	November	December
Seabird vulnerability	3	5	5	5	5	5	4	5	5	5	3	3

Vulnerability index	5 = low	4 = medium	3 = high	2 = very high	1 = extremely high	ND = No data

Figure 5-21: Seabird density surface maps for the species identified as frequently occurring in the SNS [46].




density
individuals km⁻²
0
0.1 - 1.5
1.6 - 6.1
6.2 - 15.7
15.8 - 34.9
35.0 - 73.6
73.7 - 185.0
black-legged kittiwake
breeding
Coastline Copyright © 2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009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individuals km⁻²
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0.1 - 1.7
1.8 - 7.0
7.1 - 20.5
20.6 - 48.0
48.1 - 96.7
96.8 - 306.8
black-legged kittiwake
winter
Coastline Copyright © 2001 ESRI All rights reserved
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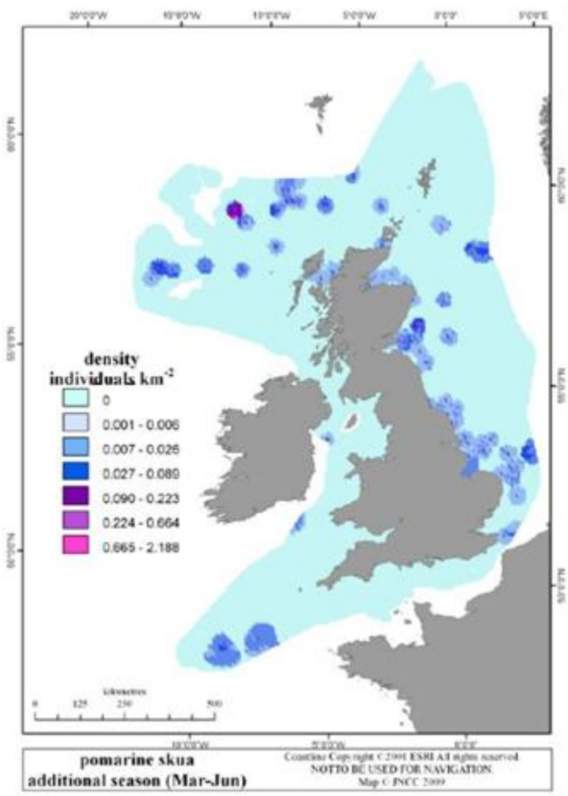
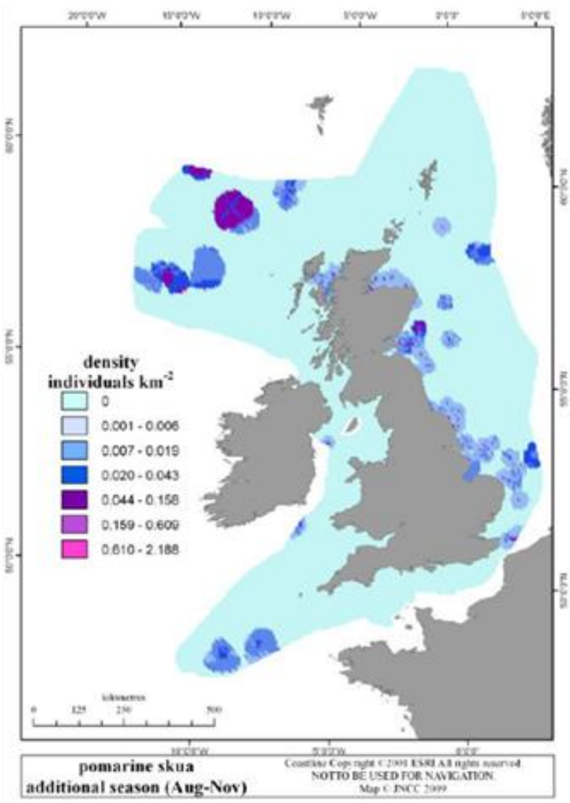
Map © JNCC 2009


density
individuals km⁻²
0
0.001 - 0.006
0.007 - 0.026
0.027 - 0.089
0.090 - 0.223
0.224 - 0.664
0.665 - 2.188
pomarine skua
additional season (Mar-Jun)
Coastline Copyright © 2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009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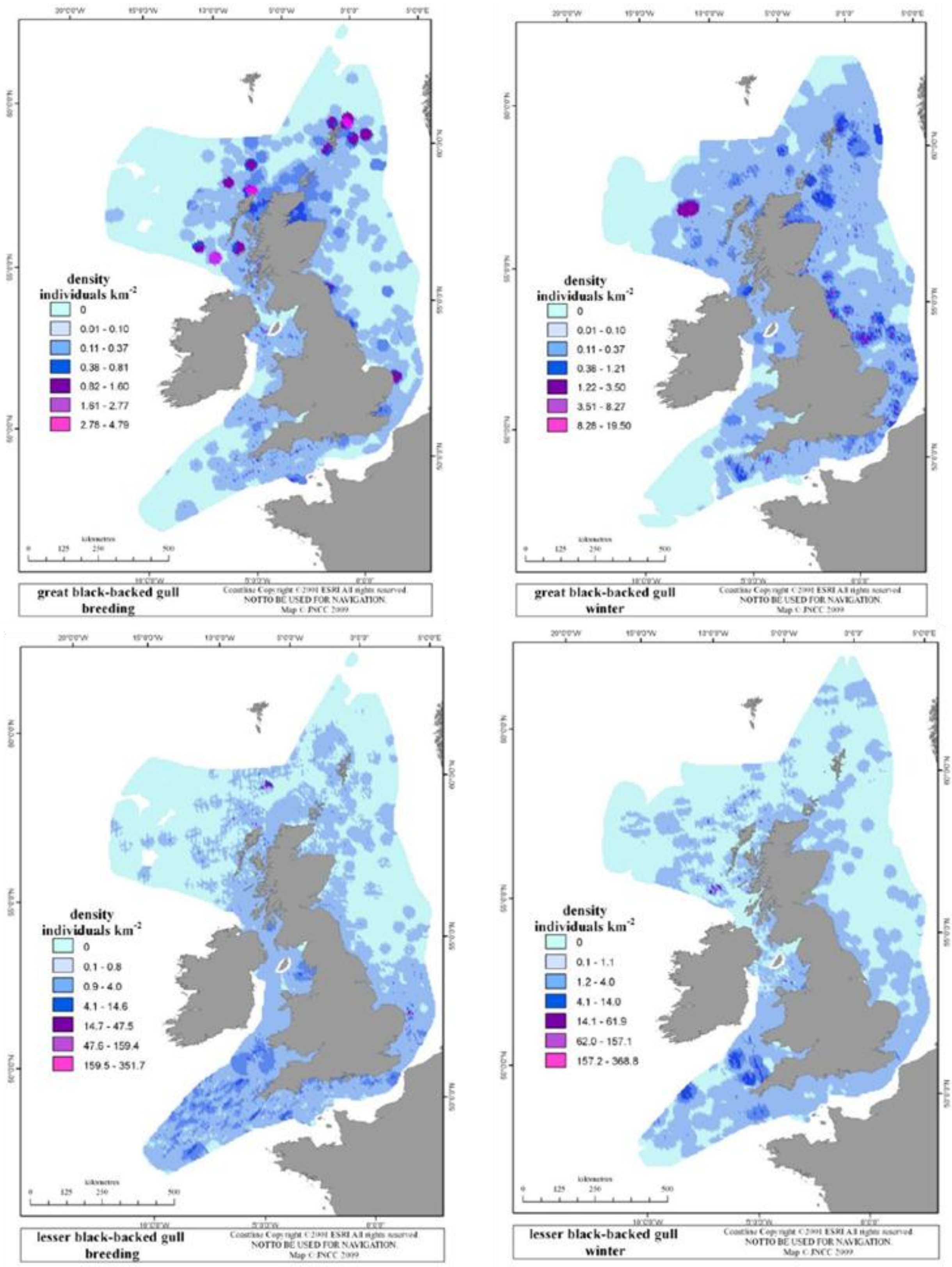
individuals km⁻²
0
0.001 - 0.006
0.007 - 0.019
0.020 - 0.043
0.044 - 0.158
0.159 - 0.609
0.610 - 2.188
pomarine skua
additional season (Aug-Nov)
Coastline Copyright © 2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009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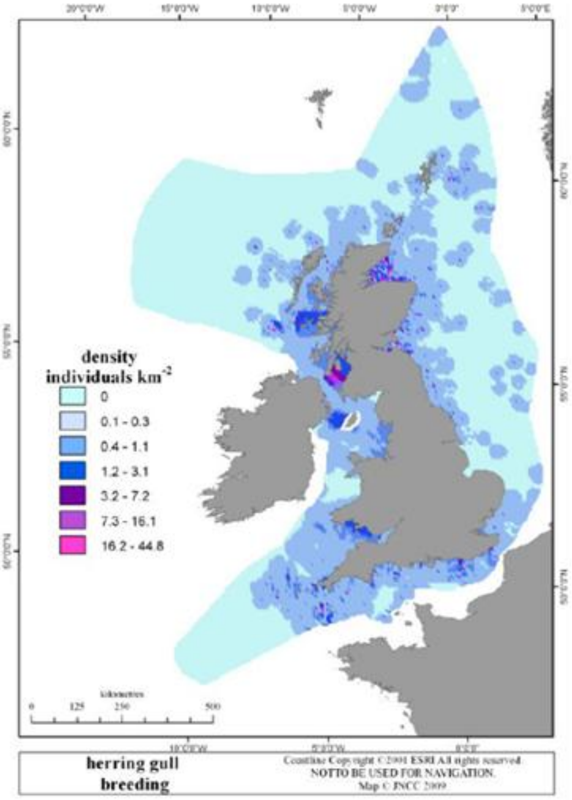
individuals km-2
0
0.01 - 0.10
0.11 - 0.37
0.38 - 0.81
0.82 - 1.60
1.61 - 2.77
2.78 - 4.79
great black-backed gull
breeding
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.01 - 0.10
0.11 - 0.37
0.38 - 1.21
1.22 - 3.50
3.51 - 8.27
8.28 - 19.50
great black-backed gull
winter
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.1 - 0.8
0.9 - 4.0
4.1 - 14.6
14.7 - 47.5
47.6 - 159.4
159.5 - 351.7
lesser black-backed gull
breeding
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.1 - 1.1
1.2 - 4.0
4.1 - 14.0
14.1 - 61.9
62.0 - 157.1
157.2 - 368.8
lesser black-backed gull
winter
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009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0.4 - 1.1
1.2 - 3.1
3.2 - 7.2
7.3 - 16.1
16.2 - 44.8
herring gull
breeding
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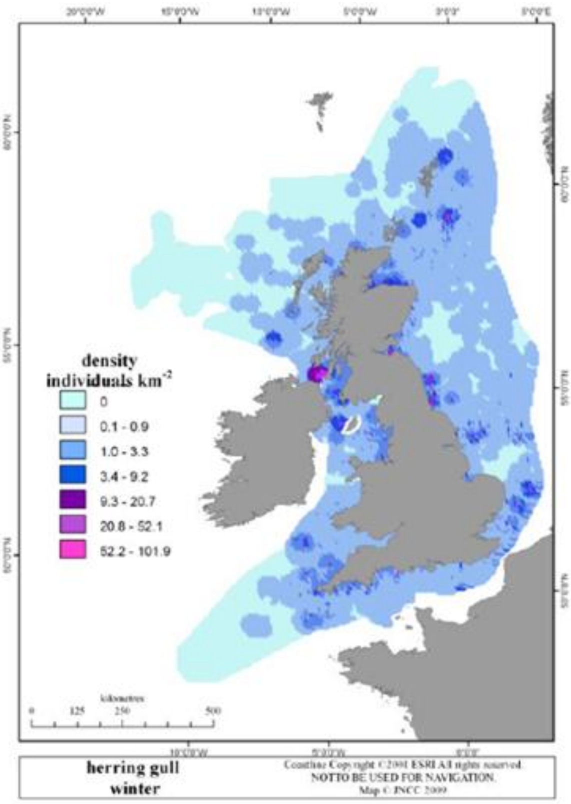
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009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individuals km-2
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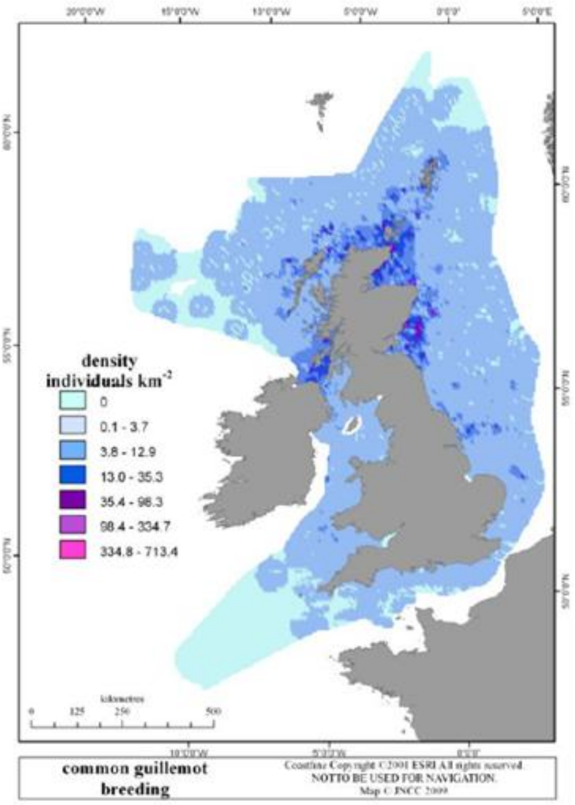
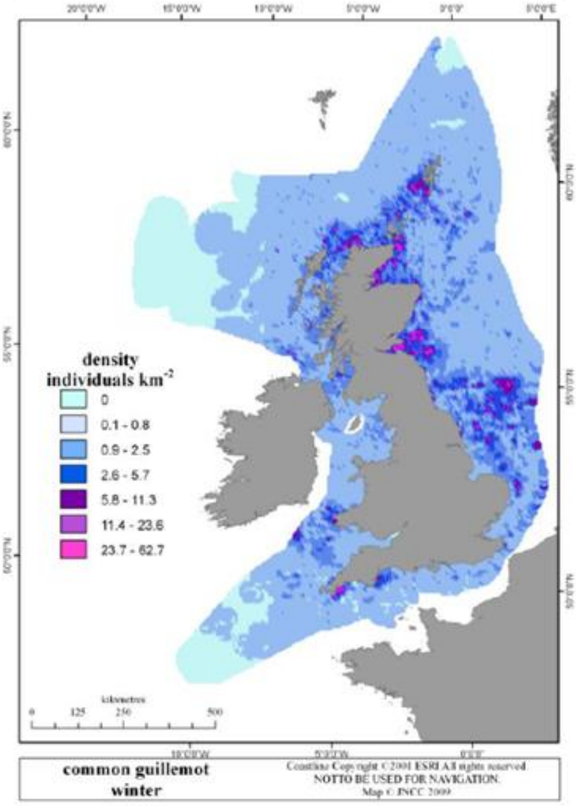
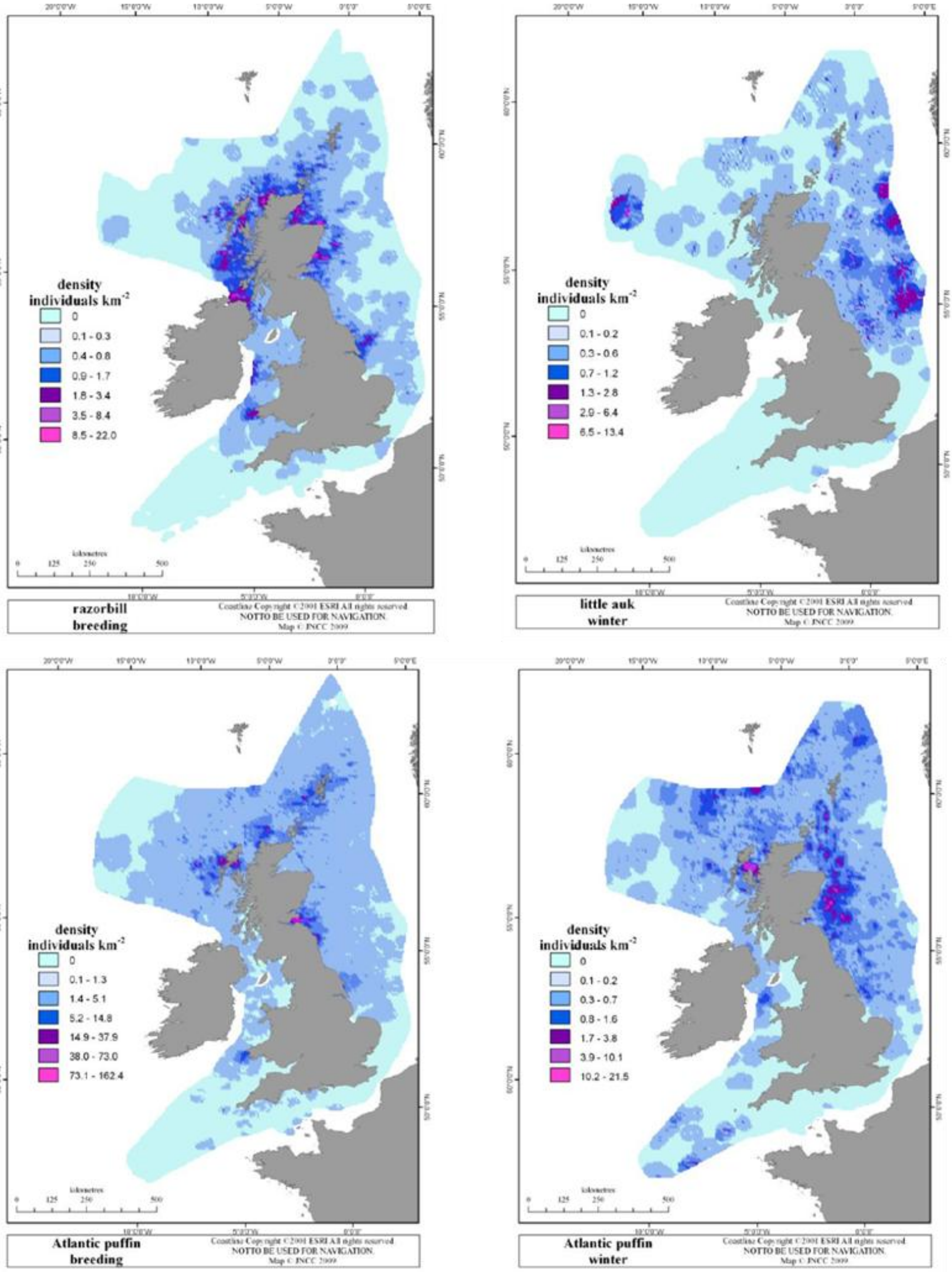
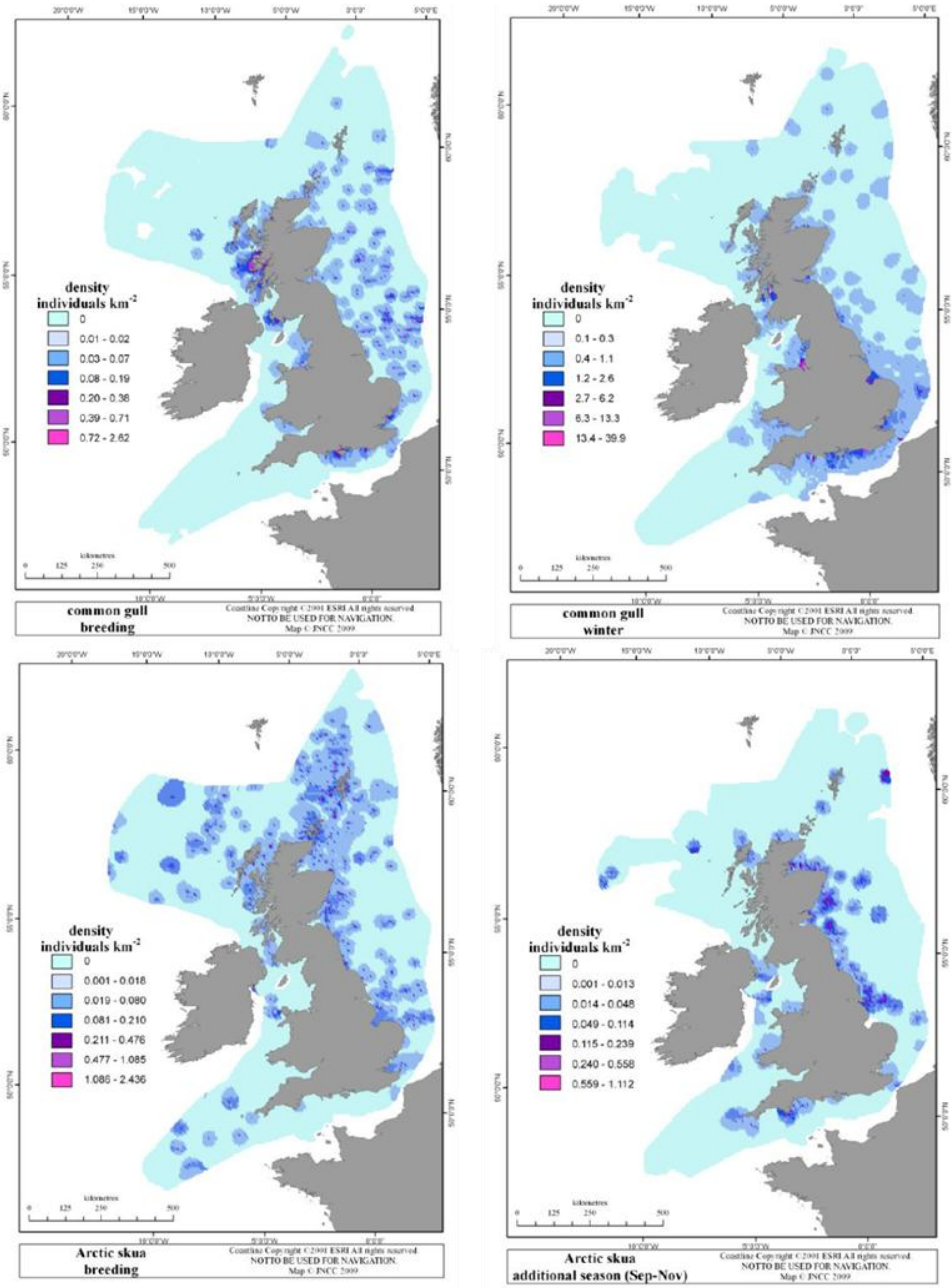
0.1 - 0.9
1.0 - 3.3
3.4 - 9.2
9.3 - 20.7
20.8 - 52.1
52.2 - 101.9
herring gull
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km-2
0
0.1 - 3.7
3.8 - 12.9
13.0 - 35.3
35.4 - 98.3
98.4 - 334.7
334.8 - 713.4
common guillemot
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km-2
0
0.1 - 0.8
0.9 - 2.5
2.6 - 5.7
5.8 - 11.3
11.4 - 23.6
23.7 - 62.7
common guillemot
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009


