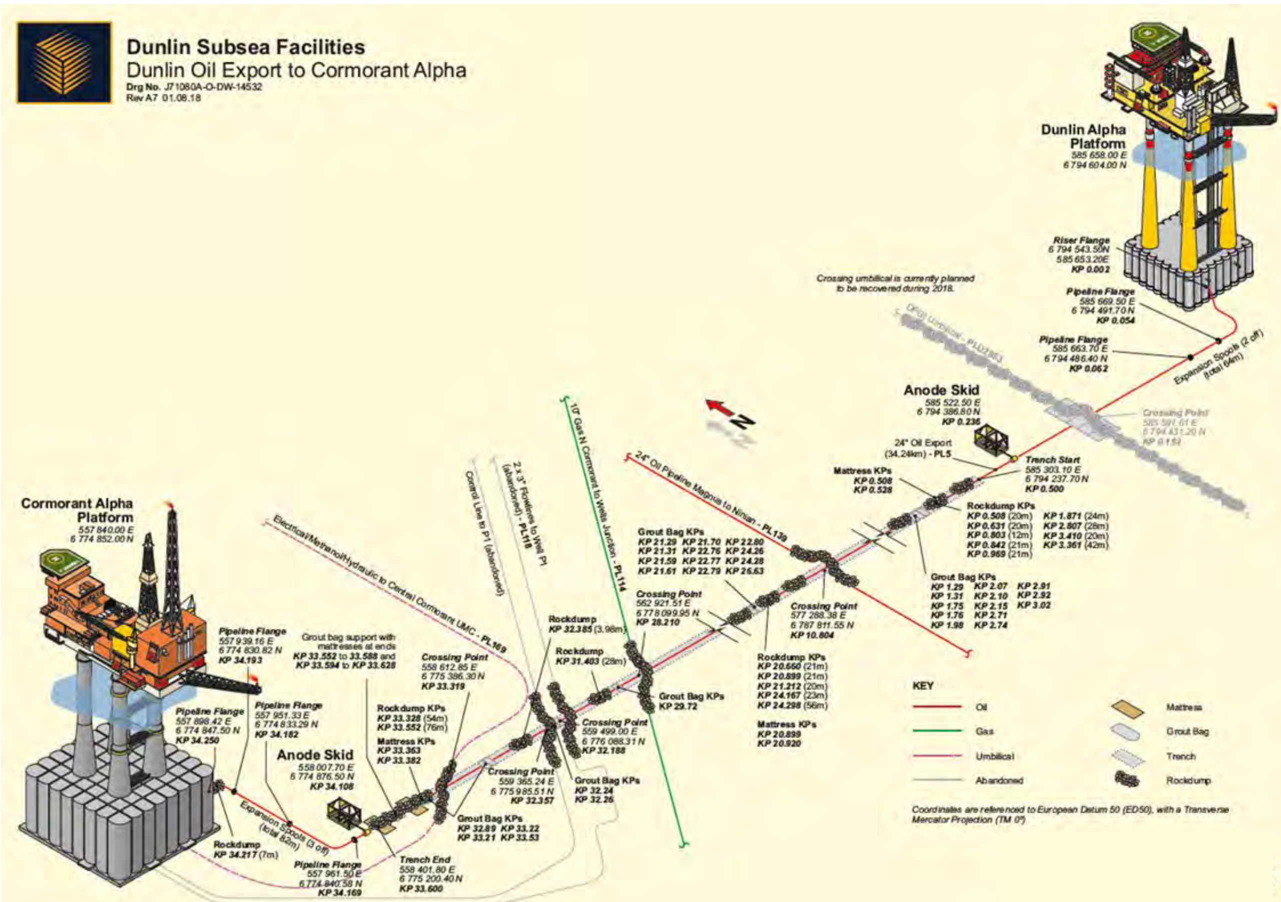
Dunlin Alpha to Cormorant Alpha Pipeline Decommissioning Environmental Appraisal Report



Supplier	Xodus Group
Ref Number (Project/Job/PO)	A-301649-S17
Supplier Document Number	A-301649-S17-REPT-005
Client Document Number	XOD-DUN-HSE-RPT-00006

This Dunlin Alpha to Cormorant Alpha Pipeline Decommissioning Environmental Appraisal Report is a supporting document to the Draft Decommissioning Programme alongside the CA Report and other documentation, available on the Fairfield website (http://www.fairfield-energy.com).

APPROVAL STATUS (To be completed by Fairfield)		SIGNED	DATE
1	Not Approved		
2	Approved Subject To Comments		
3	Approved	[signature]	25/3/19
4	For Information Only		

REVISION HISTORY					
A03	22/03/19	Issued for Use	[signature]	[signature]	[signature]
A02	01/03/19	Issued for Use	J. Smith	G. Jones	G. Jones
A01	20/12/18	Issued for Use	J. MacDonald	G. Jones	J. MacDonald
R03	30/11/18	Re-issued for Client Review	M. Billet	G. Jones	J. MacDonald
R02	29/11/18	Re-Issued for Client Review	M. Billet	G. Jones	J. MacDonald
R01	01/11/18	Issued for Client Review	M. Billet	G. Jones	J. MacDonald
Revision	Date	Description	Originator	Checked	Approved

Contents

Acronyms

%	Percent
£	Pound sterling
°	Degrees
°C	Degrees Celsius
µm	Micrometre
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
BAT	Best Available Technique
BEIS	Department for Business, Energy and Industrial Strategy
CA	Comparative Assessment
CEMP	Coordinated Environmental Monitoring Programme
CGBS	Concrete Gravity Base Substructure
cm	Centimetre
CO_2	Carbon Dioxide
CoP	Cessation of Production
CPR	Continuous Plankton Reader
CRP	Cod Recovery Plan
CSV	Construction Support Vessel
dB re 1 µP @ 1 m	Decibel relative to one micropascal measured at 1 m from the source
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DP	Decommissioning Programme
DFGI	Dunlin Fuel Gas Import
DSV	Diving Support Vessel
EA	Environmental Appraisal
EC	European Commission
EBS	Environmental Baseline Survey
EMS	Fairfield's Environmental Management Strategy
ENVID	Environmental Issues Identification
EPS	European Protected Species
ERL	Effects Range Low
ES	Environmental Statement
EU	European Union
EUNIS	European Union Nature Information System
FOCI	Features of Conservation Importance
FRS	Fisheries Research Services
GPS	Global Positioning System
HAZMAT	Hazardous Material
HSE	Health, Safety and Environment
ICES	International Council for the Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organisation
IOGP	The International Association of Oil and Gas Producers
IP	Institute of Petroleum
ISO	International Organisation for Standardisation
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
kg	Kilogram
km	Kilometre
km/h	Kilometres per hour
km^2	Square kilometre
LTOBM	Low Toxicity Oil Based Mud
m	Metre
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam Echosounder
MCA	Maritime and Coastguard Agency
MEMW	Marine Environmental Modelling Workbench

MER	Maximised Economic Recovery
mg	Milligram
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSBL	Mean Seabed Level
m/s	Metres per second
NBN	National Biodiversity Network
NCMPA	Nature Conservation Marine Protected Area
NM	Nautical mile
nm	nanometre
NMPi	National Marine Plan Interactive
NOAA	United States National Oceanic and Atmospheric Administration
NORBRIT	Norway-UK Joint Contingency Plan
NORM	Naturally Occurring Radioactive Material
OBM	Oil-Based Mud
OGA	UK Oil and Gas Authority
OGUK	Oil and Gas UK
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSPAR	Oslo Paris Convention
PAH	Polycyclic Aromatic Hydrocarbons
PL	Pipeline
PMF	Priority Marine Feature
PEXAs	Practice and Exercise Areas
PWA	Pipeline Works Authorisation
ROV	Remotely-Operated Vehicle
SAC	Special Area of Conservation
SAHFOS	Sir Alister Hardy Foundation for Ocean Science
SCCS	Scottish Conservation Credit Scheme
SCOS	Special Committee on Seals
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fishermen's Federation
SIMOP	Simultaneous operations
SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SOPEP	Shipboard Oil Pollution Emergency Plans
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Area
SSS	Side Scan Sonar
Te	Tonnes
THC	Total Hydrocarbon Concentration
TOM	Total Organic Matter
UMC	Cormorant Underwater Manifold Centre
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKOOA	United Kingdom Offshore Operators Association
UNESCO	United Nations Educational, Scientific and Cultural Organization
UXOs	Unexploded Ordinances
WHS	World Heritage Site

Non-Technical Summary

Introduction

Fairfield Betula Limited (Fairfield) is the operator of the Greater Dunlin Area, located in United Kingdom Continental Shelf (UKCS) Block 211/23 of the northern North Sea. Infrastructure associated with Dunlin, Merlin and Osprey fields are currently being decommissioning.

The Dunlin field lies approximately 137 km from the nearest landfall point, 197 km north east of Lerwick and 13.5 km west of the UK/Norway boundary (Figure i). The 24-inch Dunlin Alpha to Cormorant Alpha oil pipeline (PL5) currently transports partially stabilised Thistle Alpha and Northern Producer crude oil from Dunlin Alpha to the Sullom Voe Terminal (Shetlands) through the Brent Pipeline System via Cormorant Alpha. Following conditioning and flushing operations, the PL5 pipeline will be taken out of service from 30th June 2019.

Termination of Production from the Greater Dunlin Area was announced in May 2015, having achieved Maximum Economic Recovery (MER) from its fields. Termination of Production was agreed with the Oil & Gas Authority (OGA) on 9th July 2015, with Cessation of Production (CoP) on 15th June 2015, confirmed by letter dated 15th January 2016.

This Non-Technical Summary provides an overview of the Environmental Appraisal Report that has been prepared specifically for the proposed decommissioning of the PL5 pipeline.

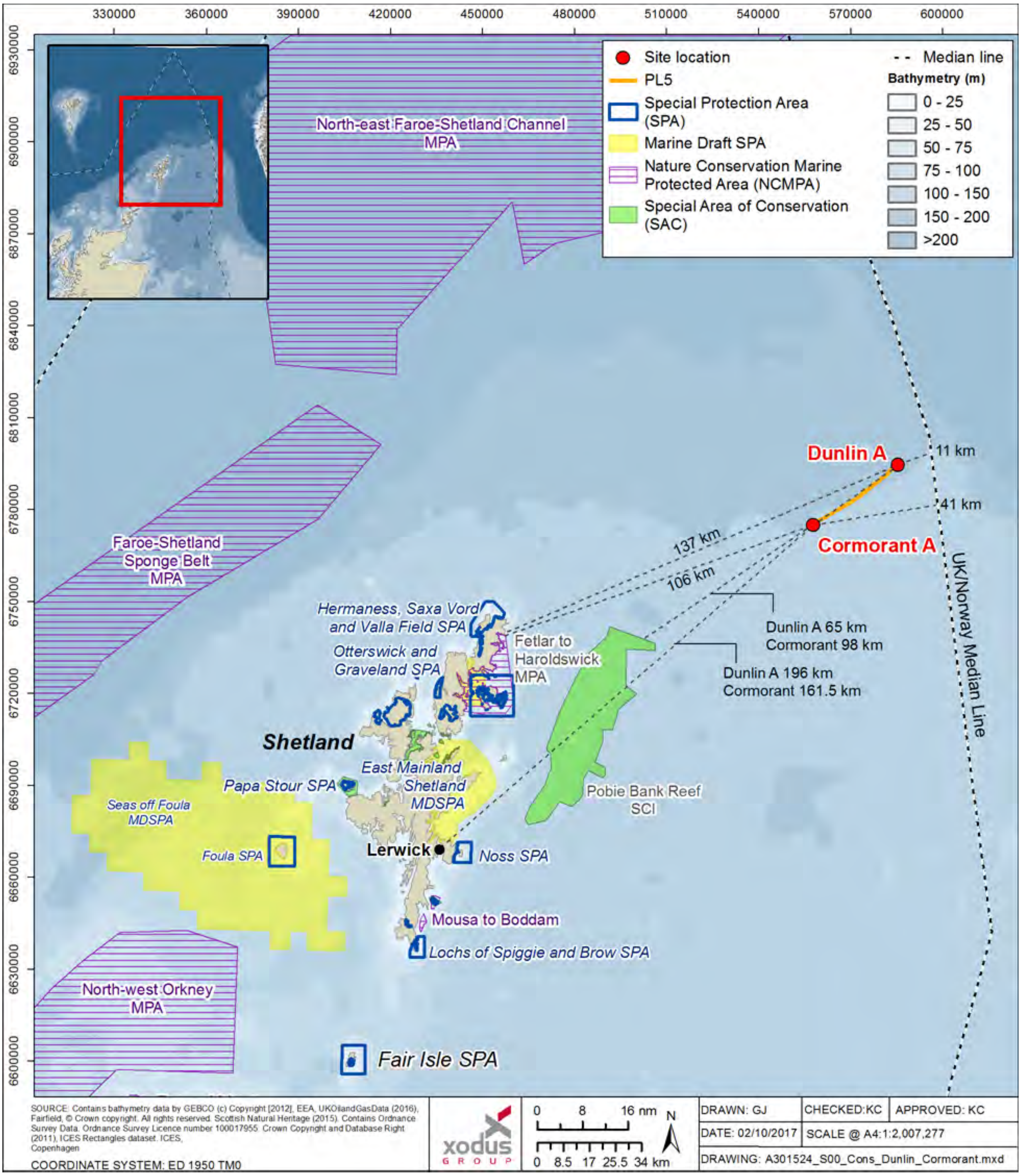


Figure i Location of PL5 pipeline

The 24-inch concrete coated rigid pipeline, PL5, extends approximately 34.2 km from the Dunlin Alpha platform to the Cormorant Alpha platform and is tied-in to the platforms through surface laid rigid spools. The majority of the pipeline was laid within an open trench below mean seabed level (MSBL) and has since accumulated varying depths of natural backfill cover. Deposits associated with the pipeline have been sub-categorised into three distinct groups for the purposes of the Comparative Assessment (CA): partially buried deposits, buried deposits and deposits used for pipe support. Most of these deposits are associated with pipeline span rectification works conducted in 2013 and 2014. A schematic of the subsea layout is shown in Figure ii.

The infrastructure to be decommissioned was arranged into groups, as detailed below.

Group	Description
1	Structures – 2 anode skids (steel framed structures with anode banks connected to the main pipeline to provide protection against external corrosion mechanisms).
2	Deposits (partially buried concrete mattresses (6x3x0.15m))
3	Deposits (buried concrete mattresses (6x3x0.15m) and buried grout bags (25kg))
4	Deposits (grout bags used for pipeline support (25kg bag))
5	Dunlin Alpha platform pipework, valves & control items (Note 1)
6	Dunlin Alpha riser within Concrete Gravity Based Substructure (CGBS) (Note 2)
7	Surface laid spools (24" rigid spools at Dunlin Alpha and Cormorant Alpha)
8	Trenched pipeline PL5 (24" concrete coated rigid pipeline 34.2km long)

Note 1: These items reside on Dunlin Alpha and shall be removed as part of the platform topsides removal scope.

Note 2: The PL5 riser is integrated within the Dunlin Alpha CGBS and will be covered under the Dunlin Alpha Decommissioning Programme.

Options for Decommissioning the Subsea Infrastructure

Following cessation of production, options to re-use the infrastructure *in situ* for future hydrocarbon developments have been considered, but to date, none have yielded a viable commercial opportunity. As such, there is no reason to delay decommissioning of the infrastructure. In line with the latest Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) guidelines on decommissioning, Fairfield has committed to fully removing a number of structures from the PL5 pipeline; these structures are detailed in the project description below and in the following list:

- Structures - two anode skids;
- Surface-laid rigid spools, which are short pieces of line that connect seabed infrastructure to a platform; and
- Partially exposed concrete mattresses.