density
individuals km-2
0
0.1 - 0.3
0.4 - 0.8
0.9 - 1.7
1.8 - 3.4
3.5 - 8.4
8.5 - 22.0
razorbill
breeding
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.1 - 0.2
0.3 - 0.6
0.7 - 1.2
1.3 - 2.8
2.9 - 6.4
6.5 - 13.4
little auk
winter
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.1 - 1.3
1.4 - 5.1
5.2 - 14.8
14.9 - 37.9
38.0 - 73.0
73.1 - 162.4
Atlantic puffin
breeding
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009
density
individuals km-2
0
0.1 - 0.2
0.3 - 0.7
0.8 - 1.6
1.7 - 3.8
3.9 - 10.1
10.2 - 21.5
Atlantic puffin
winter
NOT TO BE USED FOR NAVIGATION.
Map © JNCC 2009


density
individuals km^{-2}
0
0.01 - 0.02
0.03 - 0.07
0.08 - 0.19
0.20 - 0.38
0.39 - 0.71
0.72 - 2.62
common gull
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009
density
individuals km^{-2}
0
0.1 - 0.3
0.4 - 1.1
1.2 - 2.6
2.7 - 6.2
6.3 - 13.3
13.4 - 39.9
common gull
winter
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009
density
individuals km^{-2}
0
0.001 - 0.018
0.019 - 0.080
0.081 - 0.210
0.211 - 0.476
0.477 - 1.085
1.086 - 2.436
Arctic skua
breeding
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009
density
individuals km^{-2}
0
0.001 - 0.013
0.014 - 0.048
0.049 - 0.114
0.115 - 0.239
0.240 - 0.558
0.559 - 1.112
Arctic skua
additional season (Sep-Nov)
Coastline Copyright ©2001 ESRI All rights reserved
NOT TO BE USED FOR NAVIGATION
Map © JNCC 2009

5.3.5 Marine Mammals

5.3.5.1 Cetaceans

Cetaceans (whales, dolphins, and porpoises) are protected under Annex IV of the Council Directive 92/43/EEC (also known as the Habitats Directive). Cetacean abundance in the SNS is relatively low compared to the northern and central North Sea, with the exception of the harbour porpoise (*Phocoena phocoena*).

The relative abundance and density of cetaceans in the vicinity of the Tyne location can be derived from data obtained during the Small Cetacean Abundance of the North Sea (SCANS-III) aerial and ship-based surveys. This project identified the abundance and density of cetacean species within predefined sectors of the North Sea and North-East Atlantic. PL 1220 / PL 1221 are situated within the SCANS-III block 'O' and was surveyed by air [33]. The density of the harbour porpoise within the SCANS-III Block O is higher than the total surveyed area, suggesting that the area may be important for these species (Table 5.15). Densities for white-beaked dolphin were a magnitude lower.

In addition to the aforementioned cetaceans, other species have been observed or have been modelled to have presence in the North Sea [90]. These include the Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*), short-beaked common dolphin (*Delphinus delphis*), and killer whale (*Orcinus orca*).

Table 5.15: Cetacean abundance and density recorded in SCANS-III aerial survey area block 'O [33]

Species	SCANS-III Block 'O'		Total (aerial survey blocks)	
	Abundance	Density Note1	Abundance	Density Note1
Harbour porpoise	53,485	0.868	424,245	0.351
White-beaked dolphin	143	0.002	36,287	0.030
Note1: Density is the number of animals per km^2				

The UK Statutory Nature Conservation Bodies have identified Marine Mammal Management Units (MMMU's) to provide information on the geographical range and abundance of marine mammals, and therefore understand the potential effects of anthropogenic activities on populations [36]. The abundance of cetacean species within their respective MMMU is shown in Table 5.16.

It is evident that harbour porpoises are the most abundant species in the North Sea compared to other species identified in Table 5.16, despite its MMMU being smaller in area. White-sided dolphins are the next most abundant within the UK sector of its MMMU; however, these were not recorded in significant numbers in other surveys (refer to Table 5.15 and Table 5.17).

Table 5.16: Estimates of cetacean abundance in the relevant MMMUs [36]

Species	Management unit	Abundance in MMMU	95% Confidence Interval	Abundance in UK part of MMMU	Confidence Interval
Harbour porpoise	North Sea (678,206 km^2)	227,298	176,360 – 292,948	110,433	80,866 – 150,811
Common dolphin	Celtic and Greater North Sea (1,560,875 km^2)	56,556	33,014 – 96,920	13,607	8,720 – 21,234
White-beaked dolphin		15,895	9,107 – 27,743	11,694	6,578 – 20,790
White-sided dolphin		69,293	34,339 – 139,828	46,249	26,993 – 79,243

Additional to the above marine mammal abundance surveys, the Atlas of Cetacean Distribution in Northwest European Water [73] provides a comprehensive review of cetacean sightings in northwest European waters. The seasonal sightings data for ICES Rectangles 37F1/37F2 is summarised in Table 5.17.

It is important to note that the lack of recorded sightings does not necessarily preclude the presence of a species at a certain time of year. In addition, the highly mobile nature of cetaceans means that species that are found within the area in general, such as the harbour porpoise, white-beaked dolphin and white sided dolphin may be present at other times of the year.

Harbour porpoise have been recorded in the vicinity of the project area for all months, with offshore sightings peaking in the early to late summer months between May – August. The Southern North Sea SAC lists Harbour porpoise as its protected feature making the reduction of noise in this environment a key objective.

Bottlenose dolphin have not been recorded in the area.

Table 5.17: Cetacean Sightings in ICES Rectangle 37F1/37F2 [73]

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
White-beaked dolphin	ND	ND	ND	ND	L	L	L	L	ND	L	ND	ND
White-beaked dolphin	ND	ND	ND	ND	ND	L	L	ND	ND	L	L	L
Minke Whale	ND	ND	ND	ND	ND	ND	L	L	ND	ND	ND	ND

Key	ND = No data	Very Low (< 0.01)	Low (0.01-10)	Medium (10-100)	High (>100)

5.3.5.2 Pinnipeds

Two species of seals; grey seal (*Halichoerus grypus*) and the harbour (or common) seal (*Phoca vitulina*) are found in the North Sea around the English east coast (Figure 5-22, Figure 5-23). Both species are listed under Annex II of the EC Habitats Directive and protected under the Conservation of Seals Act 1970 (from 0 to 12 nautical miles (nm) from the coast) and listed as UK Biodiversity Action Plan priority marine species.

On the east coast of England, established colonies of grey seals are present at Donna Nook, at the mouth of the Humber, and around Blakeney on the North Norfolk coast [78]. Like all seals, grey seals spend a significant proportion of their time hauled out on land during the breeding, moulting and pupping seasons and also between tides and foraging trips [78]. Grey seals forage down to depths of 100m and at distances of up to 100km from their haul-out sites and, therefore, whilst unlikely, could be present in the vicinity of the pipelines, particularly at their western most extent. Models of marine usage by grey seals show that there are high levels of foraging activity along the east coast of England. The Trent platform is located 115km and the Tyne platform is located 170km from the nearest coastline, and thus the distribution of grey seals in the vicinity of Tyne pipelines is low (1 individual per 25km^2) [74].

Harbour seals are the smaller of the two species and tend to be found closer to the coast [62]. As with grey seals, the UK harbour seal population is predominantly found around the Scottish coast with smaller colonies around The Wash and along the east coast of England [62]. Harbour seals are restricted to their haul-out sites and the surrounding waters during pupping (June and July) and during their annual moult (August) [62]. This species can be found offshore from late August through to the following June and tends to forage within 40 – 50km of its haul-out sites. Therefore, due to the considerable distance to shore, the harbour seal at-sea utilisation of waters surrounding the Tyne pipelines is very low (less than one individual per 25km^2) [74].

Figure 5-22: Grey seal (*Halichoerus grypus*) at sea density

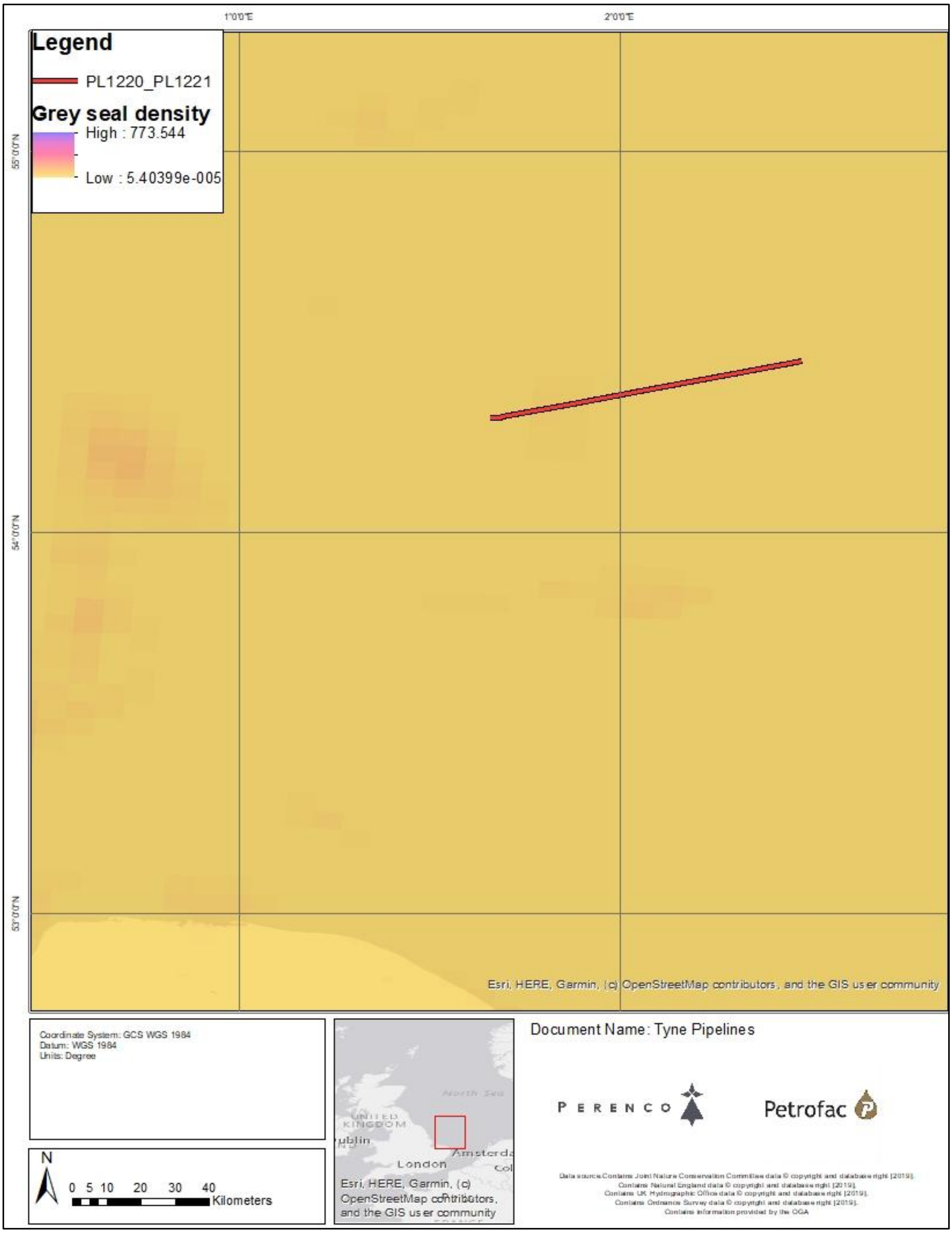
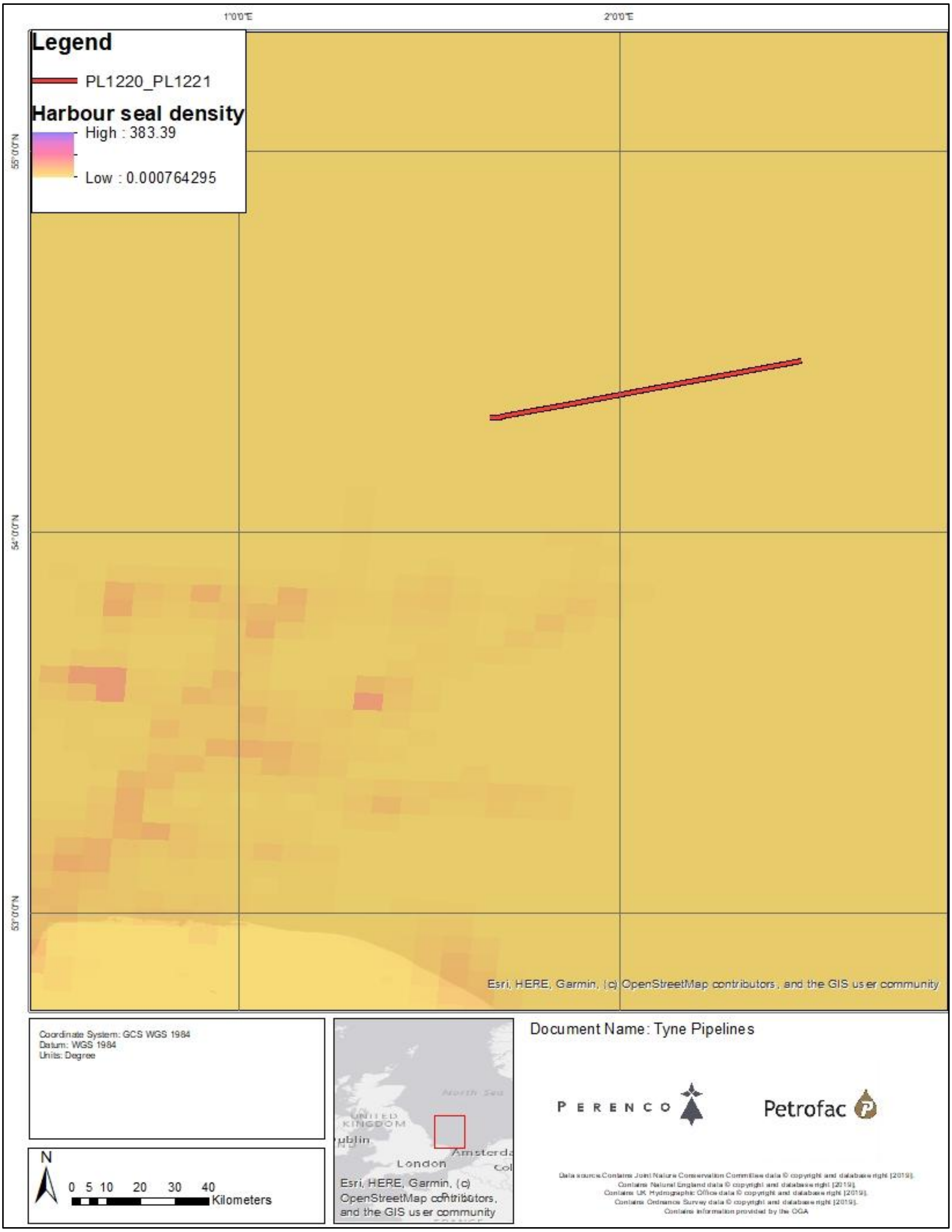


Figure 5-23: Harbour seal (*Phoca vitulina*) at sea density.



5.4 Management

5.4.1 Conservation Areas

The UK is party to a number of international agreements to establish an ecologically network of Marine Protected Areas (MPA's) in UK waters. As a signatory to the OSPAR Convention the UK must establish an ecologically coherent and well-managed network of MPA's across the northeast Atlantic by 2016 [39]. These commitments are transposed through national legislation and regulations. The main types of MPA's in UK waters are:

- SAC (also known as European Sites of Community Importance which are designated for habitats and species listed under the EU Habitats Directive. These qualifying features include three marine habitat types (shallow sandbanks, reefs and submarine structures made by leaking gases) and four marine species (grey seal, harbour seal, bottlenose dolphin and harbour porpoise) [39]. In the UK there are 115 SACs with marine components [39].
- Special Protection Areas (SPA's) which are designated to protect birds under the EU Wild Birds Directive. The Directive requires conservation efforts to be made across the sea and land area. In the UK 112 SPAs with marine components have been designated, including four wholly marine SPA's [39].
- Marine Conservation Zones (MCZ's) which are designated under the Marine and Coastal Access Act (2009) to protect nationally important marine wildlife, habitats, geology, and geomorphology and can be designated anywhere in English, Welsh territorial, or UK offshore waters [39]. To date there are 97 designated MCZ's in UK waters [39].