For the remaining infrastructure, where the option to remove is not obviously the best option, Fairfield has followed the OPRED guidelines and undertaken a formal CA process. The CA process allows for the development of a preferred decommissioning methodology, based on consideration of five key criteria: safety risk, environmental impact, technical feasibility, societal impacts and economic factors. The infrastructure for which CA was undertaken is shown in Table i. To compare each option against the others to determine a recommendation, Fairfield utilised a Multi Criteria Decision Analysis (MCDA) tool. This tool allows review of the available data for each option and determination, using terms such as 'neutral', 'stronger', 'much stronger' and so on, how each option compares to the other for the five criteria. The CA process decision outcomes, supported by an appropriate amount of specialist study work, are summarised in Table i, with the selected options highlighted in green.

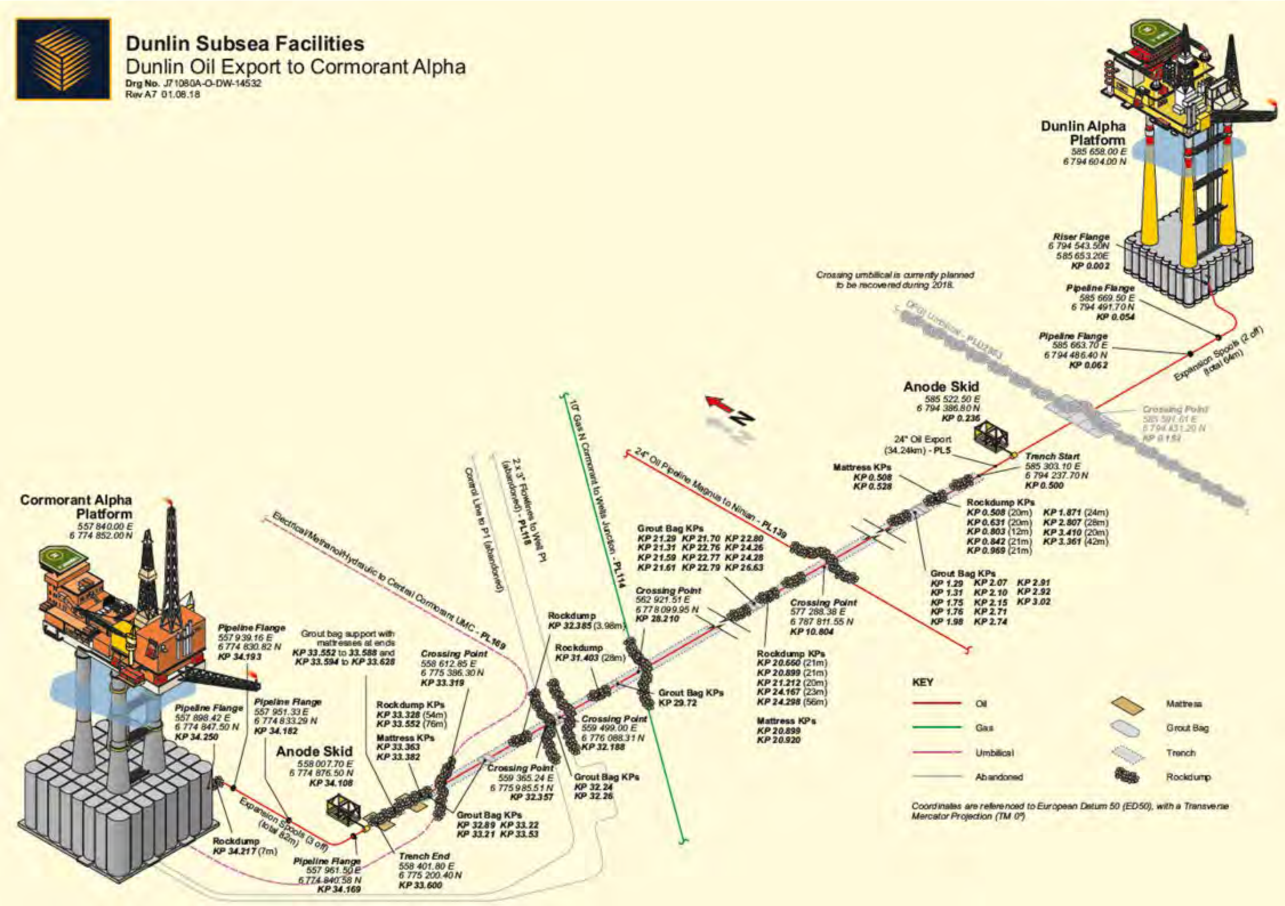


Figure ii PL5 pipeline subsea infrastructure

Group	Option			
	Minimal Intervention	Major Intervention		Full Removal
2 – Deposits (Partially Buried)	Leave *In Situ* – No Intervention	-	-	Full Removal – Lift/Recover
3 – Deposits (Buried)	Leave *In Situ* – No Intervention	-	-	Full Removal – Lift/Recover
4 – Deposits (Pipeline Support)	Leave *In Situ* – Minimal Intervention	-	-	Full Removal – Lift/Recover
8 – Trenched Pipeline	Leave *In Situ* – Minimal Intervention	Leave *In Situ* – Major Intervention (Full Rock Placement)	Leave *In Situ* – Major Intervention (Full Re-trench)	Full Removal – Cut and Lift

Table i Dunlin subsea infrastructure subject to the CA process

Full details on how the infrastructure will be decommissioned are given in the project description.

Project Description

Fairfield anticipates executing the PL5 decommissioning project activities in 2019. However, the specific timing of decommissioning activities will be agreed with OPRED and with the Health and Safety Executive. Applications for all relevant permits and consents will be submitted and approval sought prior to activities taking place.

A subsea contractor (or multiple contractors) will mobilise a fleet comprising vessels that can support underwater operations (including use of a remotely operated vehicles, diving, cutting, excavation and rock cover placement) and survey vessels. The vessels' cranes will lift any disconnected/cut subsea infrastructure onboard, which will then be transported to a suitable onshore dismantling site. Vessel types and the estimated days they are to be used during the decommissioning of the PL5 infrastructure are summarised in Table ii; these are based on detailed method designs undertaken for the project (Xodus, 2018c). The infrastructure lifted from the seabed will be transported to an onshore dismantling site by the vessels described above.

Vessel type	Approximate number of days		
	Mobilisation/ Demobilisation	In transit	In the field
Diving support vessel	4	2	10.00
Rock placement vessel	2	1	9.58
Survey vessel	2	2	1.82
Trawler	2	2	5.00
Total	**10**	**7**	**26.40**

Table ii Estimated requirement for vessel types and days

Taking into account both the requirement to fully remove the subsea structures and surface laid spools, and the outcome of the CA process which determined some infrastructure should remain *in situ*, Fairfield has developed a 'campaign approach' to the PL5 decommissioning activities. This campaign approach means that Fairfield has considered how to deploy vessels in the field to make best use of time, helping to keep the vessel requirement to a minimum. Weather permitting, Fairfield intends to complete the activities in the spring and summer months in Q2/3 of 2019 for an estimated duration of 40 days.

Table iii details the decommissioning activities to be carried out for the different infrastructure, including a description of the vessels and methodology.

Infrastructure	Decommissioning option	Method
Group 1 - Structures – 2 anode skids	Structures are to be fully removed and recovered to shore.	A dive support vessel will be mobilised to carry out these operations. Localised deburial of structures where required prior to disconnection from the main pipeline and recovery to the vessel.
Group 2 - Deposits (partially buried concrete mattresses (6x3x0.15m))	Concrete mattresses will be fully removed from the seabed.	A dive support vessel will be used to deploy a mass flow excavator to complete deburial of the mattresses as required. Lifting gear, that will allow multiple mattresses to be recovered to the vessel in one lift, will be used (Figure iii).
Group 4 - Deposits (grout bags used for pipeline support (25kg bag))	Local rock cover over the grout bags in areas providing pipeline support	A rock placement vessel will be mobilised to provide remedial rock cover at the ends by way of a flexible fall pipe (an example of this occurring is shown in Figure iv).
Group 7 - Surface Laid Spools (24” rigid spools at Dunlin Alpha and Cormorant Alpha)	Spools are to be fully removed and recovered to shore.	A dive support vessel will be mobilised to carry out these operations. Localised deburial of the spools where required prior to disconnection from the main pipeline and recovery to the vessel.
Group 8 - Trenched Pipeline PL5 (24” concrete coated rigid pipeline 34.2km long)	This pipeline will be decommissioned by removing the ends of the pipeline and placing local rock cover at the cut ends and areas of pipeline spanning.	A dive support vessel and rock placement vessel will be mobilised to undertake these operations. Dredging will be undertaken around the cut locations before the pipeline ends are cut, recovery rigging attached and the ends recovered to the vessel. A rock placement vessel will be mobilised to provide remedial rock cover at the ends by way of a flexible fall pipe (an example of this occurring is shown in Figure iv).

Table iii Description of decommissioning activities for the PL5 infrastructure

Figure iii Illustration of multiple mattresses being lifted (system shown from Subsea Protection Systems)

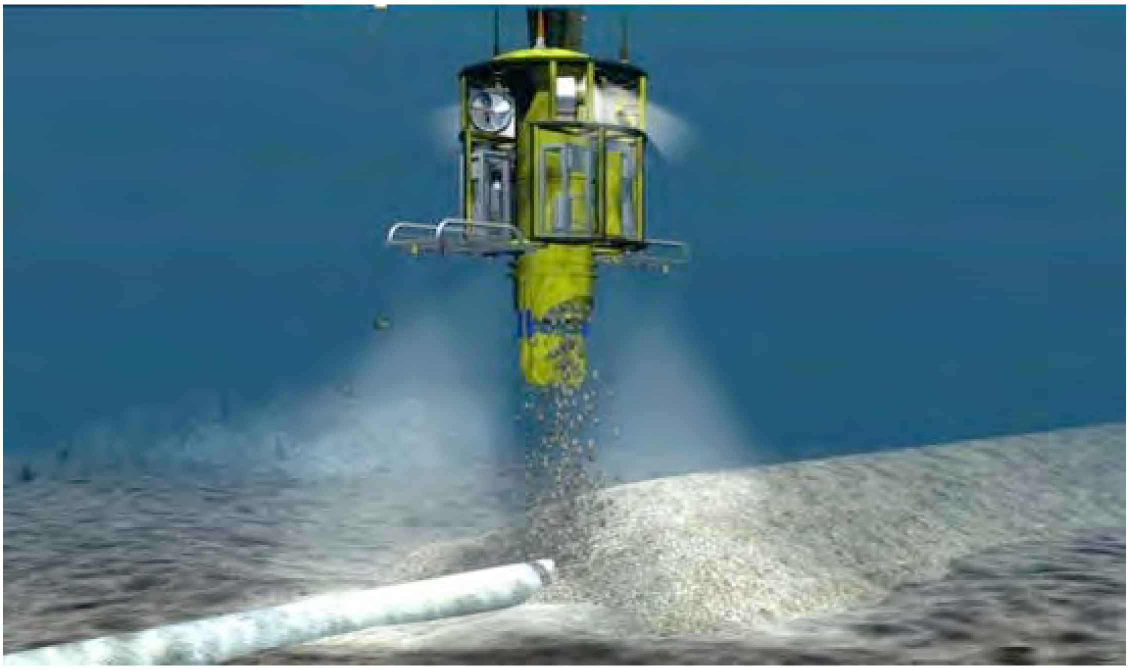


Figure iv Illustration of a flexible fall pipe being used to deploy rock (system shown from Offshore Fleet)

Table iv summarises the infrastructure to be decommissioned *in situ* and Figure v shows how the seabed will look following completion of the decommissioning activities.

Item to be decommissioned *in situ*	**Post-decommissioning status**
Group 3 - Deposits (buried concrete mattresses and grout bags)	No change to current status.
Group 4 - Deposits (grout bags used for pipeline support (25kg bag))	Spot rock cover over snag hazards to provide over-trawlable berm profile. (Note 1)
Group 8 -Trenched Pipeline PL5 (24" concrete coated rigid pipeline 34.2km long)	The pipeline will be decommissioned in its trench, with rock cover applied to areas of pipeline spanning and snag hazards. (Note 1)

Note 1: As a worst case, Fairfield has considered the deposition of rock on these areas identified above to a depth of cover 0.6 m of rock. However, it should be noted that, through discussion with the Scottish Fishermen's Federation, if adequate cover can be maintained, efforts will be made to reduce this cover in line with mean seabed level in these areas.

Table iv Infrastructure to be decommissioned *in situ*

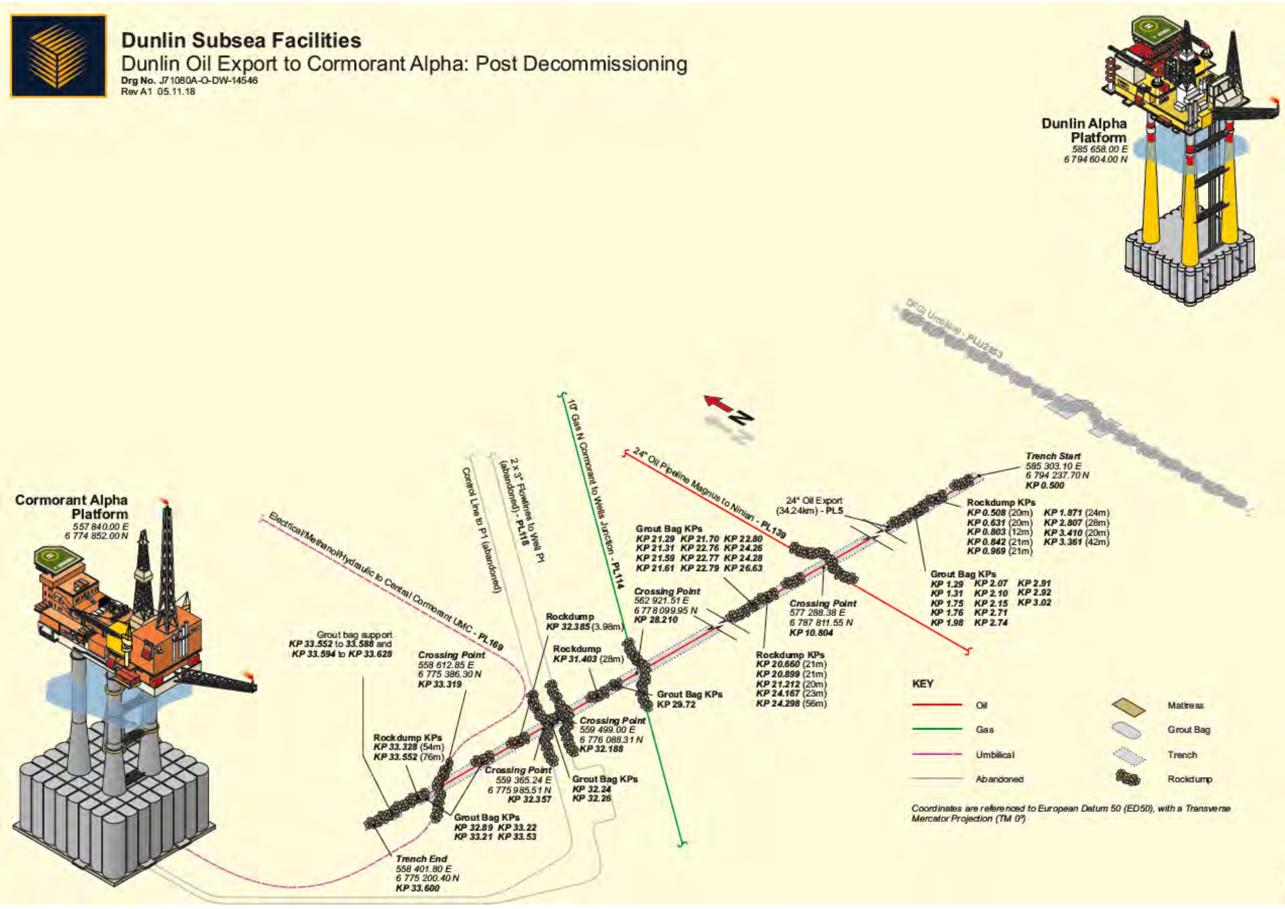


Figure v Subsea layout after completion of the decommissioning activities

A post-decommissioning survey will be undertaken along the pipeline corridor and assessed to determine if further offshore works are required. The frequency of any future monitoring required will be agreed with OPRED and informed by a risk-based approach based on survey findings.