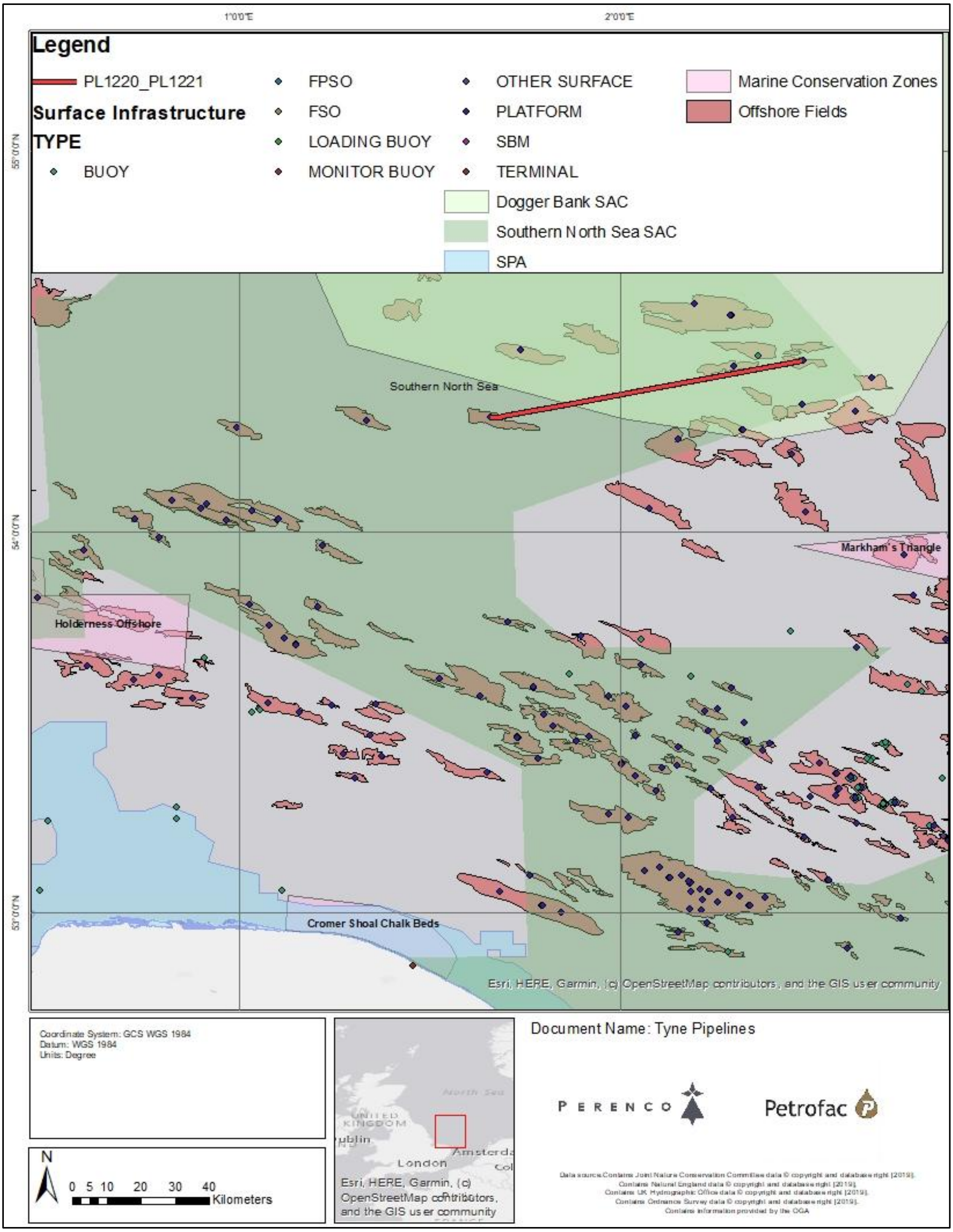
SAC's and SPA's form part of the European Natura 2000 network. Other international designations such as Ramsar Wetlands of International Importance (hereafter referred to as Ramsar sites), and national designations such as Sites of Special Scientific Interest also form part of the UK MPA network through their protection of marine, coastal terrestrial and geological features [39]. OSPAR MPA's encompass existing MPA's designated under existing legislation and Conventions including SAC's, SPA's and MCZ's [39].

There are two MPA's within 40km of PL 1220 and PL 1221. Table 5.18 presents the qualifying features and a description for each of these sites and Figure 5-24 shows the MPA's in the vicinity of the of the Tyne pipelines.

Table 5.18: MPA's within 40km of PL 1220 / PL 1221

Site Name	Distance and Direction	Qualifying Features and Site Description
Southern North Sea SAC	0km	This site features Annex II species: Harbour porpoise (*Phocoena phocoena*). Proposed for designation for the Annex II species harbour porpoise. The conservation objective for the Southern North Sea SAC is "to avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to maintaining Favourable Conservation Status for the UK harbour porpoise".
Dogger Bank SAC	0km	The previous Tyne Platform location and 40km of associated pipelines (PL 1220/ PL 1221) are located within the Dogger Bank SAC, which lists Sandbanks 'which are slightly covered by seawater all of time' as its protected feature.

Figure 5-24: Pipelines location in relation to UK Offshore infrastructure and MPA



5.4.2 National Marine Plans

Table 5.19 details policies and objectives contained within relevant marine plans and highlights how these have been addressed by the proposed decommissioning strategy [55].

Table 5.19: Marine planning objectives and policies relevant to the proposed decommissioning strategy

Relevant Objectives	Associated Policies	Addressed by Project
Economic Productivity - To promote the sustainable development of economically productive activities, taking account of spatial requirements of other activities of importance to the East marine plan areas.	**EC1** - Proposals that provide economic productivity benefits which are additional to Gross Value Added currently generated by existing activities should be supported.	The proposed decommissioning strategy is in line with minimising taxpayer costs for decommissioning oil & gas infrastructure in the SNS.
Employment and Skill Levels - To support activities that create employment at all skill levels, taking account of the spatial and other requirements of activities in the East marine plan areas.	**EC2** - Proposals that provide additional employment benefits should be supported, particularly where these benefits have the potential to meet employment needs in localities close to the marine plan areas.	The proposed operations will utilise local contractors in the area and a support base close to the proposed operations.

Heritage Assets - To conserve heritage assets, nationally protected landscapes and ensure that decisions consider the seascape of the local area.	**SOC2** - Proposals that may affect heritage assets should demonstrate, in order of preference: a) that they will not compromise or harm elements which contribute to the significance of the heritage asset; b) how, if there is compromise or harm to a heritage asset, this will be minimised; c) how, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against, or; d) the public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset. **SOC3** - Proposals that may affect the terrestrial and marine character of an area should demonstrate, in order of preference: a) that they will not adversely impact the terrestrial and marine character of an area; b) how, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them; c) how, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against; d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	The proposed decommissioning strategy is not anticipated to have an impact on any heritage assets or the character of the marine area.
Healthy Ecosystem - To have a healthy, resilient, and adaptable marine ecosystem in the East marine plan areas.	**ECO1** - Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation.	Refer to Section 7. Environmental & Social impact assessment.
	ECO2 - The risk of release of hazardous substances as a secondary effect due to any increased collision risk should be taken account of in proposals that require an authorisation.	The proposed decommissioning strategy minimises the risk of release of hazardous substances to low levels compared to alternative strategies. The decommissioning activities will be carried out on an area with existing shipping exclusion zone.

Biodiversity - To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas.	**BIO1** - Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial).	The proposed decommissioning strategy reduces any potential impact on biodiversity in the East marine plan and terrestrial areas.
Marine Protected Areas (MPAs) - To support the objectives of MPAs (and other designated sites around the coast that overlap or are adjacent to the East marine plan areas), individually and as part of an ecologically coherent network.	**MPA1** - Any impacts on the overall MPA network must be taken account of in strategic level measures and assessments, with due regard given to any current agreed advice on an ecologically coherent network	The proposed decommissioning strategy will not significantly impact on two SAC's located within the East marine plan area (refer to section 5.4.1).
Governance - To ensure integration with other plans, and in the regulation and management of key activities and issues, in the East marine plans, and adjacent areas.	**GOV2** - Opportunities for co-existence should be maximised wherever possible.	Refer to Section 5.5
	GOV3 - Proposals should demonstrate in order of preference: a) that they will avoid displacement of other existing or authorised (but yet to be implemented) activities; b) how, if there are adverse impacts resulting in displacement by the proposal, they will minimise them; c) how, if the adverse impacts resulting in displacement by the proposal, cannot be minimised, they will be mitigated against or; d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts of displacement.	Refer to Section 5.5

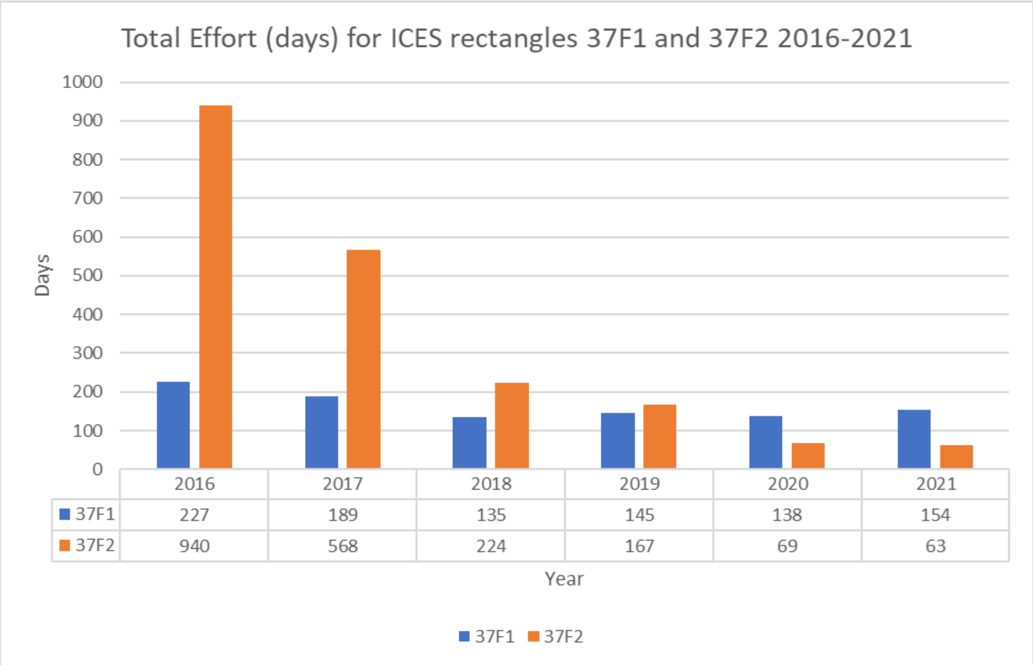
5.5 Societal

5.5.1 Commercial Fisheries

Fishing effort within ICES rectangles 37F1 and 37F2 between 2016 and 2021 is presented in Figure 5-25. Fishing activity in the area primarily takes place between May and October and is dominated by traps, trawls, dredges, and seine nets [49]. Data presented within the Navigational Risk Assessment indicates fishing vessel activity on Automatic Identification System (AIS) (15m length and above) to be moderate in the area. The main fishing vessels operating in the area were UK and Dutch trawlers [1].

Landings (by weight) are dominated by demersal fisheries, which comprise 65% of landings, with shellfish contributing to the remaining 35%. However, fisheries value is split equally between demersal (50%) and shellfish (50%) species. Both species and Nephrops dominate fisheries landings and value [49].

Figure 5-25: Fishing effort for ICES rectangle 37F1 and 37F2



5.5.2 Oil & Gas Activities

The Trent and Tyne fields lie in a collection of gas fields in the SNS and therefore oil and gas activity surrounding the Tyne pipelines is high. The nearest platforms are the Munro MH platform (12km west) and the Katy KT platform (13km southeast). The Tyne to Trent (PL 1220/ PL 1221) traverse Block 44/18 connecting the Tyne platform to the Trent platform in Block 43/24 (Figure 5-27).

5.5.3 Marine Aggregates

Several offshore aggregate areas are located to the south and southwest of the project area. The closest UK area, known as Humber 4 & 7 falls 65km south of the project area (Figure 5-28). A single aggregate extraction area called E1 is located 55km northeast of the previous Tyne platform location on the other side of the Netherlands/UK median line.

5.5.4 Offshore wind

Four offshore windfarms are located north of the project area (Creyke Beck A, Creyke Beck B, Sofia, and Teesside A), the closest of which to the project area is Creyke Beck A at a distance of 36km. To the south of the project area lies Hornsea 1, 2 & 3 offshore windfarms (Figure 5-28).

5.5.5 Commercial Shipping

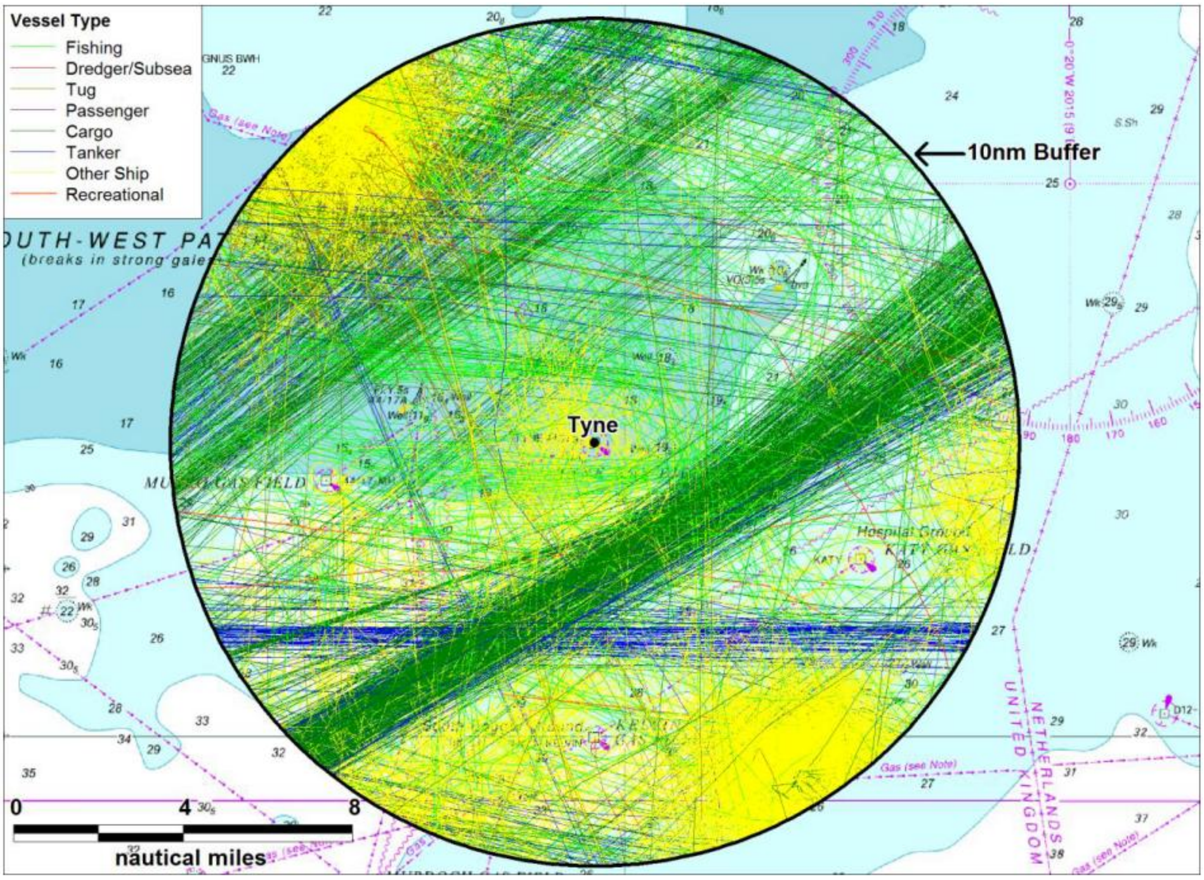
The density of shipping traffic in the SNS is relatively high due to the presence of fishing vessels, some ferries between the UK and the rest of Europe and cargo and offshore support vessels [16].

The waters surrounding the Tyne pipelines are described as having ‘High’ shipping activity [64]. A Navigational Risk Assessment commissioned by PUK in 2016 identified the area as having high shipping density, with an estimated 2,095 vessels per year passing within 10nm of the Tyne location. This corresponds to an average of 5 to 6 vessels per day. The majority of these vessels were defined as cargo vessels [1].

5.5.6 Wrecks

There are circa 38 wrecks recorded within 50km the project area, however none are recorded as protected [56].

Figure 5-26: Shipping tracks recorded within 10nm of the Tyne platform [1]



5.5.7 Telecommunications & Cables

There are two subsea cables within 40km of the pipelines, MCCS and Norsea Com 1 Seg 2, both operated by Tampnet. Located to the east of the project area, running north/south, the shortest distance between the project area and the Tampnet cables is 11km at the previous Tyne platform location (Figure 5-28).

5.5.8 Military Activity

UKCS blocks 43/24, 43/25, 43/20, 44/16, 44/17 and 44/18 lie within a known Ministry of Defence (MoD) practice and exercise area [16]. However, there are no restrictions identified by the MoD for UKCS blocks of interest [65].

5.5.9 Tourism

Due to the distance between the project area and the nearest landfall, no recreational vessel use is known to occur in the area.

Figure 5-27: PL 1220/ PL 1221 in relation to surrounding oil and gas activity

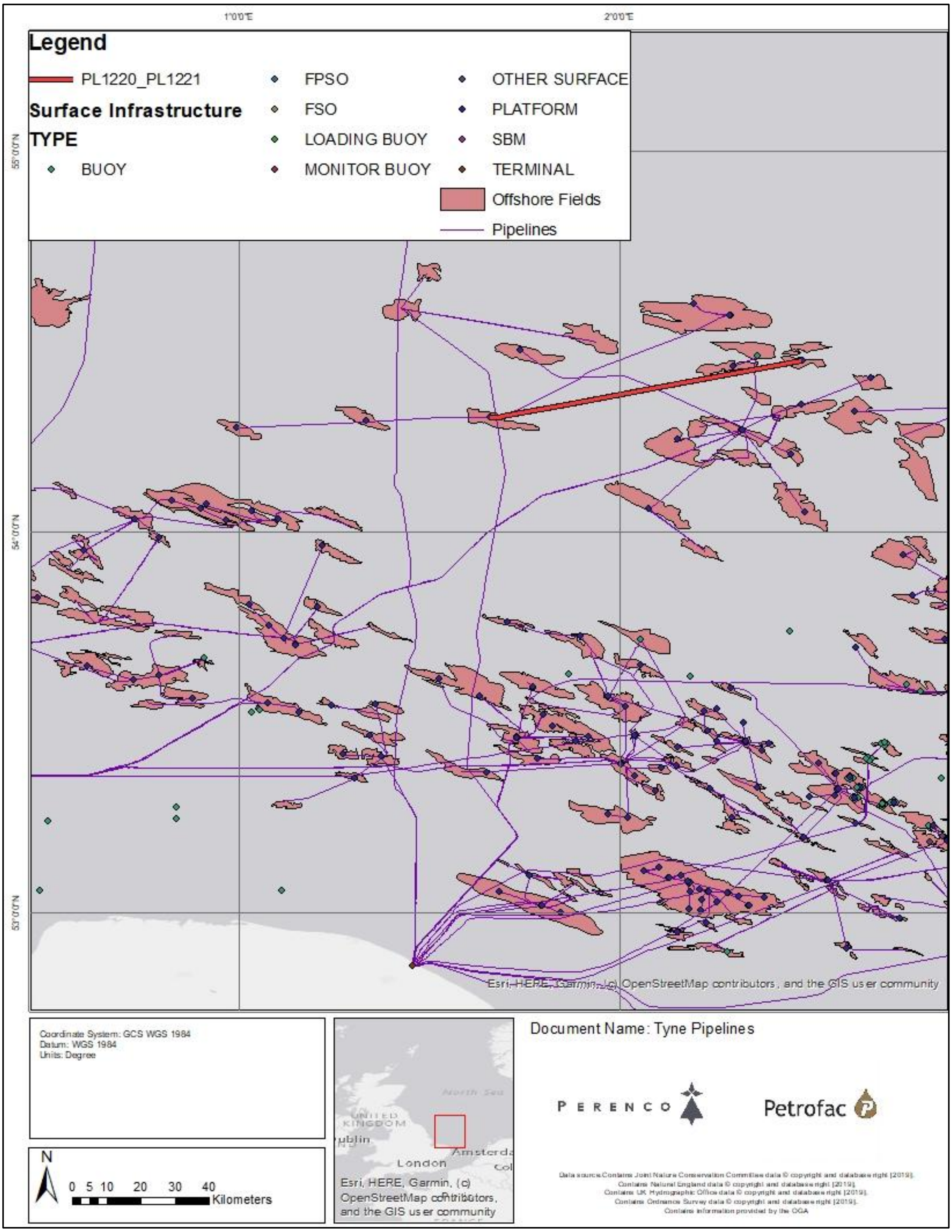
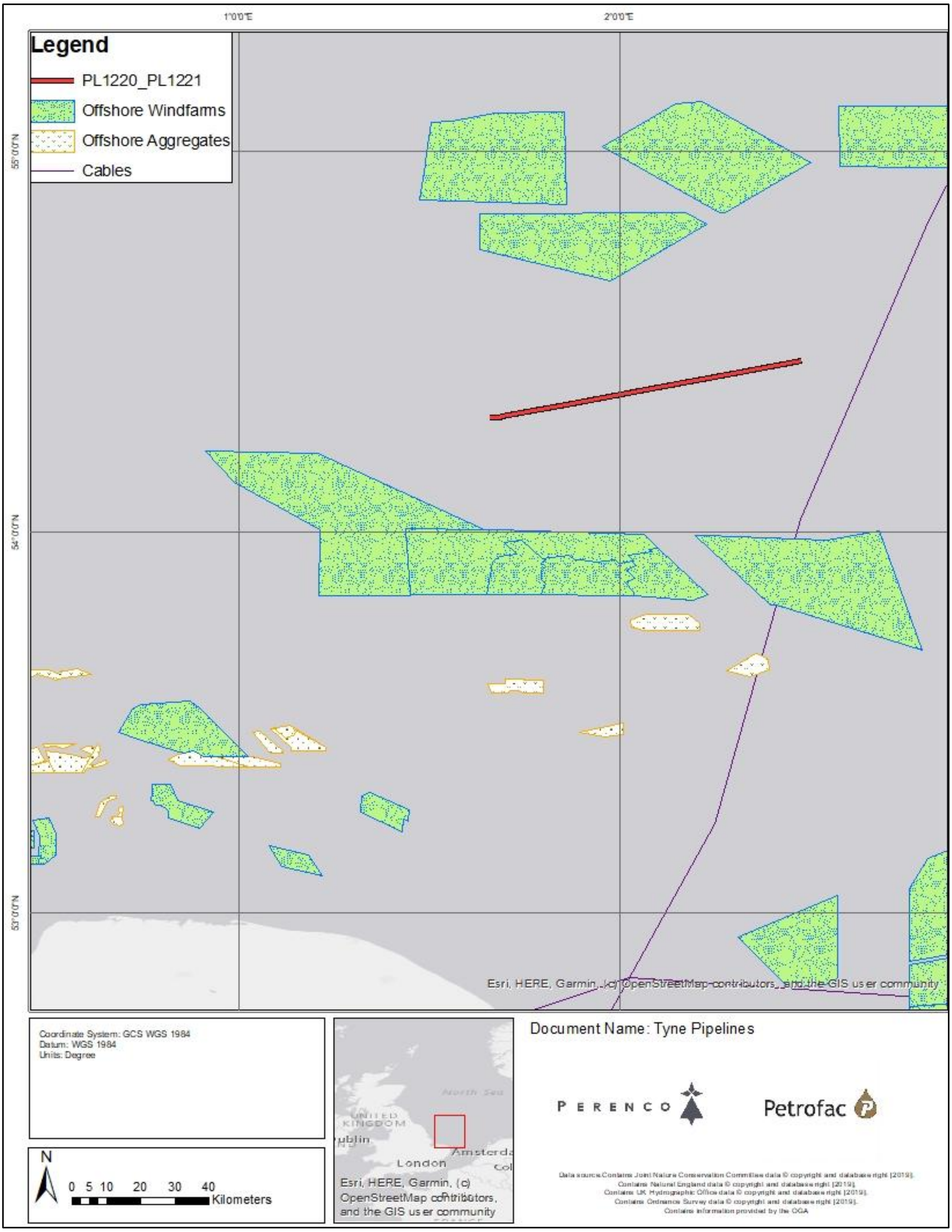


Figure 5-28: PL 1220/ PL 1221 in relation to surrounding aggregate, offshore renewables, and cable activity.



6 Environmental Impacts Identification (ENVID) Summary

Table 6.1 provides details of the potential impacts associated with the preferred decommissioning option as identified in the ENVID. All significant potential impacts have been scoped in for further assessment in section 7.

Table 6.1: Assessment of impacts from the preferred decommissioning option

Assessment Topic	Project Activity / Event	Physical Receptors				Biological Receptors						Human Receptors										
		Seabed Sediments	Water Quality	Air Quality	Climate	Plankton	Benthic Communities	Fish & Shellfish	Seabirds	Marine Mammals	MPA	Shipping	Commercial Fisheries	Oil & Gas & CCS Activity	Subsea Cables	Renewable Energy Activity	Cultural Heritage	Military Activity	Disposal, Dredging & Aggregate Activity	Seascape	Tourism & Leisure	Population & Human Health
Leave in situ with rock placement of the scour basin																						
Physical presence	Use of fall pipe ROV and survey vessels	*	*	*	*	*	*	*	*	*	*	A	A	A	*	*	*	*	*	*	*	*
	Removal of 500m exclusion zone	*	*	*	*	*	*	*	*	*	*	P	P	*	*	*	*	*	*	*	*	*
	Physical presence (infrastructure left in situ)	*	*	*	*	*	P	P	*	P	*	*	P	*	*	*	*	*	*	*	*	*
	Physical degradation (infrastructure left in situ)	*	A	*	*	A	A	A	*	*	A	*	A	*	*	*	*	*	*	*	*	*
	Residual contaminants released from infrastructure	*	A	*	*	A	A	A	*	*	A	*	A	*	*	*	*	*	*	*	*	*
	Physical presence of the rock placement	A	*	*	*	*	A	P	*	P	A	*	P	*	*	*	*	*	*	*	*	
Seabed Disturbance	Overtrawl survey	A	A	*	*	*	A	A	*	*	A	*	*	*	*	*	*	*	*	*	*	*
	Rock placement	A	A	*	*	*	A	P	*	*	A	*	*	*	*	*	*	*	*	*	*	*
Noise emissions	Use of vessels	*	*	*	*	*	*	A	*	A	A	*	*	*	*	*	*	*	*	*	*	*
	Use of survey equipment	*	*	*	*	*	*	A	*	A	A	*	*	*	*	*	*	*	*	*	*	*
Marine discharges	Vessel discharges (operational/domestic)	*	A	*	*	A	A	A	A	A	A	*	*	*	*	*	*	*	*	*	*	*
Atmospheric emissions	Use of fall pipe ROV and survey vessels	*	*	A	A	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Waste (Hazardous/non-hazardous)	Operational/domestic waste from vessel	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	A
	Decommissioning waste	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Accidental Events	Vessel collision	*	A	A	A	A	A	A	A	A	*	A	A	A	*	*	*	*	*	*	*	A

Key:

	Potential for significant effects		No potential for significant effects	A - Adverse effect	P - Beneficial effect	* - No interaction

7 Environmental & Social Impact Assessment

7.1 Assessment Methodology

7.1.1 Introduction

The method PUK has been used to determine if the project is likely to have any significant effects on the environment described in this section, and follows EIA good practice guidance [28; 9; 81; 37]. The process commences with the identification of project activities (or aspects) that could impact environmental and socio-economic receptors (i.e., components of the receiving environment), with consideration given to both planned (routine) activities and unplanned (accidental) events. The terms "impact" and "effect" have different definitions in EIA, and one may occur as a result of the other. Impacts are defined as changes to the environment as a direct result of project activities and can be either beneficial or adverse.

Effects are defined as the consequences of those impacts upon receptors. Impacts that could potentially result in significant effects are then subject to detailed assessment based on best available scientific evidence and professional judgement so that, where necessary, measures can be taken to prevent, reduce or offset what might otherwise be significant adverse effects on the environment through design evolution or operational mitigation measures. Residual effects are those that are predicted to remain assuming the successful implementation of the identified mitigation measures and are reviewed by PUK to confirm that the project complies with legal requirements and does not adversely impact the East Offshore Marine Plan policy goals and objectives.

7.1.2 Identification of Impacts

Environmental and social receptors that may be impacted by the project, have been identified in the receptor-based activity and events matrix in Table 6.1. The matrix has been populated by PUK after completion of an ENVID, with reference to the requirements of Article 3(1) of the EIA Directive [28], the BEIS OPRED EIA Guidance [5] and relevant BEIS Offshore Strategic Environmental Assessment Reports (2003-2022).

It is noted that the type of impacts which could occur from the project can be categorised as follows:

- **Direct:** resulting from a direct interaction between a planned or unplanned project activity and a receptor;
- **Indirect:** occurring as a consequence of a direct impact and may arise as a result of a complex pathway and be experienced at a later time or spatially removed from the direct impact;
- **In-combination (or Intra-Project):** arising from different activities within the project resulting in several impacts on the same receptor or where different receptors are adversely affected to the detriment of the entire ecosystem;
- **Cumulative (or Inter-Project):** resulting from incremental changes caused by other past, present, or reasonably foreseeable projects/proposals together with the project itself.

The nature, duration, scale, and frequency of the effects resulting from these impacts will vary and are described using the terminology in Table 7.1.

Table 7.1: Categories and definitions of effects

Category	Descriptor	Definition
Nature	Adverse	Unfavourable consequences on receptors.
	Beneficial	Favourable consequences on receptors.
Duration	Short-term	Effects are predicted to last for a few days or weeks.
	Medium-term	Effects are predicted to last for a prolonged period of time, between one and five years.
	Long-term	Effects are predicted to last for a prolonged period of time, greater than 5 years.
	Temporary	Effects are reversible.
	Permanent	Effects are irreversible.
Scale	Local	Effects are limited to the area surrounding the project site or are restricted to a single habitat/biotope or community.
	Regional	Effects occur beyond the local area to the wider region.
	National	Effects occur at a national level (UKCS).
	Transboundary	Effects occur at an international level (outside of the UKCS).
Frequency	One-off	Effects which occur only once.
	Intermittent	Effects that occur on an occasional basis.
	Continuous	Effects that occur continuously.

PUK has undertaken a preliminary assessment of the impacts identified in Table 6.1 to determine whether there is the potential for any significant effects on the environment to occur.

Where it has been identified that a project activity has the potential to result in a likely significant effect on the environment, a detailed assessment of the impact(s) and effect(s) has been undertaken, using the significance criteria defined in Section 7.1.3. The results of the assessment are documented in section 7.2 and 7.3. For some project activities, potential impacts have been identified, but none of the resulting effects are likely to be significant. These impacts have therefore been scoped out from detailed assessment.

Despite potential significance, in accordance with BEIS guidance [5], there is no requirement to assess accidental events such as spills from vessels within the EA. This has therefore been scoped out of further assessment.

7.1.3 Evaluation of Impact Significance

This section describes the criteria used for determining the likely significance of effects on the environment and society to ensure the assessment process is as transparent and consistent as possible. Where uncertainty exists, this has been acknowledged in the assessment text.

Planned Activities

For planned activities, the significance of effects has been evaluated by considering the sensitivity of the receptor affected in combination with the magnitude of impact that is likely to arise, having regard to the criteria detailed in Annex III of the EIA Directive, including:

- The magnitude and spatial extent of the impact (geographical area and size of the population likely to be affected);
- The nature of the impact;
- The transboundary nature of the impact;
- The intensity and complexity of the impact;
- The probability of the impact;
- The expected onset, duration, frequency, and reversibility of the impact;
- The accumulation of the impact with the impact of other existing and / or approved projects and / or projects not yet approved, but that PUK is aware of;
- The possibility of effectively reducing the impact.

Sensitivity Criteria

Sensitivity is a function of the value of the receptor (a measure of its importance, rarity and worth), its capacity to accommodate change when a pressure is applied (resistance or tolerance), and its subsequent recoverability (resilience). The criteria presented in Table 7.2 has been used as a guide in this assessment to determine the sensitivity of receptors.

Table 7.2: Determining sensitivity.

		Resistance and Resilience			
		Very High	***High***	***Medium***	***Low***
Value	***Low***	Low	Low	Medium	Medium
	Medium	Low	Medium	Medium	High
	High	Low	Medium	High	Very High
	Very High	Medium	High	Very High	Very High

Definitions:

Resistance and Resilience	
Very High:	Highly adaptive and resilient to pressure. High recoverability in the short-term.
High:	Some tolerance / capacity to accommodate pressure. High recoverability in the medium-term.
Medium:	Limited tolerance / capacity to accommodate pressure. Recoverability is slow and/or costly.
Low:	Very limited or no tolerance / capacity to accommodate pressure. Recovery is unlikely or not possible.
Value	

Very High:	Very high value and/or of international importance.
High:	High value and/or of national importance.
Medium:	Moderate value and/or of regional importance.
Low:	Low value and/or of local importance.

Magnitude of Impact Criteria

The magnitude of impact considers the characteristics of the change that are likely to arise (e.g., a function of the spatial extent, duration, reversibility, and likelihood of occurrence of the impact) and can be adverse or beneficial. Where it is not possible to quantify impacts, a qualitative assessment has been carried out, based on best available scientific evidence and professional judgement. The criteria presented in Table 7.3 has been used as a guide in this assessment to define the magnitude of impact.

Table 7.3: Determining magnitude of impact

Magnitude	Definition
Substantial	Permanent or long-term (>5 years) change in baseline environmental conditions, which is certain to occur. Impact may be one-off, intermittent, or continuous and/or experienced over a very wide area (i.e., transboundary in scale). Impact is likely to result in environmental quality standards or threshold criteria being routinely exceeded.
Major	Medium to long-term (1 – 5 years), reversible change in baseline environmental conditions, which is likely to occur. Impact may be one-off, intermittent, or continuous and/or experienced over a wide area (i.e., national in scale). Impact could result in one-off exceedance of environmental quality standards or threshold criteria.
Moderate	Short to medium-term (< 1 year), temporary change in baseline environmental conditions, which is likely to occur. Impact may be one-off, intermittent, or continuous and/or regional in scale (i.e., beyond the area surrounding the Project site to the wider region). Impact is unlikely to result in exceedance of environmental quality standards or threshold criteria.
Minor	Short-term (a few days to weeks), temporary change in baseline environmental conditions, which could possibly occur. Impact may be one-off, intermittent and/or localised in scale, limited to the area surrounding the proposed Project site. Impact would not result in exceedance of environmental quality standards or threshold criteria.
Negligible	Immeasurable or undetectable changes (i.e., within the range of normal natural variation).

Significance of Effect

For planned activities, the overall significance of an effect has been determined by cross referencing the sensitivity of the receptor with the magnitude of impact, using the matrix shown in Table 7.4.

In the context of this assessment, effects classed as **Major** or **Moderate** are considered to be "significant" in EIA terms and therefore mitigation measures are required to be identified in order to prevent, reduce, or offset adverse significant effects or enhance beneficial effects. The overall significance of the effect is then re-evaluated, taking the mitigation measures into consideration, to determine the residual effect utilising the methodology outlined above.

Effects classed as **Minor** are not considered to be significant and are usually controlled through good industry practice.

Effects classed as **Negligible** are also not considered to be significant.

Table 7.4: Significance Evaluation Matrix (Planned Activities)

		Magnitude of Impact				
		Negligible	**Minor**	**Moderate**	**Major**	**Substantial**
Receptor Sensitivity	**Low**	Negligible	Minor	Minor	Minor	Minor / Moderate note1
	Medium	Negligible	Minor	Minor	Moderate	Moderate / Major[1]
	High	Negligible	Minor	Moderate	Major	Major
	Very High	Negligible	Minor / Moderate[1]	Moderate / Major[1]	Major	Major

Note 1 The choice of significance level is based upon professional judgement and has been justified in the assessment text in section 7.2.

Unplanned Events

In accordance with BEIS guidance [5], there is no requirement to assess accidental events such as spills from vessels within the EA. This has therefore been scoped out of further assessment.

7.2 Insignificant Impacts

With regards to the aspects presented in Table 6.1 following the methodology outlined above, the aspects for which PUK consider there to be minimal or non-significant impact and therefore have been screened out from further detailed assessment within this EA report are described below.

7.2.1 Energy And Emissions

Although the project will produce atmospheric emissions and consume energy, these activities are required to be undertaken to meet decommissioning obligations for the infrastructure. The preferred option has been considered with a focus on minimising vessel time and therefore minimising any associated emissions. An assessment of air emissions associated with the preferred option is presented in Appendix 1. Although it should be noted that this assessment accounts for a single fall pipe ROV operation for the decommissioning activities and a single post-decommissioning survey, these contributions are far below any thresholds for emissions in the UKCS or on a global scale and are not significantly larger than general vessel operations in the region. Future legacy survey frequency will be determined and agreed with OPRED; however, the resulting emissions from these surveys are determined to be negligible as they will be extremely small in the context of UKCS and global emissions.

Sensitivity: High

Magnitude: Negligible

Significance: Negligible

Best practices will be employed to minimise this environmental footprint. This includes optimal remediation operations and survey planning and procurement of vessels which operate effective EMS minimising their emissions.

As a result, no further assessment is required.

7.2.2 Operational Discharges to Sea

Prior to decommissioning activities, pipework and subsea flowlines have been cleaned to an agreed standard with OPRED. Any potential residual volumes are expected to be minimal and have previously been considered under the individual permit consent applications for the decommissioning activities through the Portal Environmental Tracking System.

Sensitivity: Medium

Magnitude: Negligible

Significance: Negligible

Vessel based discharges will be limited to those generally associated with vessel operations and controlled via established methods under the International Convention for the Prevention of Pollution from Ships. Approved contractor procedures will assess and minimise vessel-based discharges.

Any residual hydrocarbons, if present within the pipelines, will continue to dissipate slowly. It should be noted that the pipelines have been cut and open to seawater since 2016, as a part of the HCF campaign.

As a result, no further assessment is required.

7.2.3 Waste Generation

All waste generated from decommissioning activities, which will be limited to two operational vessels waste, will be handled, and recovered or disposed of in line with existing waste management legislation following the principles of the waste hierarchy. Raw materials will be returned to shore with the expectation to recycle the majority of the returned non-hazardous material. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Hazardous waste will be disposed of in accordance with established waste legislation.

Only licensed contractors will be used for waste handling and treatment/disposal.

Sensitivity: Medium

Magnitude: Negligible

Significance: Negligible

As a result, no further assessment is required

7.2.4 Physical Presence of Vessels in Relation to Other Sea Users

The requirement to deploy vessels to the area for the preferred decommissioning option will be limited to a single fall pipe ROV vessel and a single survey vessel. Further legacy survey frequency is expected to be agreed with OPRED and will consist of a single vessel per survey.