Environment Description

Based on previous experience, studies (including Fairfield-commissioned surveys), review of scientific data and consultation, it has been possible to identify the key environmental sensitivities in the project area; these are summarised in Table v.

Animals living on or in the seabed
The habitat assessment undertaken for the project determined the sediments to be mainly muddy sand and mixed sediment. The visible animals found across the survey area included polychaete worms, crustaceans and molluscs. Species were generally considered to be intolerant of hydrocarbon contaminations. Surveys showed the seabed to host a relatively diverse range of species, with little variation across the area. Ocean Quahog (*Arctica islandica*) has been observed however it is well distributed in the North Sea and the project area is not considered a particularly important area for ocean quahog. 
Fish
 The fish populations in the project area are characterised by species typical of the northern North Sea, including long rough dab, hagfish and Norway pout. Basking shark, tope and porbeagle are all also likely to occur in small numbers. The project area is located within the spawning grounds of cod, haddock, Norway pout, whiting and saithe, meaning that these species may use the area for breeding. Nursery grounds, where juvenile fish remain to feed and grow, for angler fish, cod, blue whiting, European hake, haddock, herring, ling, mackerel, horse mackerel, place, sandeel, saithe, sprat, Norway pout, spurdog and whiting are also found in the wider area.
Seabirds
The project area is important for fulmar, northern gannet, great black-backed gull, Atlantic puffin, black-legged kittiwake and common guillemot for the majority of the year. The seasonal vulnerability of seabirds to oil pollution in the immediate vicinity of the project area has been derived from JNCC data; the months of November to January are those when seabird species in the project area are considered most vulnerable to surface pollution. Overall annual seabird vulnerability is reported to be low. 
Whales, dolphins and seals
 Spatially and temporally, harbour porpoises, white-beaked dolphins, minke whales, killer whales and white-sided dolphins are the most regularly sighted cetacean species in the North Sea. Given the distance to shore, species such as the bottlenose dolphin and grey and harbour seals are unlikely to be sighted in the project area.

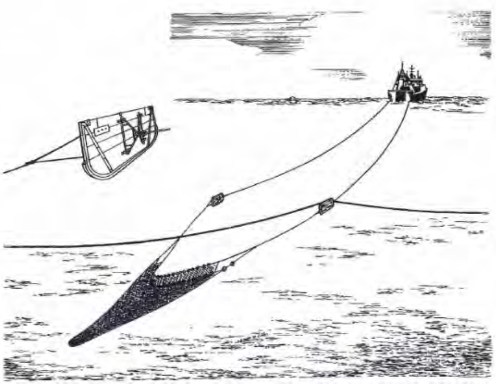
Conservation
None of the survey work undertaken in the project area has identified any seabed habitats or species that are of specific conservation significance, apart from low numbers of juvenile ocean quahog, which is considered to be a threatened species. There are also no designated or proposed sites of conservation interest in the project area; the closest designated site, 'Pobie Bank Reef' Special Area of Conservation, lies approximately 98 km to the south west of Dunlin, off the east coast of Shetland.
Fisheries and other sea users
Saithe and other demersal species are the key commercial species landed by UK vessels from the project area. However, they are of relatively low value when compared to total landings into Scotland; combined, landings of saithe from the wider area within which the project sits comprises only 0.1% of the value of landings into Scotland in 2016. Other species of commercial value include: mackerel megrim, cod and monkfish/anglers. There is very little shipping activity in the project area, and no sites of renewable or archaeological interest. There is also limited infrastructure related to other oil and gas developments. 

Table v Summary of the key environmental sensitivities of the project area

Impact Assessment

The environmental impact assessment has been informed by a number of different processes, including scoping with the regulators and their statutory advisors, workshops with specialists and the CA process.

An initial screening of the impacts and receptors was undertaken as part of the environmental identification (ENVID) process (Appendix A).

Where potentially significant impacts have been identified, mitigation measures have been considered. The intention is that such measures should remove, reduce or manage the potential impacts to a point where the impacts are not significant or 'as low as reasonably practicable' (ALARP). Table vi presents the findings of the environmental impact assessment for the potentially significant impacts identified for the project. The potential for cumulative and transboundary impacts is also considered.

Key potential impacts assessed	Significance
Residual Risk to Other Users from Materials Decommissioned *In Situ*	
Impact assessment: Infrastructure will either be removed or decommissioned in a state that will pose no risk to fisheries through snagging (overtrawl and rock-placement where required), alongside a continued risk-based monitoring programme and mitigation and control measures as detailed in Section 6, there will be no significant impact. **Cumulative**: As all infrastructure will either be removed or decommissioned *in situ* in an overtrawlable condition, there is expected to be no cumulative impact with other structures decommissioned as part of the PL5 pipeline decommissioning project, or indeed with other North Sea decommissioning projects. **Transboundary**: There are a number of non-UK vessels using the project area. However, decommissioning activities will be temporally limited, and infrastructure decommissioned *in situ* will be overtrawlable, meaning fishing will not be restricted. Non-UK fisheries users will therefore not be negatively affected by the decommissioning activities.	Not significant
Seabed Disturbance	
Impact assessment: *Direct:* Interaction with the seabed will occur during decommissioning activities. In the main, this will come from the trawling of chain mats to ensure the seabed is left in a suitable condition for future use by fisheries. As a worst-case scenario, this could result in a maximum of approximately 6.8 km^2 of seabed being trawled, and a slightly larger area experiencing an increase in sediment as it is stirred up into the water column. However, non-invasive geophysical survey methods will be deployed, where appropriate, to minimise potential seabed disturbance. Moreover, these impacts are considered to be temporary in nature and will recover in a period of between 0-5 years. *Indirect:* The estimated area of indirect impact is approximately 7.52 km^2 with a 10 m radius within which sediments may settle. This represents the entire direct impact area from a worst case, complete overtrawl seabed survey, which will be appropriately minimised through non-invasive geophysical survey methods. As stated in the direct impacts section above, this area is negligible compared to the area of ICES rectangle 51F1 which is continually disturbed via other users of the sea without significant effect to the habitats/ species currently found there. **Cumulative**: In the context of the possible cumulative impact from seabed disturbance occurring as part of the nearby Merlin and Osprey subsea decommissioning activities, the absence of seabed habitats and species of conservation interest and the general homogenous nature of the seabed alongside the short recovery rate of the seabed means that there is no likelihood of the PL5 decommissioning activities causing significant impact through cumulative means.	Not significant

Key potential impacts assessed	Significance
Transboundary: Despite the proximity to the UK/Norway median line, the highly localised nature of the seabed interaction means there is expected to be no potential for impacting seabed habitat or species outside of UK waters. **Effects on protected sites**: The distance to the nearest protected site means there is expected to be no potential for impacting protected sites.	
Discharges to Sea	
Impact assessment: Since the pipeline will have been flushed and cleaned to ALARP levels by the time the decommissioning activities commence, there is expected to be only seawater or residual traces of produced water, hydrocarbons, scale, metal oxides and other trace elements from the formation fluids. Although as the pipeline degrades these materials will be released to the environment the majority of these are not readily biologically available. The will be a small degree of disturbance to the drill cuttings in the vicinity of the cut pipeline ends which will result in a release of hydrocarbons however this is expected to impact a relatively local area and that impact is only expected to persist for around 160 days where levels of contaminants will have returned to near baseline levels. Release during decommissioning activities would have no potential to significantly impact species using the seabed or the water column around the project area. **Cumulative**: In the context of the possible discharges from the nearby Merlin and Osprey subsea decommissioning activities, and those made from the operation of installations in the North Sea, there is no likelihood of the minimal discharge from the PL5 decommissioning activities causing significant impact through cumulative means. **Transboundary**: Despite the proximity to the UK/Norway median line, the discharge of only seawater or nitrogen gas means there is expected to be no potential for impacting species or habitats outside of UK waters. **Effects on protected sites**: The limited discharge of only seawater or nitrogen gas means there is expected to be no potential for impacting protected sites, the nearest of which is 98 km away.	Not significant

Table vi Details of the potential environmental impact of the proposed activities

Environmental Management

The project has limited activity associated with it beyond the main period of preparation for decommissioning *in situ* and removal of components of the PL5 pipeline infrastructure; there are a likely to be a small number of post-decommissioning surveys. The focus of environmental performance management for the project is therefore to ensure that the activities that will take place during the limited period of decommissioning happen in a safe, compliant and acceptable manner. The primary mechanism by which this will occur is through Fairfield's Environmental Management Policy and specifically through the associated Environmental Management System that Fairfield operates.