It is not anticipated that vessel movements would require a significant exclusion area to operate within (circa 1km), instead the impacts of this presence will be managed via standard maritime navigational rules. Furthermore, the decommissioning activity will be located within the existing 500m exclusion zone designation given by the previously installed Tyne platform.

It is noted that rock placement and pipelines survey campaigns cannot occur at the same time. The typical duration for each vessel operation takes approximately six days to complete, including travel to and from port. The project area has a moderate amount of shipping activity within it, which will not be significantly increased due to project activity.

Sensitivity: Medium

Magnitude: Negligible

Significance: Negligible

Vessel traffic and activity will be managed by the issuing of kingfisher notice to mariners and vessel operated AIS. There will be an overall positive benefit of opening up of 500m exclusion zone following seabed clearance at the previous Tyne platform location.

As a result, no further assessment is required.

7.3 Assessment of Potentially Significant Impacts

7.3.1 Infrastructure Left in Situ

The Tyne pipelines infrastructure that will be left in situ includes, pipelines (PL 1220/PL 1221) and associated stabilisation materials (concrete mattresses and rock placement).

7.3.1.1 Source of Potential Impacts

The decommissioning of the Tyne pipelines has the potential to impact on other users of the offshore environment through the physical presence of subsea infrastructure decommissioned in situ, which may pose a potential snagging risk for commercial fisheries. The long-term presence of materials left in situ has the potential to interfere with other sea users. For subsea infrastructure this is particularly applicable to bottom trawl (demersal) fishing. In addition to the pipelines themselves, other materials left in situ such as the proposed rock placement, concrete mattresses and grout bags all have the potential to add to this snagging risk.

In addition to the above, the decommissioning of the Tyne pipelines in situ has to potential to impact on the environment through the degradation and mobilisation of materials left in situ, including plastics used for pipeline coating and pipeline residues.

Pipeline surveys completed along the pipeline route in 2016 confirmed both PL 1220 and PL 1221 are buried with an average depth of 0.9m across the entire length except for the scour basin within the Tyne 500m exclusion zone and non-reportable exposures on the pipeline route. An additional post-decommissioning survey completed in 2022 confirmed that the pipeline remains buried with non-reportable exposures apart from the scour basin. Due to the time period between these surveys, it is reasonably assumed that the pipelines from Trent 500m exclusion zone to the beginning of the scour basin are stable and will remain buried at a suitable depth in their current location.

A snagging hazard assessment of the scour basin associated with the Tyne installation was undertaken in 2018 [82]. This assessment confirmed the presence of a scour basin with a depth of 2.6m in relation to mean seabed levels and approximate dimensions of 48m wide and 120m long. Previous assessments did not consider the scour basin to have a significant impact on the snagging risk for commercial fisheries as it was expected that natural seabed remediation would infill the scour basin. However, subsequent surveys have confirmed that the scour basin is not naturally infilling at the expected rate, with the latest survey conducted from 2021 to 2022 sizing the scour basin in approximately 52m in length by 38m wide (Figure 7-1)

In line with this, PUK is proposing the placement of an overtrawlable berm over the exposed spool pieces within the Tyne 500m exclusion zone. The proposed rock placement will comprise of crushed rock in order to provide a safe overtrawlable berm over exposed sections of PL 1220 and PL 1221 and preventing further scouring. Overall, the rock will absorb and dissipate energy from water movements, reducing erosive forces on the seabed and protecting the seabed from future scouring. Rock placement will be targeted and deployed over the intended target, monitored by fall pipe ROV. This will ensure that excess rock placement is not used.

PUK have commissioned a rock berm design [75] where it was determined that a berm of 0.5m cover height (excluding the concrete mattresses on top of the pipeline) with a total rock requirement of 833te, would provide an overtrawlable berm whilst minimising total rock volume [95].

The remaining concrete mattresses that will not be covered by rock placement are not expected to present a snagging hazard. Previous surveys indicate that the mattresses are buried within the seabed to different degrees (Figure 7-3).

7.3.1.2 Effects on Sensitive Receptors

Physical presence of infrastructure

In respect to the effects on sensitive receptors from the presence of infrastructure left in situ this includes effects on commercial fisheries and the physical environment.

The Tyne infrastructure lies within ICES Rectangles 37F1 and 37F2. Overall annual landings from ICES Rectangle 37F2 are greater than those from ICES Rectangle 37F1. Annual fishing effort for ICES rectangle 37F1 is on average 76 days [49] with an average value of £810,518 per annum, and annual fishing effort for ICES rectangle 37F2 is on average 207 days with an average value of £1,582,474 [49, 50, 51].

The dominant gear types were demersal bottom trawling gears such as otter trawls, beam, trawls. In ICES Rectangle 37F1, the next notable gear type is pots and traps [51]. However, further analysis of fishing activity has also shown that mobile demersal fishing activity was moderate to low within the blocks of interest and an area of moderate to high activity for mobile Nephrops fishing lies adjacent to the southern boundary of Block 43/25.

Of the species caught between the years 2016 and 2020, plaice, sandeels, crabs and Nethrops are landed in greatest tonnages in ICES Rectangle 37F1 and 37F2. This is reflected in the dominant fishing gear type in ICES Rectangle 37F1 and 37F2, which are classified as traps, trawls, and dredges [58]. In both ICES rectangles, landings are consistently very low between December and March then rise steadily to peak during August to low in ICES Rectangle 37F1 and to moderate in ICES Rectangle 37F2 and fall back to very low by December [49].

Figure 7-1: Extract from NAVIMODEL with linear dimensions of the scour basin (2022)

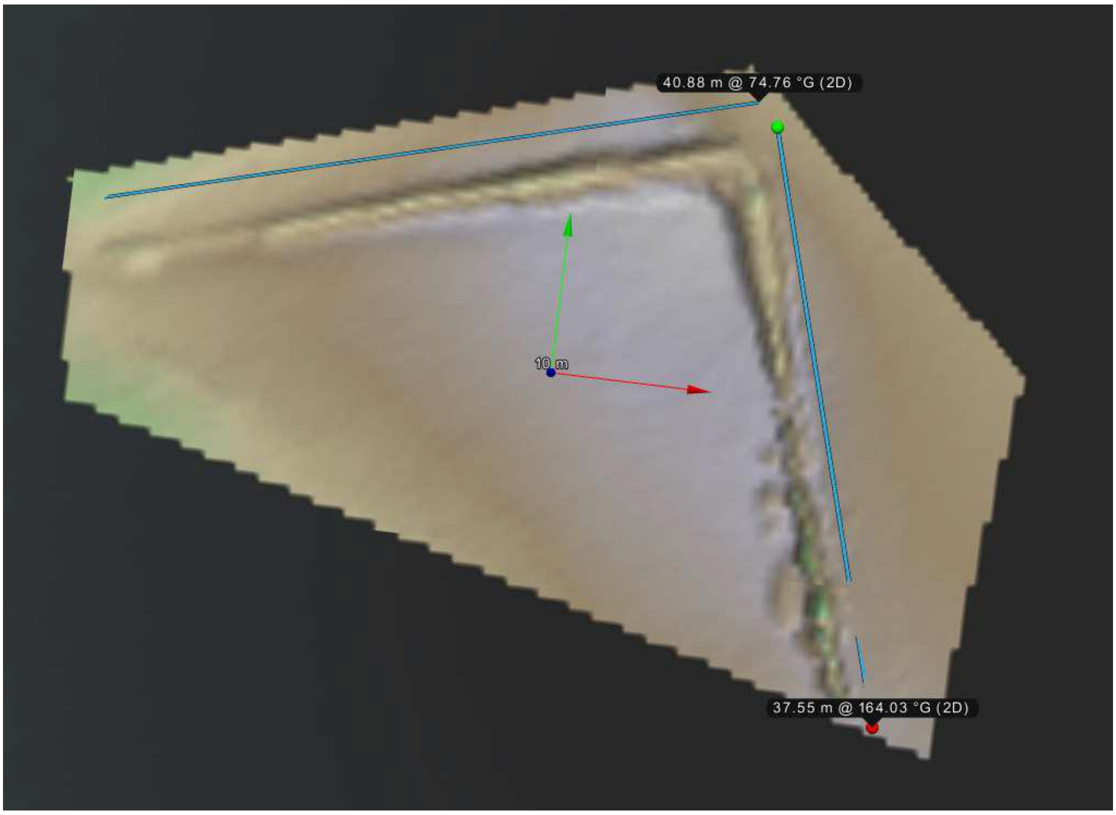


Figure 7-2: Proposed rock berm design

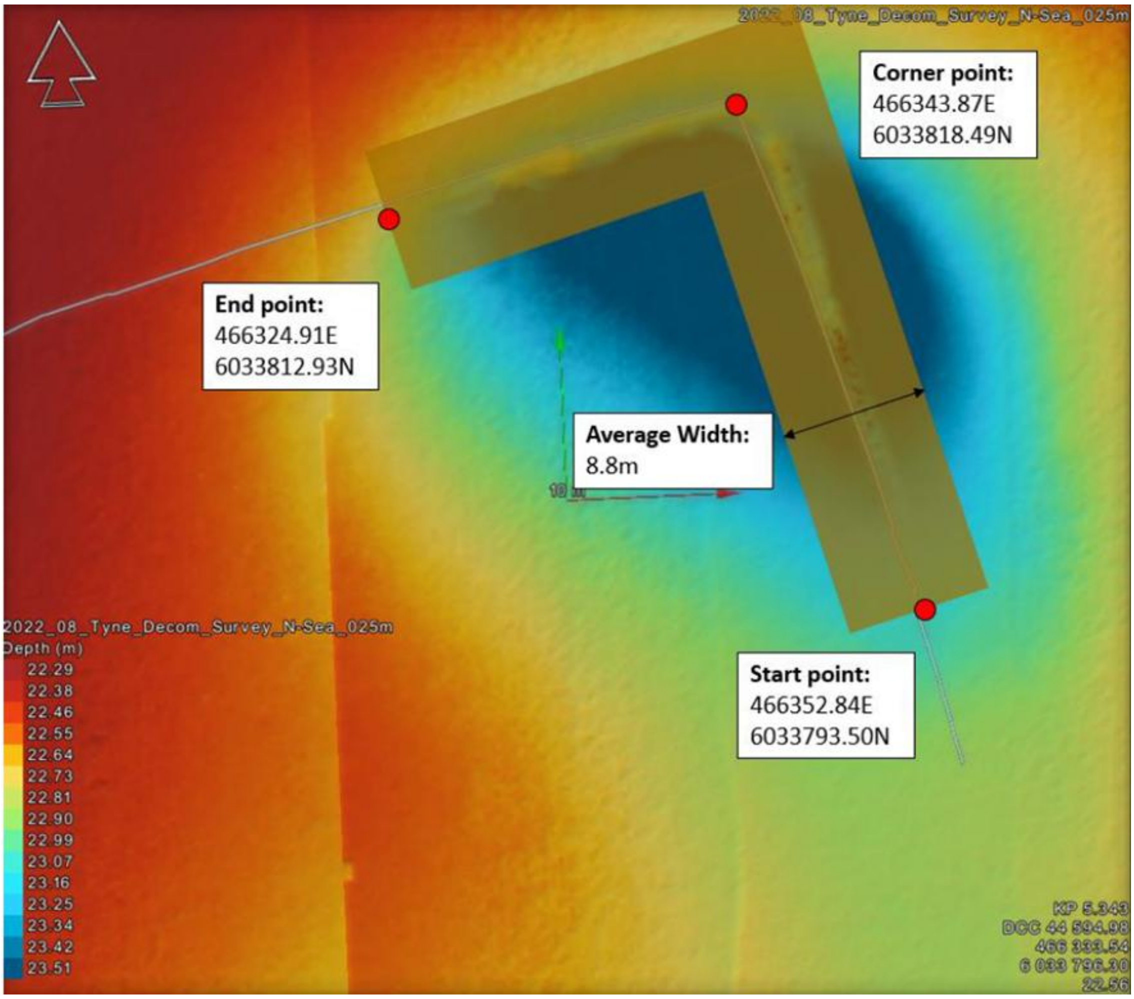


Figure 7-3: Survey images of concrete mattresses at the approach to the previous Tyne platform

The physical presence of hard substrate in a predominantly soft sediment area has the potential to impact on the environment primarily via the ability for non-native species to become established. INNS can have serious negative impacts on native habitats and species and the economy where fisheries and tourism are impacted. However, not all the non-native species that arrive in UK waters become invasive, many are present without significant effect. INNS of concern in UK waters include:

- Atlantic jack-knife clam (*Ensis leei*);
- *Monocorophium sextonae*;
- American lobster (*Homarus americanus*);
- carpet sea-squirt (*Didemnum vexillum*);
- Pacific oyster (*Magallana gigas*);
- Japanese kelp, wakame (*Undaria pinnatifida*);
- Chinese mitten crab (*Eriocheir sinensis*);
- slipper limpet (*Crepidula fornicata*);
- Australian tubeworm (*Ficopomatus enigmaticus*);
- Asian shore crab (*Hemigrapsus sanguineus*);
- brush-clawed crab (*Hemigrapsus takanoi*);
- American oyster drill (*Urosalpinx cinerea*) [58].

Of these only *Monocorophium sextonae*, *H. americanus*, *D. vexillum, M. gigas, C. formicate and F.* enigmaticus are likely to benefit from the introduction of hard substrate to a soft sediment area.

Two INNS were found across the Tyne field in the Tyne post-decommissioning survey: the Atlantic jack-knife clam (*Ensis leei*) and the crustacean *Monocorophium sextonae*. However, only three individuals of *E. leei* were identified across the survey area. Only one specimen of *M. sextonae* was recorded across the Tyne field.

These INNS clams can form dense colonies and smother native species; potentially changing local habitats. *M. sextonae* is originally from New Zealand and was first introduced to the UK in the 1930's. Effects on the environment due to the presence of this INNS seem negligible; however, *M. sextonae* has been seen competing with native amphipod *Crassicorophium bonellii* [29]. Atlantic jack-knife clams are native to the east coast of America and reportedly accidentally introduced into the UK in ballast water of cargo ships.

While the introduction of hard substrate in a soft sediment environment has the potential to allow INNS to establish and expand their distribution, the limited nature of the rock placement will minimise this potential impact.

Degradation of materials

The degradation of materials left in situ has the potential to impact on the environment depending on the chemical nature of the materials involved and the degradation process it undergoes. Any degradation of the pipelines left in situ will be a gradual process cause by the corrosion of the pipelines steel structure and eventual collapse under their own weight. During this process, degradation products derived from the exterior and interior of the pipe will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity.

The primary degradation products will originate from the following pipeline components:

- Steel;
- Sacrificial anodes;
- FBE coating (PL 1221).

- CTE coating (PL 1220).

Note: The pipelines have previously been flushed clean to an agreed standard with OPRED and left open to sea since 2016.

PL 1220 is coated with glass fibre wrap in CTE and reinforced with concrete, while PL 1221 is coated with a 0.55mm layer of FBE. These coating materials are not considered to be directly toxic in the marine environment. However, as no micro-organisms have evolved to utilise the chemically resistant polymer chains as a carbon source, these plastics can be expected to persist in the environment for centuries [66]. Microplastics in general in the marine environmental have been identified as a major contaminant of concern where ingested by zooplankton [4]. Due to their small size, microplastics are potentially bioavailable, via ingestion, to a wide range of organisms as they overlap with the size range of their prey. Ingestion of microplastics has been reported in several marine species over a broad range of taxa including cetaceans, seabirds, molluscs, echinoderms, zooplankton, and corals [4], where it has been reported to cause several detrimental effects including physical injury and reduced feeding behaviour with the knock-on effects for growth and reproduction.

For ingestion to occur however, any plastic in the marine environment would need to incur a level of degradation. Degradation may occur as a result of mechanical disturbance and/or chemical and biological processes, particularly exposure to ultraviolet radiation [7].

As both pipelines are buried below the seabed in a stable condition or buried under the proposed overtrawlable berm, it is not expected that they would be subject to mechanical or chemical degradation and there are no known biological species capable of biologically breaking down FBE or CTE material. As such the degradation and subsequent release of microplastic and other materials into the surrounding sediment or water column in not expected, preventing the ingestion of microplastics by marine fauna and mobilisation into the food chain.

Due to the highly localised nature of any potential degradation products being released over an extended period it is highly unlikely that these products will be detectable above current background conditions in the area.

7.3.1.3 Cumulative and Transboundary Impacts

The Tyne Field is located around 184km east of the nearest UK coastline (Flamborough Head), and approximately 22km to the west of the UK/ Netherlands median line.

As the working area is beyond the UK's 12nm limit, EU and non-EU vessels are also permitted to fish in the area, subject to management agreements including, for example, quota allocation and days at sea. Although the area is primarily fished by UK registered vessels (61% of fishing vessels) there are a number of other nationalities who utilise the area. Including French (35%), Dutch (3%) and Danish and Flemish (1% combined). These foreign vessels are primarily stern trawlers and dredgers; however, this activity is still relatively low in comparison to other regions of the North Sea.

There are no significant cumulative impacts associated with the proposed post-decommissioning activities as the lack of snagging hazards along the pipeline route will be confirmed by a clear seabed certificate, which will prevent impacts on fishing vessels from the UK and EU.

Additionally, it is not anticipated that any degradation materials would present any significant impacts either cumulatively or transboundary in nature due to the pipelines being fully buried and stable below the seabed or rock berm.

7.3.1.4 Mitigation Measures

The following mitigation measures will be employed to further reduce any impacts associated with the decommissioning option:

- All offshore decommissioning and survey activities will be notified to stakeholders prior to vessels undertaking these activities. Notifications will be sent out via kingfisher navigation bulletins and direct notification with the fishing industry. In addition, the 500m safety exclusion zone will remain in operation during the decommissioning activities limiting exposure of other sea users to the presence of these vessels.
- All vessels will operate a manned bridge policy and have active AIS positioning in operation so other vessels can identify the decommissioning vessels via radar.
- Suitable size of rock used for the decommissioning activity to minimise the snagging risk for fishing gear.
- The Tyne pipelines are currently shown on Admiralty Charts, the FishSafe system and the NSTA Infrastructure data systems (NSTA Open Data).
- Post-decommissioning surveys will be undertaken to confirm lack of snagging hazards and obtain clear seabed verification. This will ensure there is no residual risk to other sea users. Non-intrusive verification techniques will be considered in the first instance, but if deemed necessary, seabed clearance may require conventional overtrawl survey methods. Any snagging hazard identified will be reviewed and discussed with OPRED on the appropriate method of remediation.
- PUK will commit to a series of post-decommissioning legacy surveys to confirm that the pipeline remains buried and does not pose a risk to other sea users. The frequency of such surveys will be agreed with OPRED as part of the decommissioning close out reporting arrangements, although it is anticipated that this will be based on a risk-based approach. During the period over which monitoring is required, the burial status of the infrastructure decommissioned in situ would be reviewed and any necessary remedial action undertaken to ensure it does not pose a risk to other sea users. The legacy surveys will also monitor the impact of rock protection on the SAC sandbank habitat by observing whether the rock protection becomes buried by sediment over time or remains fully exposed. The findings will be communicated to OPRED to support the evaluation of long-term interactions between the rock material and sediment dynamics.

7.3.1.5 Residual Impact

Considering the above assessment and mitigations, it has been determined that the decommissioning of the Tyne pipelines and stabilisation materials by rock placement of scour basin is unlikely to pose a significant hazard to other sea users by way of a snagging hazard, or the environment by way of the degradation of materials.

7.3.2 Seabed Disturbance

7.3.2.1 Source of Potential Impacts

The Tyne pipelines decommissioning option will require activities that interact with the seabed, which may result in either short-term or long-term disturbance to the seabed sediments and marine organisms. The extent of any disturbance, combined with the seabed type and hydrodynamic conditions during the activities, will determine the burial and smothering from suspended sediments and any indirect impact to species or habitats.