Fairfield senior management is responsible for ensuring that the company's Environmental Management System is applied to all activities. To support this, a project Health, Safety and Environment (HSE) Plan will be developed which outlines how HSE issues will be managed and how the policies will be implemented effectively throughout the project. The plan will apply to all work carried out, whether onshore or offshore. Performance will be measured to satisfy both regulatory requirements including compliance with environmental consents, as well as to identify progress on fulfilment of project objectives and commitments.

Fairfield has also developed a waste management strategy for the project in order to describe the types of materials identified as decommissioning waste and to outline the processes and procedures necessary to support the Decommissioning Programme for the PL5 Pipeline. The waste management strategy details the measures in place to ensure that the principles of the waste management hierarchy are followed during the decommissioning (as shown in Figure vi).

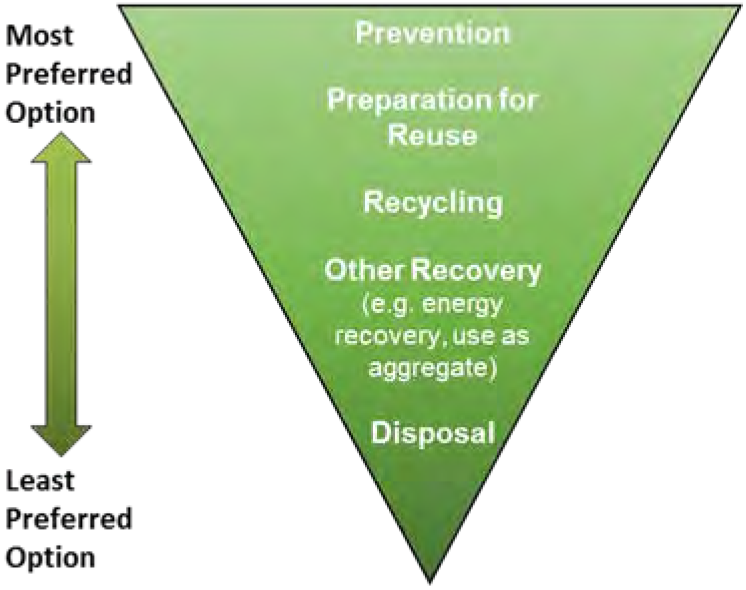


Figure vi Waste hierarchy

Conclusions

The planned operations have been rigorously assessed through the Environmental Appraisal and CA processes, resulting in a set of selected options which present the least risk of environmental impact whilst satisfying safety, technical, societal and economic requirements. Based on the findings of the Environmental Appraisal and the identification and subsequent application of the mitigation measures identified for each potentially significant environmental impact (which will be managed through Fairfield Environmental Management System), it is concluded that the project will result in no significant environmental impact.

1. Introduction

1.1. Overview of Infrastructure

The 24-inch Dunlin Alpha to Cormorant Alpha oil pipeline, herein referred to as PL5 or ‘the pipeline’, currently transports partially stabilised Thistle Alpha and Northern Producer crude oil from Dunlin Alpha to the Sullom Voe Terminal (Shetlands) through the Brent Pipeline System via Cormorant Alpha (Figure 1.1). Following conditioning and flushing operations, the pipeline is to be taken out of service from 30th June 2019.

The Dunlin Alpha platform is a fixed installation located in the Dunlin field, which lies within the East Shetland Basin of the northern North Sea, originally serving as a manned production facility for the Dunlin, Dunlin South West, Osprey and Merlin fields. The installation stands in 151 metres of water, 506 km north-north-east of Aberdeen in block 211/23a of the UK sector of the continental shelf. The installation is orientated 20° west of true north.

Termination of Production from the Greater Dunlin Area was announced in May 2015, having achieved Maximum Economic Recovery (MER) from its fields. Termination of Production was agreed with the Oil & Gas Authority (OGA) on 9th July 2015, with Cessation of Production (CoP) on 15th June 2015, confirmed by letter dated 15th January 2016.

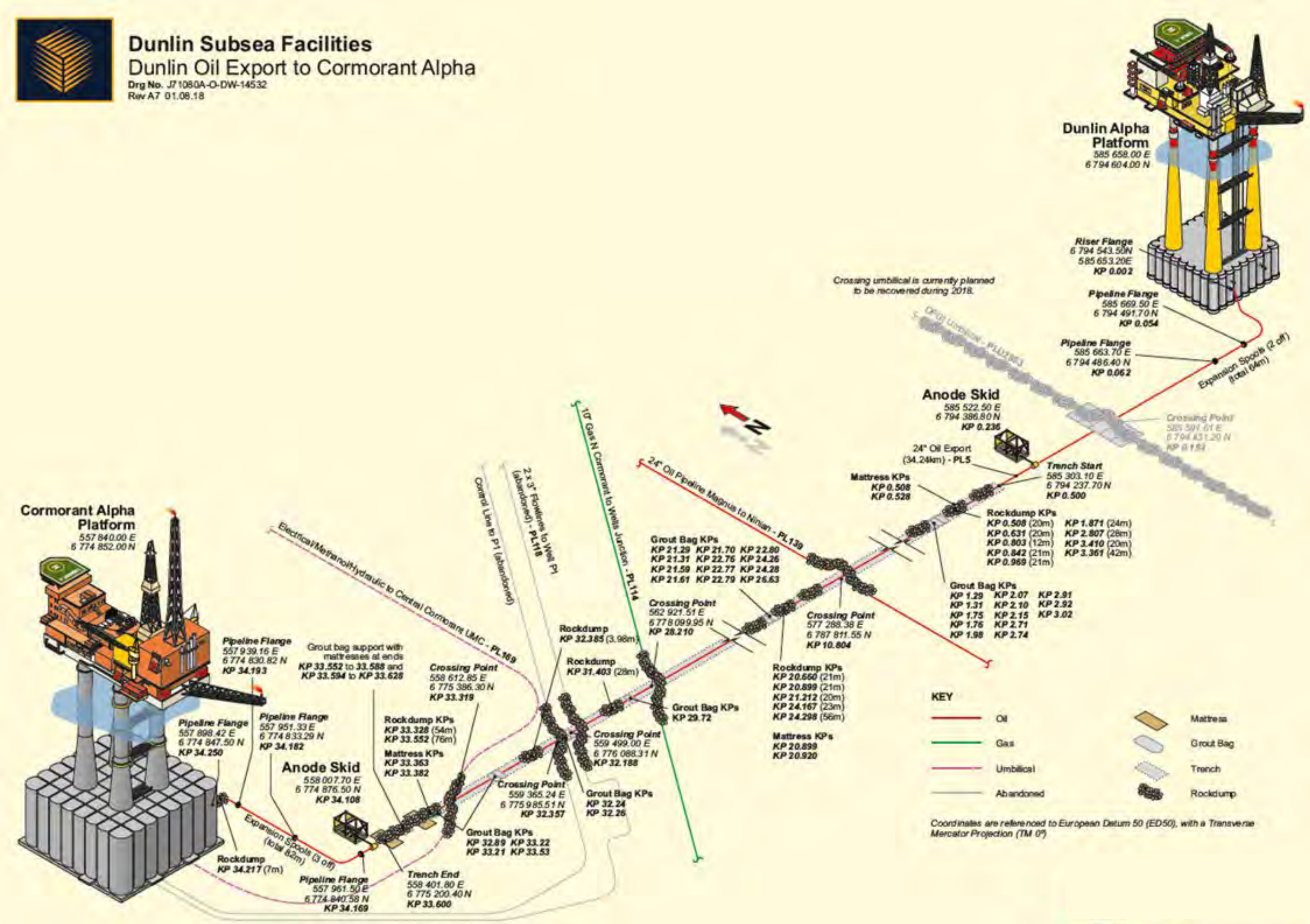


Figure 1.1 Dunlin Alpha to Cormorant Alpha pipeline (PL5 pipeline) overview schematic

1.2. Purpose of Environmental Appraisal

The purpose of this Environmental Appraisal (EA) Report is to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with decommissioning the PL5 pipeline and to demonstrate the extent to which these can be mitigated and controlled to an acceptable level. This is achieved in the following sections which cover:

- The process by which Fairfield has arrived at the selected decommissioning strategy (Section 2);
- A description of the proposed decommissioning activities (Section 2);
- A summary of the baseline sensitivities relevant to the assessments that support this EA (Section 3);
- A description of the appraisal methodology adopted for this assessment (Section 4);
- The findings of the recent Environmental Impact Identification (ENVID) reviews (Section 5);
- An assessment of the key environmental impacts (Section 6);
- An overview of the decommissioning project waste management philosophy (Section 7);
- A description of how the key environmental impacts will be mitigated and controlled (Section 7.4);
- Appraisal conclusions (Section 8).

This EA Report has been prepared in line with Fairfield's environmental assessment requirements and has given due consideration to the regulatory guidelines (BEIS, 2018) and to Decom North Sea's Environmental Appraisal Guidelines for Offshore Oil and Gas Decommissioning (Decom North Sea, 2017).

1.3. Regulatory Context

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998 (as amended[1]). Decommissioning is also regulated under the Marine and Coastal Access Act 2009 and Marine (Scotland) Act 2010. The responsibility for ensuring compliance with the Petroleum Act 1998 rests with Department of Business, Energy and Industrial Strategy (BEIS), formerly the Department for Energy and Climate Change (DECC).

The Petroleum Act 1998 (as amended) governs the decommissioning of offshore oil and gas infrastructure, including pipelines, on the UKCS. The Act requires the operator of an offshore installation or pipeline to submit a draft Decommissioning Programme (DP) for statutory and public consultation, and to obtain approval of the DP from the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), part of BEIS, before initiating decommissioning work. The DP must outline in detail the infrastructure to be decommissioned, the method by which the decommissioning will take place, and the schedule and phasing of programme.

The primary guidance for offshore decommissioning from the regulator OPRED (BEIS, 2018) details the need for an EA to be submitted in support of the DP. The guidance notes set out a framework for the required environmental inputs and deliverables throughout the approval process. The guidance outlines that an EA should be a document providing necessary content in proportion to the complexity and magnitude of a project. DECOM North Sea's (Decom North Sea, 2017) Environmental Appraisal Guidelines for Offshore Oil and Gas Decommissioning provides further definition on the requirements of EA Reports.

[1] The most recent amendment to the Petroleum Act 1998 was by the Energy Act 2016 which, amongst others, requires relevant persons to consult the UK Oil and Gas Authority (OGA) before submitting an abandonment programme to the Secretary of State for the Department of Business Energy and Industrial Strategy, and to require the latter to consider representations from the OGA when deciding whether to approve a programme.

In terms of activities in the northern North Sea, the National Marine Plan has been adopted by the Scottish Government to help ensure sustainable development of the marine area. This plan has been developed in line with UK and European Union (EU) legislation and international agreements under the Oslo Paris Convention (OSPAR). With regards to decommissioning, the plan states that 'where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process'. As part of the conclusions to this assessment (Section 9), Fairfield has given due consideration to the National Marine Plan during project decision making and the interactions between the project and plan.

1.4. Environmental Management

Relevant to the EA, and to all of Fairfield's activities, is the company's commitment to managing all environmental impacts associated with its activities. Continuous improvement in environmental performance is sought through effective project planning and implementation, emissions reduction, waste minimisation, waste management, and energy conservation; this mindset has fed into the development of the mitigation measures developed for the project. A summary of Fairfield's Environmental Management Policy is presented in Figure 1.2.

It is the policy of Fairfield Energy Limited (Fairfield) to seek to conduct its business in a responsible manner that prevents pollution and promotes the preservation of the environment. Fairfield appreciates that our activities can interact with the natural environment in many ways. We recognise that sustained development of Fairfield and our long-term success depends upon achieving high standards of environmental performance. We are therefore committed to conducting our undertakings in an environmentally responsible manner. This means that we will:

- Integrate environmental considerations within our business and ensure that we treat these considerations with at least equal importance to those of productivity and profitability;
- Incorporate environmental risk assessment in our business management processes, and seek opportunities to reduce the environmental impact of our activities;
- Continually improve our environmental management performance;
- Comply with all environmental laws, regulations and standards applicable to our undertakings;
- Allocate necessary resources to implement this policy; and
- Communicate openly in matters of the environment with government authorities, industry partners and through public statements.

In particular, we will:

- Maintain an environmental management system in accordance with international best practice and with the BS-EN-ISO 14001:2015 standard, including arrangements for the regular review and audit of our environmental performance;
- Conduct environmental analyses and risk assessments in our areas of operation, in order to ensure that we understand the potential environmental impacts of our activities and that we identify the necessary means for addressing those impacts;
- Manage our emissions according to the principles of Best Available Techniques;
- Publish an annual statement on our public web site, providing a description of our environmental goals and performance; and
- Maintain incident and emergency systems in order to provide assessment, response and control of environmental impacts.

Ultimate responsibility for the effective environmental management of our activities rests with the Managing Director and the Board. This policy shall be implemented by line management through the development and implementation of working practices and procedures that assign clear responsibilities for specific environmental activities with our employees and contractors. In addition, each of our employees has a personal responsibility to conduct themselves in a manner that enables us to implement this policy and our environmental management system.

John Wiseman, Managing Director

Figure 1.2 Environmental management policy

2. Project Scope

2.1. Description of Infrastructure Being Decommissioned

2.1.1. Overview

The Dunlin Alpha platform is a fixed installation located in the Dunlin field, which lies within the East Shetland Basin of the northern North Sea, originally serving as a manned production facility for the Dunlin, Dunlin South West, Osprey and Merlin fields. The installation stands in 151 metres of water, 506 km north-north-east of Aberdeen in block 211/23a of the UK sector of the continental shelf. The installation is orientated 20° west of true north.

The Dunlin Alpha to Cormorant Alpha oil pipeline (PL5) currently transports partially stabilised Thistle Alpha and Northern Producer crude oil from Dunlin Alpha to the Sullom Voe Terminal (Shetlands) through the Brent Pipeline System via Cormorant Alpha (Figure 1.1).

PL5 is a 24-inch concrete-coated rigid pipeline that extends approximately 34.2 km from the Dunlin Alpha platform to the Cormorant Alpha platform, and is tied-in to the platforms through surface laid rigid spools. The majority of the pipeline was laid within an open trench below mean seabed level (MSBL) and has since accumulated varying depths of natural backfill cover.

Anode skids were installed at the Dunlin Alpha and Cormorant Alpha pipeline ends to provide protection against external corrosion. These skids are made up of a steel framed structure with anode banks.

Deposits (concrete mattresses and grout bags) associated with the pipeline have been subcategorised into three distinct groups: partially buried deposits, buried deposits, and deposits used for pipe support. The majority of these deposits are associated with pipeline free span rectification works and provide additional pipeline stability, reducing the risk of snag hazards.

2.1.2. Project Boundary Limits

The scope of this decommissioning project is captured by the boundary limits defined in the following table. The full boundary limits are provided in the Pipeline Works Authorisation (PWA) 351/V/17. For more information, please refer to the project inventory summary compiled by Fairfield (Fairfield, 2017a).

Major Boundary Limit	Start	Dunlin Alpha Pig Launcher	6 794 604.0N 585 658.0E
	End	Subsea Riser Flange at Cormorant Alpha Platform	6 794 543.2N 585 653.0E

Note – Riser at Cormorant Alpha is contained within the platform leg. Therefore, it is considered that the decommissioning of the Riser and the associated Topsides pipework, Pig Receiver and Control System are to be covered under Cormorant Alpha Platform decommissioning programme (DP).