In their current condition the exposed spool piece sections may represent a significant hazard to other users, particularly bottom trawl fishing. As such, a detailed assessment of the scour basin focused on a 2,000m^2 area around the previous existing Tyne jacket was undertaken by PUK, with MBES survey information from 2012 to 2022 [87]. Analysis of the survey data indicated that the scour basin had increased in volume by 6241m^3 over a 10-years period. The proposed decommissioning option to rectify this is the placement of rock cover over the exposed pipeline spool pieces within the scour basin.

As a result, the decommissioning activities which may cause impact on the seabed are rock placement over the scour basin and overtrawl survey of the Tyne 500m exclusion zone (should this method be used), as detailed in Table 7.5.

The scour basin is located within the boundary of the Dogger Bank SAC, as such this section also addresses the impact of the Tyne decommissioning activities on the Dogger Bank SAC, an area designated for Annex I habitat ‘Sandbanks which are slightly covered by sea water all the time’.

Table 7.5: Summary of seabed impacts from the proposed decommissioning option.

Decommissioning activities	Environmental impact			
	Suspended sediments	Release of contaminants	Burial and smothering	Change in habitat
Overtrawl survey Tyne 500m exclusion zone and pipeline route	Short-term	Short-term	Short-term	Short-term
Rock placement over the sour basin	Short-term	Short-term	Long-term	Long-term

The principal source of potential seabed impact from the selected decommissioning option is the use of rock placement over the scour basin to mitigate the snagging risk to other sea users and the completion of overtrawl surveys.

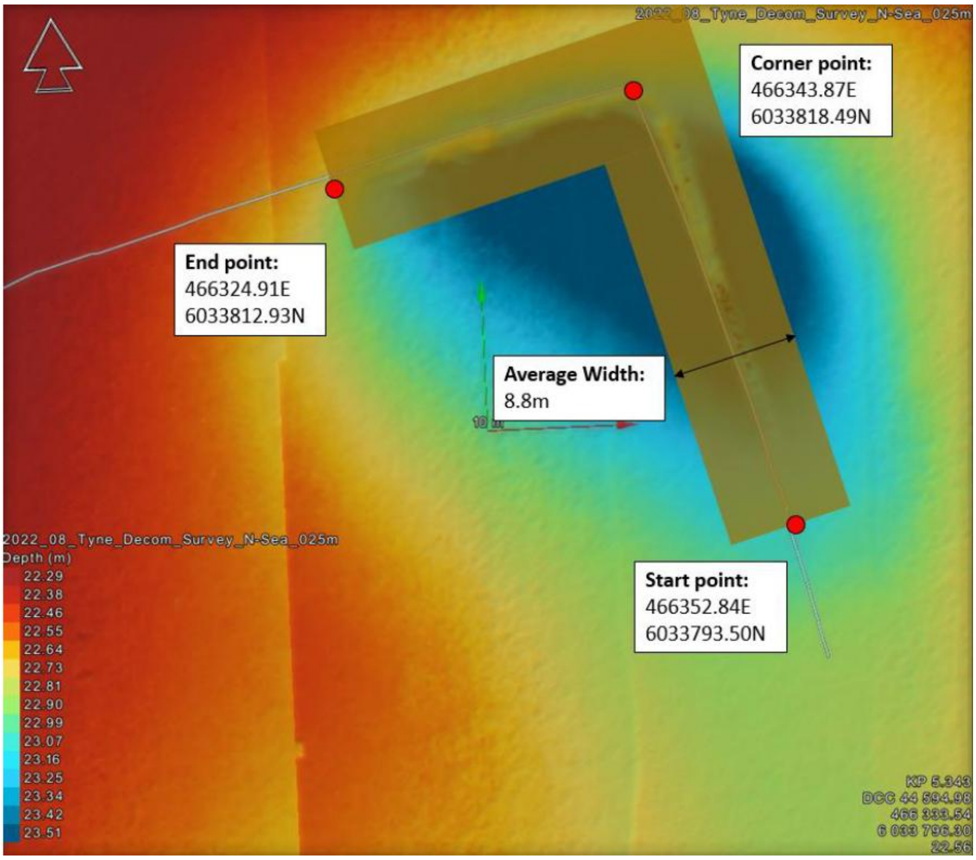
A detail analysis of the required rock berm design determined that a berm of 0.5m cover height (excluding the concrete mattresses on top of the pipeline), would provide an overtrawlable berm whilst minimising total rock volume (Table 7.6, Figure 7-4) [95].

The final volume of rock based on the volumes of the cross sections is 157m^3. However, for a worst-case assessment a factor of 2 has been applied giving a final required volume of 314m^3, this is to account for any changes in the spool exposure since the 2022 inspection. With a total length of the rock berm of 52m and average and 8.8m width, it can be expected that the proposed rock placement campaign will impact upon approximately 458m^2 of seabed, with a total deposit of 833te at a rock density of 2.65te/m^3. This volume was assessed during the CA process for the selected decommissioning option.

Table 7.6: Proposed rock berm details

Property	Unit	Value
Top width	m	0.6
Max height of rock berm	m	1.4
D_{50}	mm	150
Max bottom width of rock berm	m	11.6
Side slope	-	1:5
Cover Height over spool	m	0.5

Figure 7-4: Proposed rock berm design



Rock mass will be carefully placed over the designated areas of the pipelines and seabed by way of a fall pipe ROV, equipped with cameras, profilers, pipe tracker and other sensors as required. This will control the profile of the rock covering, thus ensuring rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance. It is also recognised that vessel will not require the use of anchors and therefore, there will not be seabed impacts associated to this vessel manoeuvrability. This type of decommissioning operation has successfully been completed by PUK on previous decommissioning campaigns, such as the stabilisation of Guinevere pipelines.

The proposed decommissioning activities will directly impact the seabed and benthic fauna living on and in the sediments at the proposed rock placement location. This impact will be localised to the scour basin and will involve permanent seabed abrasion and disturbance, along with alterations to habitat type due to the long term deposition of rock.

Seabed Abrasion/Disturbance

The deposition of 833te of rock over the natural seabed may disturb, injure, or cause mortality to mobile and, in most cases, low-mobility benthic fauna. This would result in localised loss of habitat and the communities dependent on it, while also creating a new hard substrate habitat. The extent of the impact is confined to the footprint of the proposed rock berm, which has been previously assessed as a maximum of approximately 458m².

Some of the benthic species found near to the Tyne development during the 2016 EBS were investigated for their sensitivity to various environmental factors [52]. *M. mirabilis, A. filiformis* and *O. fusiformis* are most vulnerable to substratum loss, while *N. latericeus* is low sensitivity to this factor. All four species show low or no sensitivity to smothering, turbidity, suspended sediment, noise, abrasion and physical disturbance, and contamination. While detailed sensitivity data was unavailable for other species, polychaetes are generally considered adaptable, though *N. latericeus* is intolerant to substratum loss. Some of the existing organisms such as bivalves and crustaceans will no longer be able to use the area affected, while new habitat will be created for other groups such as encrusting sponges and anemones. Any mobile marine fauna that depend on the natural sand sediment habitat will likely relocate to nearby areas where the natural substrate remains intact.

It should be noted that a change in biotopes was observed across the survey area from 2016 to 2022. In 2016, the dominant biotope was A5.151, characterized by *G. maculata, Nemertea,* and *Glycera spp*. By 2022, two dominant biotopes, A5.145 (with *Notomastus spp*) and A5.261 (dominated by *A. filiformis*), were identified. There was also a significant increase in macrofauna abundance and diversity, indicating a shift in the community over this period.

The surrounding area may also experience temporary disturbance due to suspended sediment caused by the deposition of the rock in sediment, but this should be short in time. It is anticipated that any seabed outside the rock placement footprint area affected by the decommissioning activities would be recolonised by benthic fauna typical of the area as a result of natural settlement by larvae and plankton and through the migration of motile animals from adjacent undisturbed benthic communities. Fine sediments, such as sands, were found at most of the samples obtained from pre- and post- decommissioning surveys, suggesting that these tend to recover much more quickly than the biologically controlled communities which characterise coarse deposits.

Change in Habitat

The placement of the rock berm in the scour basin area will also transform the habitat from a dynamic, mobile sand environment into a stable, immobile rocky habitat. This change will reduce the area covered by the Annex 1 Habitat classification: "*Sandbanks which are slightly covered by seawater all the time*". However, overtime, the rock may potentially bury or be partially buried by sand deposition. The extent to which this occurs will depend on local currents at each site; however, the naturally dynamic marine conditions of the SNS are expected to facilitate this process. Evidence from post drilling surveys undertaken at the Cygnus field reported no evidence of rock previously placed for rig stabilisation and concluded that the rock had been most likely become buried [30]. This evidence suggests that the placement of rock in soft sediment areas has little or no impact on sediment dispersion and deposition [71]. Consequently, it is predicted that the placement of rock that is subsequently buried will not impact on the physical functioning of the sedimentary habitat types within the site. Furthermore, buried rock is predicted not to have an impact on the biological communities within the site that are typical for fine sand and muddy sand habitats [71]. Therefore, buried rock is predicted to have little, if any, influence on the long term biological assemblages or sandbank sediments [3].

Overtime it is predicted that a proportion of the rock placed on the seabed will be buried and not cause an ongoing long-term loss of habitat.

Although the deposition of rock will lead to localised loss of benthic organisms and introduction of a new hard substrate habitat, leading to a change in habitat type and the associated fauna, the overall impact is minimal due to the very small area directly impacted and the large extension of similar natural substrate available nearby.

An additional source of potential impact from the selected decommissioning option includes the completion of overtrawl surveys conducted to determine the presence of snagging hazards in the proposed rock placement area and along the pipeline route. Specific survey methods will be discussed and agreed with OPRED prior to commencement. Where possible to do so preference will be given to non-intrusive survey methods such as SSS and ROV surveys to determine a clear seabed. Where these are deemed inconclusive targeted overtrawling surveys may be undertaken to ensure no residual risk of snagging remains post-decommissioning. These techniques involve the deployment of bottom trawl fishing gear followed by a number of ‘sweeps’ across the target area. The targeted nature of these surveys will limit damage to the seabed to specific areas around the pipeline route.

Should overtrawling be required, it will be conducted by fishing vessel(s) using trawl gear that is appropriate for the area.

A clear seabed will be validated by an independent verification survey of the pipeline. The aim of this clean seabed verification is to ensure the seabed is left in a safe condition for future fishing effort, in line with the current decommissioning guidance [5]. Any debris identified shall be reviewed and discussed with OPRED and recovered accordingly if required.

7.3.2.2 Effects on Sensitive Receptors

The proposed rock placement location and approximately 42km of pipeline lies within the Dogger Bank SAC. The site is designated for its Annex I habitat under the Europe EU Habitats Directive and implementing regulations with the presence of 'Sandbanks which are slightly covered by sea water all the time'. Additionally, the area falls within the Southern North Sea SAC, an important area for the North Sea harbour porpoise population. Grey and common seals are also known to visit the area.

The southern area of the bank, where PL 1220 and PL 1221 lies, are covered by shallow water around 20m deep with other areas reaching depths down to 35-40m. Its location in the open sea exposes the bank to substantial wave energy and prevents the colonisation of the sand by vegetation on the shallower parts of the bank.

There are a number of oil and gas fields within (or immediately adjacent to) the Dogger Bank and Southern North Sea SAC, the majority of which have been present prior to the sites being designated. In total, there is 457.7km of oil and gas pipeline within the Dogger bank SAC, some with piggy-backed umbilicals and fibre optic cables [3]. During a Habitat Risk Assessment (HRA), BEIS identified that decommissioning of oil and gas industry related infrastructure in the SAC is predicted to increase in future years [3].

Potential impact on Dogger Bank SAC

The Dogger Bank SAC covers an area of 12,331km^2 and is currently classified as being in unfavourable condition [3].

It is recognised that proposed decommissioning activities relating to the rock placement have the potential to cause a likely significant effect on the qualifying features of the Dogger Bank SAC and bring negative impacts on local ecology. As such, a detailed seabed disturbance assessment of the decommissioning option within the Dogger Bank SAC for the selected decommissioning option was completed to support the CA report. In total, 41.88km of PL 1220 and PL 1221 lie within the boundary of the Dogger Bank SAC; however, only 52m in length of the exposed pipeline at the previous located Tyne installation are subject to the remediation activities. As such, the proposed overtrawlable berm will impact upon approximately 458m^2 of Dogger Bank SAC seabed, corresponding to a 3.7e^{-6} % of the SAC total area (Table 7.7).

Table 7.7: SAC seabed disturbance for the rock placement of snagging hazards [93]

Total Seabed Disturbance from rock placement (m^2)	458
Total Seabed Disturbance in SAC from rock placement (m^2)	458
Area of SAC impacted (%)	3.7e-6

In its Strategic HRA of future decommissioning activities within the Dogger bank SAC (in which PUK contributed data on the Tyne Pipelines), BEIS concluded that while proposed activities could cause physical loss of habitat through the removal of infrastructure and smothering (particularly through rock placement), there would be no significant effect on maintenance of favourable status of the SAC from the included decommissioning activities. During the assessment it was assumed that:

- Following cleaning all buried pipelines will be left in situ. Pipeline ends and spool pieces will be removed.
- Mattresses, grout bags and existing rock dump will be left in situ. This provided a worst-case scenario for the physical impact on the seabed. It is possible that where the conditions allow mattresses and grout bags will be removed. However, this will be decided on a project specific basis and the worst-case scenario is that all existing mattresses, grout bags and rock dump are left in place.
- Post decommissioning debris clearance will be undertaken [3].

Based on the predicted level of decommissioning and predicted scale of impacts, along with evidence from existing studies of the likely potential effects on the qualifying features, BEIS concluded that the planned activities will not cause a likely significant effect on any qualifying features connected with the designated site either alone or in combination with other plans or projects. It will therefore not have an adverse effect on the integrity of Dogger Bank SAC [3].

Rock placement

The proposed overtrawlable berm will impact upon approximately 458m^2 (0.00045km^2) of Dogger Bank SAC seabed, corresponding to a 3.7e-6 % of the SAC total area. This is significantly below of the total area of 0.0006% or 0.078km^2 assumed to be impacted by the use of rock during future decommissioning activities within the Dogger Bank SAC by BEIS. However, it should be noted that the HRA considered this total physical loss of habitat due to rock placement for both the stabilisation of rigs and accommodation vessels (accounting for 0.0006% or 0.0768 km^2 of the overall impact on the SAC) in addition to the remediation of pipeline cut ends (accounting for 0.0006 km^2 of the overall impact).

The estimated 458m^2 of seabed impact from rock placement over the scour Tyne basin does not align with the data presented by the HRA with regard the future free-span exposures. Along a total pipeline length of 323.6km within the SAC, the rock required for remediation of free spans was assumed to cover an area of 310.5m^2 (0.0003 km^2).

The HRA recognised that there is potential for future remediation of free-spans along exposed pipelines within the SAC, such as the proposed Tyne scour basin protection. However, it was not possible to determine the overall extent of this at the time of the assessment. The HRA acknowledges that any future requirement to remediate exposure by rock placement may require additional assessments in accordance with the Habitat Regulations [3]. PUK will support OPRED in the provision of required information, should this be determined to be necessary.

Based on overall accumulative seabed impact from the future use of rock placement within the Dogger Bank SAC, the extent of rock required for Tyne decommissioning still remains relatively small. There is also potential for other operations considered within the HRA to have used less rock than was assumed in the assessment e.g. for rig stabilisation where it is acknowledged that previous experience has demonstrated that at the majority of rig locations there is minimal, if any, requirement for rock to be placed for rig stabilisation.

Further, PUK's assumption on the long term fate of the rock is aligned with that detailed within the HRA, that is that overtime it is predicted that a proportion of the rock placed on the seabed will be buried and not cause an ongoing long-term loss of habitat.

The proposed rock placement over the scour basin is therefore not expected to significantly alter the outcomes of the previously completed HRA.

Overtrawl surveys

Should traditional methods of overtrawl survey be employed, this has the potential to impact on the seabed including within the Dogger Bank SAC. The Dogger Bank HRA completed by BEIS assumes a worst-case potential corridor of 200m along the pipeline route within which the seabed may be impacted. Assuming a 200m wide corridor (as per the HRA), this has the potential to impact on 8.37km^2 of seabed within the SAC. However, this is a worst-case scenario as it is likely that no overtrawl surveys are required to be undertaken along buried pipelines [3].

In line with the HRA, current guidelines and based on the technical assessment presented within the Tyne DP documentation, it is not expected that the proposed decommissioning option would have a significant adverse effect on the functioning of the SAC or seabed ecology.

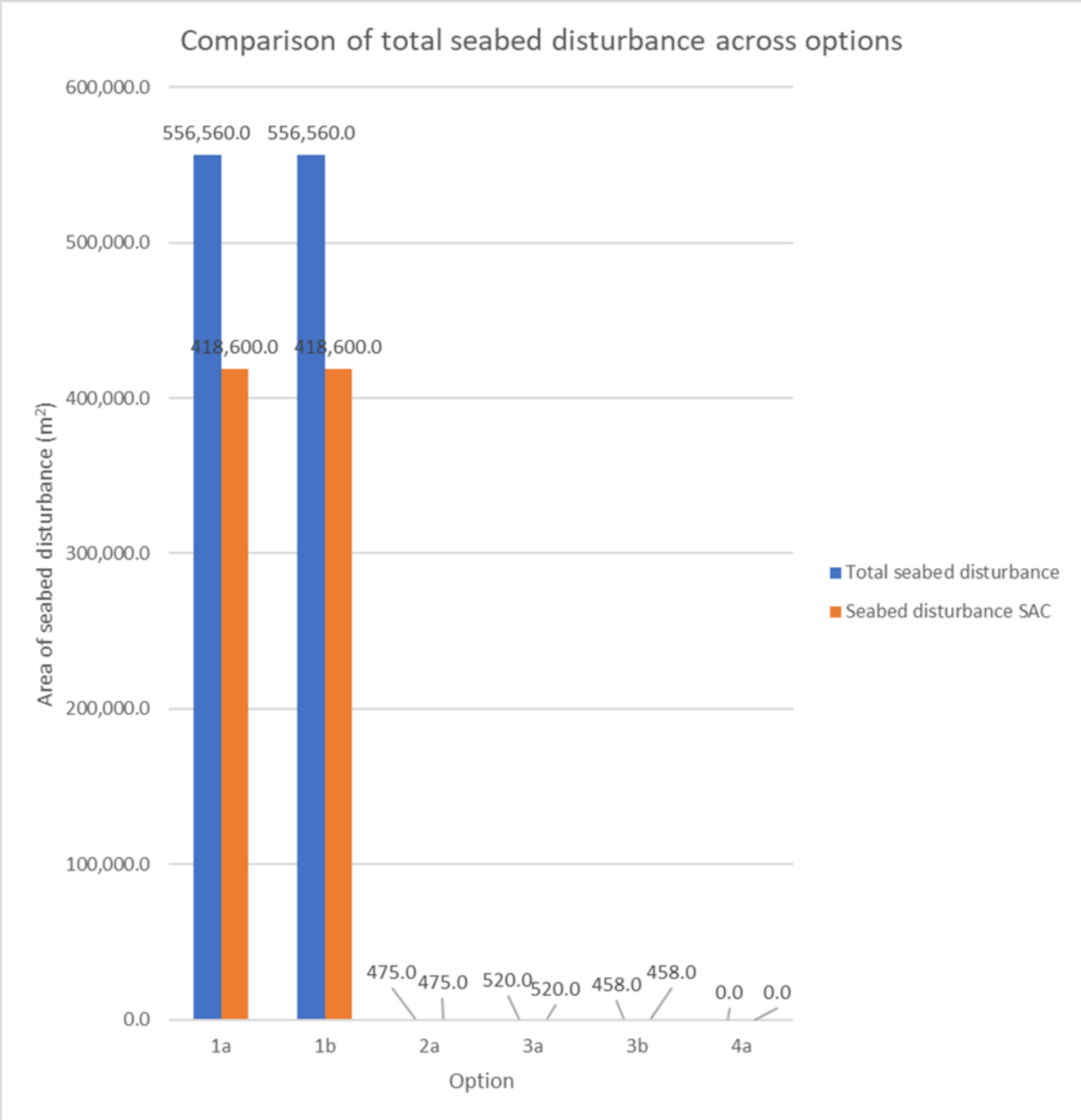
Mobilisation of contaminants

EBS completed both pre and post decommissioning indicate a low level of contaminants in the seabed adjacent to the previous platform location and along the pipeline route (see section 5.2.3). The potential level for the mobilisation of contaminants is similar to that of seabed disturbance, where it is the physical disturbance of the seabed which may mobilise embedded contaminants. As seabed disturbance for the selected method is relatively low both in spatial extent and frequency, the potential for the mobilisation of contaminants is also expected to be low. Therefore, the proposed decommissioning method is unlikely to lead to the mobilisation of significant levels of contaminants into the water column.

Positive impacts from leave in situ option

While there will be some impact on the seabed from the selected decommissioning option as stated above, the level of impact is significantly lower than that associated with other assessed options including full removal (0.56km^2) and partial removal of the scour basin section (0.00047km^2) (Figure 7-5). In comparison to these options there will be minimal negative impact on the seabed and the potential for positive impact on fish species, where rock provides fish aggregation and sediments/benthic communities remain undisturbed.

Figure 7-5: Comparison of seabed impact across decommissioning options. 1a and 1b – full removal, 2a – partial removal, 3a and 3b leave in situ with remediation and 4a leave in situ without remediation



7.3.2.3 JNCC Conservation Advice Assessment - Dogger Bank

An assessment of the seabed impact caused by the proposed activity with reference to the conservation objectives and the specific attribute targets described within the JNCC Conservation Advice for the Dogger Bank MPA has been undertaken by PUK. This assessment is made to determine whether the planned pipeline decommissioning activity may have an impact, in isolation or in combination with ongoing activities, on the qualifying features of the Dogger Bank SAC.

The qualifying feature of the Dogger Bank SAC is Annex I Sandbanks which are slightly covered by seawater all the time, specified in the site's conservation objectives.

For this feature to be in favourable condition, thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of the SAC, the JNCC has established Conservation Objectives for the Dogger Bank SAC. These objectives aim to maintain or restore, subject to natural change:

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

As indicated in Table 7.8, JNCC considers that the current condition status of the Dogger Bank SAC as unfavourable. This may be due to several factors, but pressure from the oil and gas industry, including the decommissioning of existing activities is capable of significantly affecting the qualifying feature of the site. These activities should be managed to restore Annex I Sandbanks to favourable condition by reducing or removing associated pressures.

Table 7.8: JNCC's Assessment on the Condition of the Qualifying Feature of the Dogger Bank SAC

Protected feature	View of condition
Annex 1 Sandbanks which are slightly covered by seawater all the time	Unfavourable

To understand whether the proposed Tyne decommissioning activities may induce additional pressure on a protected feature and subfeatures of the site, an initial assessment has been undertaken following the Advice on Operations approach [40]. This identifies the pressures associated with the decommissioning of oil and gas infrastructure and provides a detailed evaluation of the sensitivity of site features and subfeatures to these pressures. A human activity is considered capable of affecting where the feature is known to be sensitive to associated pressures.

Data from Tyne Platform Post-Decommissioning survey was used to identify the subfeatures present at the intended decommissioning area. Nine out of 11 stations located along the cruciform were classified as Slightly Gravelly Sand belonging to EUNIS Broad Scale Habitat (BSH) A5.2 (Sand and Muddy Sand). Conversely, two stations classified as Gravelly Sand and fell under BSH A5.1 (Coarse sediment). Given the slight variability presented in the samples obtained in 2022, the subfeature selected for the initial assessment was Sandbanks with subtidal mixed sediments.

The Risk Profiling of Pressures (RPP), conducted by JNCC, provides an initial assessment of how an activity may impact the MPA's features. Medium-High Risk indicates that the pressure requires further consideration as part of an assessment, while Low Risk suggests that the pressure generally occurs at a level unlikely to cause concern.

Table 7.9: Pressure caused by Oil and Gas Decommissioning activities that could harm the site's qualifying features [40]

Pressures	Features: Sandbanks with subtidal mixed sediments	Further assessment	Justification	RPP Score
Abrasion/disturbance of the substrate on the surface of the seabed	Sensitive	Yes	Rock deposition being place on the seabed leading to abrasion/disturbance.	Medium-high
Barrier to species movement	Not relevant	No	Localised rock placement will not interfere in the movement of species.	
Changes in suspended solids (water clarity)	Sensitive	No	The proposal will not excavate or dredge seabed.	
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Not relevant	No	A single medium-size vessel will be used to deploy rock for a short period of time.	
Habitat structure changes - removal of substratum (extraction)	Sensitive	No	The proposal do not require any removal of equipment/ material.	
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Unknown	No	The proposal will not release any type of contamination.	
Introduction of light	Not relevant	No	A single vessel will only introduce light at levels comparable to standard navigation lighting.	
Introduction of other substances (solid, liquid or gas)	Unknown	No	No discharge of any type of chemicals or substances is anticipated.	
Introduction or spread of invasive non-indigenous species (INIS)	Sensitive	Yes	The introduction of hard substrate could create conditions that facilitate the spread of invasive species.	Low
Litter	Unknown	No	The proposal do will not dispose litter in the marine environment.	
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Sensitive	No	The proposal will not disturbance of the substrate below the surface of the seabed.	
Physical change (to another seabed type)	Sensitive	Yes	Habitat change will occur due to placement of rock over natural sediment	Medium-high

Physical change (to another sediment type)	Sensitive	Yes	Habitat change will occur due to placement of rock over natural sediment.	Medium-high
Smothering and siltation rate changes (Light)	Sensitive	No	The proposal will not cause noticeable increase in suspended sediment.	
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Unknown	No	The proposal will not introduce contamination substances into the marine environment.	
Transition elements & organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Unknown	No	The proposal will not introduce contamination substances into the marine environment.	
Underwater noise changes	Not relevant	Yes	The proposal will introduce temporary noise due to the use of vessel and rock placement activities.	Medium-high
Visual disturbance	Not relevant	No	The proposal will not interfere in the sea landscape.	
Water flow (tidal current) changes, including sediment transport considerations	Sensitive	No	The proposal will not change the hydrodynamic processes.	

The initial assessment of the Tyne pipeline decommissioning identifies abrasion/disturbance of the seabed surface and physical changes to seabed and sediment type as key pressures resulting from rock placement (see Table 7.10). Further assessment has been undertaken below with reference to the Supplementary Advice on Conservation Objectives for Dogger Bank SAC [41].

It is recognised that there is a remote possibility for the introduction of INNS due to the rock placement. The presence of hard materials in an environment dominated by soft substrate has the potential to causes a significant change to the substrate, which in turn alters the habitat and ecology, creating preferential areas for benthic organisms that live on hard substrates. As a result, this can create an impact on the marine environment by providing novel habitat for the establishment of alien species. Two INNS were found across the Tyne field: the Atlantic jack-knife clam (E. leei) and the crustacean *M. sextonae*. Only three individuals of E. leei were identified across the survey area with two individuals sampled at station TY_04 and one at station ENV_P08. Only one specimen of *M. sextonae* was recorded across the Tyne field identified at station TY_11_REF. These invasive species do not rely on rock habitats for proliferation. It primarily expands in soft substrates, making it unlikely to benefit from rock placement during decommissioning activities.

Underwater noise changes will be limited to rock deposition and the use of decommissioning and survey vessels. Previous similar operations by PUK have shown that the associated noise levels from these activities are well below thresholds that could significantly impact fish or marine mammals. The conservation features of the Dogger Bank SAC are not specifically sensitive to underwater noise.

Table 7.10: Influence of Tyne decommissioning pressures over the feature attributes of the Dogger Bank

Specific Attributes of the Dogger Bank SPA	Tyne Decommissioning Pressures			
	Abrasion/ disturbance	Introduction INNS	Physical change habitat	Underwater noise
Extent and distribution	x	n/a	x	n/a
Structure and function	x	x	x	n/a
Supporting processes	n/a	n/a	x	n/a

Extent and distribution

A reduction in the extent of habitat can affect the biological and physical functioning of sedimentary habitats [23]. The distribution of habitat influences the communities that are present and can contribute to the health and resilience of the habitat [42]. Therefore, the extent and distribution are interrelated.

Any activities planned within the SAC must aim to minimise, as far as possible, changes to the substratum within the site to avoid further impacts on the extent and distribution of the feature. The introduction of rock will change the seabed from sedimentary material to a hard substrate. This will affect the sandbank communities, causing these areas to no longer qualify as part of the sandbank feature.

The introduction of rock at the Tyne location will generate abrasion of the seabed. The area will be affected by a single event, covering 458m² of the natural strata, which represents 3.7e-6 % of the entire SAC. In isolation, this impacted area does not result in a significant loss of the large-scale topography, biological assemblages, or sediments of the sandbank feature. The rock berm design will aim to minimise the impact area while ensuring the stabilisation of the scour basin and preventing snagging hazards. Overall, there would be a negligible habitat loss.

While the introduction of rock is considered a permanent disturbance, evidence suggests that local natural restoration of the sandbank is likely to occur, with recolonisation of sandbank communities in the impacted area. This will be monitored and reported to OPRED as a part of the post-decommissioning legacy survey obligations.

However, when considering cumulative impacts, the extent and distribution of the sandbank feature could be affected by other activity. It is considered that the following activities, in-combination with the proposed decommissioning activity could result in in-combination effects on the qualifying features of the Dogger Bank SAC:

- Oil and gas activity;
- Offshore renewable activity;
- Aggregate extraction;
- Commercial fishing.

Since 2018, significant oil and gas infrastructure decommissioning has taken place within the site, primarily involving the placement of protective materials to support the removal of infrastructure and the deposition of materials (e.g., rock dumps). PUK is not aware of any immediate future oil and gas field developments planned within the SAC. However, existing oil and gas infrastructure such as pipelines, stabilisation materials or rock placement remain on the seabed and will be subject to future decommissioning operations.

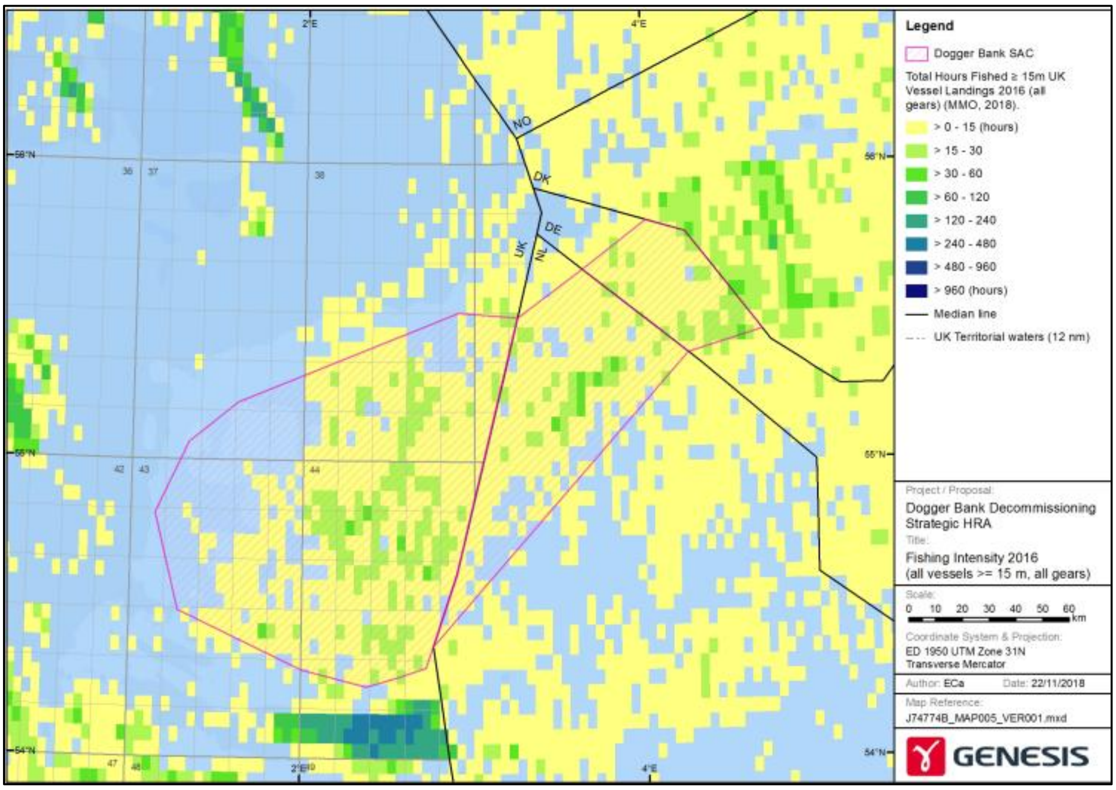
Additionally, four large-scale offshore wind farms and associated cables have been approved for the site, with the first phase expected to be completed in the second half of 2025. Furthermore, two additional offshore wind farms have been proposed through The Crown Estate's Offshore Leasing Round Four process. After a period of time, they will also generate habitat loss from installation decommissioning activities.

No offshore aggregates operations are currently active or planned near the Dogger Bank SAC despite Aggregate extraction areas 466/1, 485/1 and 485/2 falling within the boundary of the SAC [3].

Fishing activity is common across the Dogger Bank. This activity has been carried out in this area for hundreds of years. More recently however, fishing using beam and demersal trawling has become more prevalent. While fishing activity varies across the site, in 2016 fishing activity occurred over an area of 8,701 km^2 within the SAC (70.5% of the total SAC area) [3].

Further details of fishing activity in the project area are presented in section 5.5.1. Between 2016 and 2021 fishing activity in the 37F1 area has remained generally consistent, while activity within 37F2 has significantly decreased.

Figure 7-6: UK Fishing effort during 2016 within the Dogger Bank SAC [3]



A detailed review of this infrastructure, activity and the potential for in-combination effects is presented within the Dogger Bank HRA [3].

Despite the identified pressures, JNCC does not believe that human activities in the site will permanently affect the large-scale topography of the sandbank but continues to advise that the extent of the sandbank, in terms of its sediment composition and biological communities, has been and continues to be reduced by ongoing activities.

In line with JNCC assessment, the HRA identified that the potential impacts from future decommissioning activities associated with the oil and gas industry in-combination with other plans or projects within the Dogger Bank SAC will cause a loss of habitat within the SAC. However, the extent of potential habitat loss is estimated to be relatively small compared to the extent of habitat within the SAC and it is predicted that less than 0.1% of the site may be lost over the next fifty years. Following the decommissioning of the planned offshore wind farms the overall area of the site impacted will be 0.01%. Overtime it is predicted that where soft sediments arise rock and mattresses will become largely buried and therefore not have an impact on the habitat or biological communities within the SAC [3].

JNCC maintains a restoration objective for the extent and distribution of the site's features. Overall, the rock deposition for Tyne decommissioning has a relatively minor impact in both intensity and frequency and does not significantly affect the extent or distribution of the protected features of the Dogger Bank SAC, individually or cumulatively.

Structure and function

The proposed activities may impact the site's finer topography, sediment composition, distribution, and characteristic communities, leading to changes in its physical and biological structure.

Dogger Bank’s sediments primarily consist of fine sands with less than 5% mud content [43], with sandy gravel patches mainly along the western edge. Dogger Bank provides crucial ecosystem services, including nutrition for commercially important fish, foraging grounds for marine birds and mammals, and climate regulation through carbon burial. The bank's biological communities and sedimentary processes support these functions, relying on natural hydrodynamics and species interactions.

Preserving key natural structural and influential species is vital for maintaining biodiversity and ecosystem function within the sandbank [44, 34]. Key species help define the habitat, while influential species play a crucial role in its ecological processes.

The proposed rock placement may alter local sediment composition and topography, potentially disrupting sediment processing and habitat availability for benthic organisms. Although some initial loss of benthic organisms may occur, the limited scale of disturbance is unlikely to alter the overall biotope composition. Additionally, the identified INNS do not favour hard substrates, reducing the risk of their proliferation and associated changes to existing communities. Given the localised nature of the impact, the broader ecological integrity of Dogger Bank is expected to remain intact.

Ross worm *S. spinulosa* is a protected species in its reef form under the Habitats Directive and as a threatened and/or declining species in the OSPAR list. A total of three individuals were identified across the Tyne pipeline survey area, both outside of the Tyne 500m exclusion zone.

It remains unclear the exact amount and composition of rock placement on the seabed through the site making it difficult to fully assess its impact on the sandbank’s substratum [29, 53, 70].

JNCC continues to advise a restoration objective for the finer-scale topography, the characteristic communities, and the sediment composition and distribution of the feature. However, overall, the rock deposition for Tyne decommissioning will not result in significant changes in the structure and function of the protected features of the Dogger Bank SAC, individually or cumulatively.

Supporting processes

The sandbank feature relies on natural processes to maintain its ecological functions and recover from adverse impacts. Key factors like hydrodynamic conditions and water and sediment quality must remain largely unaffected to support the site's stability and health.

The introduction of a rock berm will not change the local hydrodynamic of the site. The berm is designed to minimise the amount of rock used while ensuring protection to sea users, so no obstructing structures will be created at the seabed. Furthermore, the rock to be used is an inert material and will not release contaminants that could compromise water or sediment quality.

JNCC continues to advise a maintenance objective for the disruption of supporting processes within the Dogger Bank SAC. However, Tyne decommissioning will not alter the hydrodynamic regime or water and sediment quality of the site.

Potential impact on Southern North Sea SAC

The Southern North Sea SAC has been identified as an area of importance for harbour porpoise. As such, the conservation objectives of the SAC are focussed around minimising disturbance and maintaining the population of this species in the area. Under the habitats Directive (92/43/EEC) and associated regulations (The Conservation of Offshore Marine Habitats and Species Regulations 2017), it is an offence to intentionally capture, kill, injure, or disturb an Annex IV(a) listed species. Disturbance is defined as:

(a) to impair their ability—

(I) to survive, to breed or reproduce, or to rear or nurture their young; or

(ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate; or

(b) to affect significantly the local distribution or abundance of the species to which they belong.

The proposed decommissioning activities will not significantly impact on the harbour porpoise or other marine mammals and therefore not impact on the conservation objective of the Southern North Sea SAC.

Activities will be both localised and limited in duration and be limited to the operation of a single vessel on any one occasion which would not be discernible above existing shipping activity in the area.

7.3.2.4 Transboundary Impacts

There are no transboundary impacts associated with the proposed decommissioning activities.

7.3.2.5 Mitigation Measures

The following mitigation measures will be employed to further reduce any impacts from seabed disturbance associated with the decommissioning option:

- PUK will apply for a Deposit Consent for the deposition of rock material after approval of DP by OPRED;
- Use of fall pipe ROV to deploy the rock mass over the targeted area in order to ensure maximum overtrawlability with minimum rock use and seabed disturbance;
- Use of optimal rock berm design to minimise rock requirement for an effective overtrawlable berm;
- Vessels will use dynamic positioning instead of anchors.
- Over-trawl survey conducted by non-intrusive methods when possible or optimised to allow survey completion with minimal sweeps.
- No infrastructure to be removed unless identified as a snagging hazard during the over-trawl survey.
- PUK will commit to a series of post-decommissioning legacy surveys to focus on the status of the score basin and seabed natural regeneration of the rock placement.
- Post-decommissioning debris clearance, surveys and monitoring shall be carried out using non-intrusive methodologies such as SSS, ROVs, etc.

7.3.2.6 Residual Impact

Localised seabed impact will occur as a result of the proposed decommissioning activities. The extent of this impact will be managed to be as low as reasonably possible.

Considering the above assessment and mitigation measures, it has been determined that the decommissioning of the Tyne pipelines and stabilisation materials by rock placement of scour basin is unlikely to pose a significant hazard to other users of the area or a significant impact on local ecology and the integrity of the SAC's or other sensitive receptors.

8 Assessment Conclusions

Following detailed review of the proposed decommissioning option, the environmental sensitivities present in the area and potential impacts on other sea users and the environment it has been determined that the decommissioning of the Tyne pipelines and stabilisation materials by leaving in situ with remediation rock placement will not present any significant impacts.

The majority of impacts associated with the decommissioning option are well understood and managed through the implementation of established mitigation measures. The impacts with potential to be significant were those associated with the leaving of infrastructure in situ including snagging hazards for other sea users, environmental impacts from material degradation and seabed disturbance associated with the rock placement over the pipeline exposures and the subsequent overtrawl surveys. However, following further assessment, these have been determined not to be significant following the implementation of the stated mitigation measures. Overall, the decommissioning option presented within this report is determined as not having a significant impact.

This finding is in line with the strategic HRA carried out by OPRED, where after consideration of all potential future decommissioning, of which the Tyne pipelines were a significant portion, and other activities, it was determined that a total of 0.16% of the dogger bank SAC could be affected by a physical loss of habitat which would not have an adverse impact on the integrity of the SAC [3]. The HRA states the following conclusions:

The potential impacts from future decommissioning activities associated with the oil and gas industry within the Dogger Bank SAC could cause a loss of habitat within the SAC. However, the extent of potential habitat loss is estimated to be relatively very small compared to the extent of habitat within the SAC and it is predicted that less than 0.0006% of the site may be impacted. Overtime it is predicted that a proportion of the rock placed on the seabed will be buried and not cause an ongoing long-term loss of habitat.

Based on the best available information BEIS is satisfied that potential future decommissioning activities relating to existing oil and gas infrastructure will not have an adverse effect upon the integrity of the Dogger Bank SAC. [3].

While the original HRA did not consider the total area of impact from rock placement proposed for the Tyne pipeline decommissioning, due to the relatively small size of the planned rock placement area, coupled with considerable variability and conservative assumptions within the HRA, PUK do not consider the impacts from the proposed Tyne Pipelines decommissioning method to be significantly outside those which are considered in the HRA.

In addition, this EA is considered by PUK to be in alignment with the objectives and marine planning policies of the East marine plan area.

Based on the assessment findings of this EA, including the identification and subsequent application of appropriate mitigation measures it is considered that the proposed decommissioning activities do not pose any significant impact to environmental or societal receptors within the UKCS or internationally.

9 Environmental Management

This section describes the arrangements that will be put into place to ensure that the mitigation and other measures of control, including the reduction or elimination of potential impacts are implemented and conducted effectively. This section also serves to outline the key elements of relevant corporate policies and the means by which PUK will manage the environmental aspects of the Tyne pipelines decommissioning operations.

9.1 Introduction

PUK hold ISO 14001 standard certification. Additionally, PUK operate under a SEMS, which forms part of the PUK Operating Management System (POMS). The POMS provide the framework for PUK to achieve safe and reliable operations day-in and day-out and ensures compliance with PUK's HSSE Policy.

In addition to enabling the implementation of identified mitigation and control measures, the SEMS provides the means to monitor the effectiveness of these measures through check and environmental performance. The SEMS, by design, will enable PUK to control activities and operations with a potential environmental impact and provide the assurance on the effectiveness of the environmental management.

9.2 Scope of the SEMS

The SEMS provides the framework for the management of Health, safety and Environmental (HSE) issues within the business. This SEMS is intended for application to all of PUK's activities as directed under the OSPAR recommendation 2003/5, promoting the design, use and implementation of EMS by the Offshore Industry. PUK, as a business, is centred on oil and gas exploration activities both onshore and offshore, with the offshore components of their business including seismic and drilling operations. As a relatively small operator PUK intend to resource such projects through the utilisation of contractors, should these not be available within the business itself.

The SEMS focuses on:

- Clear assignment of responsibilities;
- Excellence in HSE performance;
- Sound risk management and decision making;
- Efficient and cost-effective planning and operations;
- Legal compliance throughout all operations;
- A systematic approach to HSE critical business activities; and
- Continual improvement.

9.3 Principle of the SEMS

The following sub-sections describe the principles followed though the utilisation of the SEMS.

9.3.1 Improvement Programmes and the Management of Change

The purpose of employing an improvement programme is to:

- Ensure the continuous development of the PUK policy commitment.

- Introduce changes and innovations that ensure the achievement of performance standards where current performance is below expectations.

The SEMS also makes provision for the management of change. Changes may occur for a number of reasons, and at a number of levels. A ‘management of change’ procedure specifies the circumstances under which formal control of change is required to ensure that significant impacts remain under control and/or new impacts are identified, evaluated, and controlled.

9.3.2 Roles and Responsibilities

PUK will review existing environmental roles and responsibilities for staff participating in the Tyne DP. These will be amended and recorded in individual job descriptions to ensure that they take into account any changes required for the management of the impacts identified in this EA.

9.3.3 Training and Competence

The competence of staff with environmental responsibilities is a critical means of control. The SEMS, in conjunction with the Human Resources department of PUK allows for the appointment of suitably competent staff. The development and implementation of training programmes facilitates understanding and efficient application.

9.3.4 Communication

Internal environmental communication generally employs existing channels such as management meetings, minutes, poster displays, etc. External communication with stakeholders and interested parties is controlled through a communication programme. This establishes links between each stakeholder, the issues that are of concern to them, and the information they require to assure them that their concerns and expectations are being addressed. This EA and the consultation process that informed its production will be used to design the ongoing communication programme. Communication and reporting will employ information derived from the monitoring programme.

9.3.5 Document Control

The control of the SEMS documents is managed in the PUK Document Control System.

9.3.6 Records

Records provide the evidence of conformance with the requirements of the SEMS and of the achievement of the objectives and targets in improvement programmes. The PUK SEMS specifies those records that are to be generated for these purposes, and controls their creation, storage, access, and retention.

9.3.7 Monitoring and Audit

Checking techniques employed within PUK’s SEMS are a combination of monitoring, inspection activities and periodic audits.

The requirement for monitoring and inspection stems from the need to provide information to a number of different stakeholders, but primarily regulators, and PUK management. As such, there is a requirement for the results of monitoring and inspection to be integrated with the PUK internal and external communication programme.

Monitoring and inspection activities focus on:

- Checks that process parameters remain within design boundaries (process monitoring);
- Checks that emissions and discharges remain within specified performance standards – (emissions monitoring); and
- Checks that the impacts of emissions and discharges are within acceptable limits (ambient monitoring).

9.3.8 Incident Reporting and Investigation

The PUK SEMS stipulates documented procedures to control the reporting and investigation of incidents.

9.3.9 Non-confidence and Corrective Action

The checking techniques outlined above are the means of detecting error or non-conformances. PUK's SEMS includes procedures for the formal recording and reporting of detected non-conformance, the definition of appropriate corrective action, the allocation of responsibilities and monitoring of close out.

9.3.10 Review

PUK's SEMS includes arrangements for management review. This provides the means to ensure that the SEMS remains an effective tool to control the environmental impacts of operations, and to re-configure the SEMS in the light of internal or external change affecting the scope or significance of the impacts. Of particular importance is the role management review plays in the definition and implementation of the improvement programme, and the management of change.

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Appendix 1 – Air Emissions Assessment

The following assumptions were used in this assessment:

- Emission factors (EF) for offshore vessel use have been taken from the Environmental and Emissions Monitoring System, Atmospheric Emissions calculations (OEUK & BEIS) [26] - default EF for diesel consumption plant operations engines.
- 100% combustion efficiency.
- Sulphur content of fuel gas is 6.4 Parts Per Million weight.
- EF for onshore transport taken from the Department for Environment, Food & Rural Affairs (DEFRA), (2020) [18] - Delivery vehicles, All diesel Heavy Good Vehicles (HGV), 100% laden.
- EF for onshore waste treatment taken from DEFRA (2020) [18] - commercial and industrial waste disposal.
- Diesel specific gravity: 0.88te/m3 (average).
- Fuel consumption for a typical expected size vessel: 5m3/24hrs (Quayside), 20m3/24hrs (Transit), 15m3/24hrs (Dynamic positioning/On location).
- Fuel consumption for a typical size Trenching ROV vessel: 6m3/24hrs (Quayside), 35m3/24hrs (Transit), 16m3/24hrs (Dynamic positioning/On location).
- Fuel consumption for a typical expected size air diving vessel: 5m3/24hrs (Quayside), 35m3/24hrs (Transit), 7m3/24hrs (Dynamic positioning/On location).
- HGV limited to 17.6te carrying capacity (Environment agency, 2010) [27].
- Distance between waste processing facility and landfill – 25km [88].
- Distance for inter-facility transports for recycling – 250km [88].
- Onshore treatment days account for waste processing, recycling, and disposal (including fugitive emissions).
- 95% recycling of pipeline waste.
- The principal surveyed disposal route for marine growth is landfilling [63].
- Vessel days taken from Schedule, costings and durations for Tyne CA issued to Petrofac 12.06.23 [76].
- Full calculations presented in CAL-009 Tyne Emissions Assessment.
- Waste figures taken from CAL-008 Tyne Waste Assessment.

Table 10.1: Offshore vessel days and fuel consumption

	Total number (days)	Diesel consumption (m^3/24hrs)	Total diesel consumption (m^3)	Total diesel (te)
Construction vessel offshore days (Transit)	2	20.000	40.000	35.200
Construction vessel offshore days (Onsite)	3	15.000	45.000	39.600
Construction vessel days (Quayside)	3	5.000	15.000	13.200
Total	**8**	**40.000**	**100.000**	**88.000**

Table 10.2: Offshore emissions

Emission gas	EF	Total volume (te)
Carbon dioxide (CO_2)	3.200	281.600
Nitrogen oxides (NOx)	0.059	5.227
Nitrous oxide (N_2O)	0.000	0.019
Sulphur dioxide (SO_2)	0.004	0.352
Carbon monoxide (CO)	0.016	1.382
Methane (CH_4)	0.000	0.016
Volatile Organic Compound (VOC)	0.002	0.176

Table 10.3: Onshore transport

	Total (te)	Total distance (km)
Total Vessel waste (Incinerated)	0.104	25.000
Total waste (landfill)	0.080	25.000

Table 10.4: Onshore transport emissions

Emission gas	EF	Total volume (te)
CO_2	1.016	0.025
NO_x	ND	0.000
N_2O	0.013	0.000
SO_2	ND	0.000
CO	ND	0.000
CH_4	0.000	0.000
VOC	ND	0.000

Table 10.5: Waste treatment emissions

Emission gas	EF reference	EF	Total volume (te)
CO2e Vessel waste Non hazardous	(Household residual waste - Landfill)	446.204	0.036
CO2e Vessel waste hazardous	(Household residual waste - combustion)	21.280	0.002
CO_2e Pipeline marine growth	(Non-hazardous animal and vegetation waste-landfill)	587.326	0.000
CO2e Pipeline	(Recycling)	0.000	0.000

Table 10.6: Option 4a total emissions

Emission gas	Total volume (te)
CO_2*	281.663
NO_x	5.227
N_2O	0.020
SO_2	0.352
CO	1.382
CH_4	0.016
VOC	0.176

***** All the CO_2e emissions from the waste treatment are considered as CO_2 emissions

APPENDIX 2 - STAKEHOLDER RESPONSES TO STABILISATION MATERIALS DECOMMISSIONING PROPOSALS.

Key Observation #1 - If a mattress continues to perform a function, it is beneficial to leave it in place.

- "The decision of leaving mattresses in situ is not opposed if decommissioning programmes can highlight they are still serving their intended function and they cannot be removed safely". **OPRED/EMT**
- Satisfied with decision of 'leave-in' because the majority of the time this will be the safest option if there is no snagging risk". **HSE**
- "Understood that safety is a priority. No point lifting something that does not need to be removed". **JNCC**
- "The waste hierarchy should be followed. Disposal is the least preferred method, whereas waste prevention most favoured". **EA**
- "If mattresses are left in place, they are not regarded as waste because they are doing their intended purpose". **EA**

Key Observation #2 – Recycle mattress if....it is currently not in use; it can be re-used for original purpose; it can be removed safely; and removal does not negatively impact the environment.

- Ideally the seabed should always be returned to a natural state or be in a condition where it can be allowed to return to its natural state. **JNCC**
- "Where practical and they are suitable for re-use, and that use is available, mattresses could be used for a similar purpose, e.g. protection of assets and pipelines". **EA**
- "Would people be comfortable using a second-hand mattress given that its purpose is for safety. The integrity of the mattress is most important when deciding whether it is recycled or not". **EA**
- "Principles of protection is the right discipline of thought", "Stick with the hierarchy of control". **HSE**
- "A consideration of cumulative effects should be made in respect to sedimentation rates from mattress removal". **Cefas**

Key Observation #3 – 'Clear seabed' is an aim not a rule.

- " 'Clear the seabed' is an aim to achieve, not an absolute requirement, as 'clear' seabed can be interpreted differently". **OPRED/EMT**
- Agreed that clear the seabed will mean different things to different people. For some it means the seabed is clear of artificial structures, whether that is removed or buried. To others it may mean returning to its natural state". **JNCC**
- Satisfied with the decision of 'leave- in' because the majority of the time this will be the safest option if there is no snagging risk as well". **HSE**
- "Environmental considerations are less of a priority if a mattress is performing its intended purpose/function". **OPRED/EMT**
- "As long as they do not pose a snagging hazard, there is no preference as to whether the clear the seabed means mattress removal or buried". **NFFO**
- "Can leave the mattresses in for certain types of fishing. This could go both ways, mattresses provide habitat for marine life and in turn food for fish, yet if mattresses pose a snag risk there is a loss of ability to fish over them". **NFFO**

Key Observation #4 - Type of fishing (& other user) activity is an important factor when assessing whether a mattress is a potential snagging hazard.

- "The fundamental principle underpinning any proposal to leave in situ (LISU) is that evidence must be provided to demonstrate that the deposits would not interfere with other users of the sea". **OPRED guidance.**
- "Can leave the mattresses in for certain types of fishing. This could go both ways, mattresses provide habitat for marine life and in turn food for fish, yet if mattresses pose a snag risk there is a loss of ability to fish over them". **NFFO**
- "Methods of fishing that are a problem for mattress decommissioning are beam trawling, scalloping and lightly rigged prawn trawler… Operators should contact the NFFO to find out what type of fishing effort, as this will affect their comments". **NFFO**
- It could be predicted that the SNS will become predominantly a crab and lobster industry, therefore leaving mattresses in would benefit them (the fishing industry)". **NFFO**

Key Observation #5 - For a Protected Area - review on a case-to-case basis and look to minimise impact on the environment.

- "Consideration should be made to the use of mattresses by alien and native species". **Cefas**
- "Impacts of increased turbidity and sedimentation of benthic communities (from removal of mattresses) and impact on onshore receptors". **Cefas**
- "Consideration of the Source-Pathway-Receptor methodology could help in assessing environmental impact of removing mattresses". **Cefas**
- "Consideration of cumulative effects should be made in respect to sedimentation rates from mattress removal". **Cefas**
- "For a protected area, i.e. protected species attached to artificial habitat, review on a case-by-case basis". **JNCC**

Key Observation #6 – Type, integrity and level of contamination of mattress impacts the availability/applicability of onshore recovery options.

- "Reuse and recovery options will need to be determined with reference to the physical state of the mattresses and whether or not they are contaminated. **EA**
- "If mattresses are heavily contaminated, it is a possibility they will not be suitable for use as aggregate and therefore will have to be disposed to landfill". **EA**
- "Possible contaminants include chromium 6 and arsenic as well as hydrocarbons and seawater". **EA**
- "Similarly with polypropylene rope, the effects on the material from exposure to the marine environment will need to be assessed and detailed. Some recovery options may not be suitable". **EA**
- "Possibility that ropes could be used as fuel in 'waste to energy' plants". **EA**
- "Consider impact of the integrity of the mattress has on waste disposal options if they are to be removed". **Cefas**

Key Observation #7 - Safety is the priority; reducing costs & protecting the environment is important but not at expense of safety.

- "Principle of protection and hierarchy of control should always be followed – keeping people out of danger is the right discipline of thought". **HSE**
- "Elimination of risk is preferable i.e. no risk to personnel, diver, trawlers and think wider snagging risks". **HSE**
- "Should work to baseline conditions but not compromise safety". **JNCC**
- "Reducing costs is understandable but not at the expense of safety". **NFFO**
- "Money needs to be considered; it is not less equal". **OGA**
- "Know what your dealing with and look at the costings before committing to disposal onshore". **EA**
- "No comparative assessment is required for removal of mattresses this is wrong – particularly when considering waste management hierarchy." **OGA**
- There has to be more discussion about what happens to the mattress when it comes to shore in a remove scenario and the current state of the mattress". **HSE**
- "Provide figures for environmental value of mattresses that are left in situ. **Cefas**

Key Observation #8 - If remediation (rock placement) is required, provide evidence that the environmental impact has been minimised.

- "Operators proposing to mitigate potential hazards using rock should recognise that this may be opposed by some stakeholders, and therefore propose how concerns will be addressed". **OPRED guidance**
- "Not completely opposed to rock-dumping. There will be trade-off between the pro's and con's…Provide the engineering calculations to show how it's been targeted to minimise impact". **JNCC**

Key Observation #9 - Overtrawl survey or equivalent is considered appropriate verification of a clear sea bed.

- "If the 'clear the seabed' certificate is provided and the overtrawlabilty survey highlights there is no snagging hazard, then it should not matter if the mattresses are taken out or left in." **NFFO**
- It is expected that Operators will present evidence including an overtrawl survey or equivalent to demonstrate why it is considered safe to leave deposits in place if the burial depth is less than 0.6 metres below the surface of the seabed. **OPRED guidance**
- When a decommissioning programme proposes that deposits that are buried to shallow depths are LISU an overtrawl trial or its equivalent will be required to demonstrate that the deposits do not present a snagging hazard as part of the verification process following execution of the project. **OPRED guidance**
- Areas where deposits have not been removed will be subject to monitoring requirements post decommissioning. Monitoring requirements may include…. Overtrawling surveys to confirm the area is clear of debris and snagging hazards. **OPRED guidance**

Key Observation #10 - Ocean is a dynamic environment – sufficient evidence is required to support leaving the mattress to cover naturally.

- "Returning the seabed to baseline conditions is challenging because the ocean is not in the same state it was before oil and gas exploration began". **OGA**
- " 'Beast from the East' completely moved sandbanks and ripples. Dynamics in the sea have totally changed." **NFFO**
- "Returning to natural state is challenging because of the dynamic environment. This remains one of the biggest issues". **JNCC**
- It is very helpful to know the whole long term picture of mattresses. i.e. when did they become exposed? Information should be up-to-date for every application, as well as providing historical data for context". **JNCC**
- Within the reports, worst case scenario will be evaluated. Operators should present a reasonable worst case and strike the balance between this and a realistic scenario. **JNCC**
- The detail has got to be shown throughout the decommissioning programmes, e.g. clear location data, engineering calculations, science". **JNCC**
- Evidence based approach is the way forward not just a simple yes/no to policy. The law of physics and nature at work have to be considered. **OGA**