Table 2.1 PL5 pipeline decommissioning project boundary limits

2.1.3. PL5 Pipeline Subsea Infrastructure

The following tables provide a high-level summary of the PL5 pipeline subsea inventory (Fairfield, 2017a) included within the scope of this project.

QTY	Description	Length (m)	Trench (m)	Buried to 0.6m in Seabed (m)	Rock cover (m)	Exposed (m)
1	24" PL5 Pipeline	34,218	31,724	1,131	755	16,012
1	Dunlin Alpha Drop Down Spool	56	-	-	-	Laid on Seabed
1	Dunlin Alpha Closing Spool	8	-	-	-	Laid on Seabed
1	Cormorant Alpha Closing Spools	13	-	-	-	Laid on Seabed
2	Cormorant Alpha Drop Down Spools	69	-	-	-	Laid on Seabed

Table 2.2 PL5 pipeline information

QTY	Description	Length (m)	Width (m)	Height (m)	Weight (Te)
2	Anode Skid	3.3	2.7	1.8	14.64

Table 2.3 PL5 pipeline structures information

QTY	Description	Weight (Te)
1,840	Grout Bags (25kg) – Buried	46
2,500 (Est.)	Grout Bags (25kg) – Exposed or Partially Buried	63 (Est.)
9	Concrete Mattresses (6x3x0.15m) – Fully Buried	54
8	Concrete Mattresses (6x3x0.15m) – Partially Buried	61
1	Rock (1"-5") 1:3 0 Free Span Rectification (17 Locations)	6,650

Table 2.4 PL5 pipeline deposit information

2.1.3.1. *Pipeline Spans*

A pipeline survey undertaken in 2016 confirmed 169 free spans of the pipeline, the longest of which is 21.0 m (and 0.39 m high) (Fairfield, 2016). The majority of the pipeline spans are sufficiently trenched to below mean seabed level, although a small percentage (approx. 175.34 m combined length – 0.51% of total pipeline length) is raised above mean seabed level and is exposed.

Pipeline spans with length greater than 10m and a gap between bottom of pipeline and seabed greater than 0.8 m height are classed as Scottish Fishermen's Federation (SFF) reportable free spans. The spans identified in Table 2.5 are all below the SFF reportable threshold, and there have been no known reportable snagging incidents during Fairfield's operation of the pipeline.

KP	Section	Span Length 0.5m – 5m	Span Length 5m – 10m	Span Length 10m +	KP	Section	Span Length 0.5m – 5m	Span Length 5m – 10m	Span Length 10m +
0.0 – 0.06	Dunlin Spools	-	-	1	18.0 – 20.0	Trenched Pipeline	2	2	1
0.06 – 0.5	Trenched Pipeline	-	-	1	20.0 – 22.0		4	9	4
0.5 – 2.0		10	12	10	22.0 – 24.0		3	1	-
2.0 – 4.0		5	10	6	24.0 – 26.0		1	2	-
4.0 – 6.0		2	4	3	26.0 – 28.0		1	1	-
6.0 – 8.0		1	-	-	28.0 – 30.0		6	4	1
8.0 – 10.0		2	-	2	30.0 – 32.0		5	5	4
10.0 - 12.0		2	-	-	32.0 – 33.5		11	9	1
12.0 – 14.0		1	-	-	33.5 – 34.2		12	2	2
14.0 – 16.0		-	-	-	34.2 - 34.3	Cormorant Spools	-	-	1
16.0 – 18.0		1	1	1	**Total**		**69**	**62**	**38**

Table 2.5 Location of pipeline spans

2.1.3.2. *Pipeline Deposits*

Concrete mattresses and grout bags have been installed along the pipeline to provide additional stability and rectify spans. The location of deposits along the PL5 pipeline is provided in Table 2.6

The majority of the grout bags are buried or partially buried under the pipeline to provide bottom support. Additional grout bags have been placed along the sides of the pipeline to provide stability, and are either exposed or partially buried.

KP	Locations of Note 1			KP	Locations of Note 1		
	Buried or Partially Buried Mattresses	Buried Grout Bags	Support Grout Bags		Buried or Partially Buried Mattresses	Buried Grout Bags	Support Grout Bags
0.0 – 0.5	1	-	-	18.0 – 20.0	-	-	-
0.5 – 2.0	1	4	4	20.0 – 22.0	1	1	4
2.0 – 4.0	-	9	2	22.0 – 24.0	-	1	3
4.0 – 6.0	-	-	-	24.0 – 26.0	-	-	2
6.0 – 8.0	-	-	-	26.0 – 28.0	-	-	1
8.0 – 10.0	-	-	-	28.0 – 30.0	-	-	1
10.0 - 12.0	-	-	-	30.0 – 32.0	-	-	-
12.0 – 14.0	-	-	-	32.0 – 33.5	-	5	1
14.0 – 16.0	-	-	-	33.5 – 34.5	6	-	1
16.0 – 18.0	-	-	-	**Total**	**9**	**20**	**19**

Table 2.6 Location of pipeline deposits

2.1.4. Exclusions

Please note that the following items are excluded from the scope of this decommissioning project:

- Dunlin Alpha topsides pipework, valves and control items – these items will be removed as part of the platform topsides removal scope.
- Dunlin Alpha Riser within the Concrete Gravity Based Substructure (CGBS) – riser is integrated within the Dunlin Alpha CGBS and will be covered under the Dunlin Alpha DP.

2.2. Consideration of Alternatives and Selected Option

This section presents the approach taken to considering the alternatives to decommissioning and the various options available for decommissioning each item of the subsea infrastructure.

2.2.1. Alternative to Decommissioning

Fairfield has considered whether there is the potential to re-use the PL5 pipeline infrastructure for future hydrocarbon developments after it is taken out of service on 30th June 2019. To date, none of the options considered have presented a viable commercial opportunity. This assessment is based on the absence of remaining hydrocarbon reserves in the vicinity of the Greater Dunlin Area. It is considered unlikely that any opportunity to re-use the pipeline and associated infrastructure will be feasible.

2.2.2. Comparative Assessment (CA)

The CA is a process by which Operators can, with input from the Regulator and other stakeholders, make decisions on the most appropriate approach to decommissioning. As such, it is a core part of the overall decommissioning planning process being undertaken by Fairfield for the PL5 pipeline infrastructure. Guidelines for CA were prepared in 2015 by Oil and Gas UK (OGUK), which describe the steps required for completing a CA.

The methodology used by Fairfield is described in detail in the PL5 CA Report (Xodus, 2018a). The evaluation phase of the CA utilises a Multi Criteria Decision Analysis (MCDA) tool which employs pairwise comparisons of quantitative and qualitative data. The options are assessed against the five main criteria defined in the OPRED decommissioning Guidance Notes (Safety; Environment; Technical; Societal; and Economics). These criteria were then further subdivided into relevant sub-criteria for the assessment. The emerging recommendation from the CA then formed the decommissioning strategy which is presented in Section 2.3.

2.2.3. Options for Decommissioning the PL5 pipeline Infrastructure

In line with the latest OPRED guidelines on decommissioning (BEIS, 2018), Fairfield has committed to fully removing a number of structures and surface laid rigid spools from the PL5 pipeline subsea area. For the remaining infrastructure, Fairfield followed the OPRED guidelines and undertook a CA to determine the recommended decommissioning approach. The PL5 pipeline CA therefore focussed on the eight groups shown in Table 2.7.

Group	Title	Description	Decommissioning Approach
1	Structure	Two anode skids	Full Removal
2	Deposits (Partially Buried)	Partially buried concrete mattresses (6x3x0.15m)	Subject to full CA
3	Deposits (Buried)	Buried concrete mattresses (6x3x0.15m) Buried grout bags (25kg)	Subject to full CA
4	Deposits (Pipeline Supports)	Grout bags used for pipeline support (25kg bag)	Subject to full CA
5	Dunlin Alpha Topside Pipework, Valves and Control Items	PL5 pipeline topsides pipework, pig launcher, associated valves and controls	Excluded from DP (see Section 2.1.4)
6	Dunlin Alpha Riser within CGBS	24" rigid riser within Dunlin Alpha platform leg 16" crossover valves	Excluded from DP (see Section 2.1.4)
7	Surface Laid Rigid Spools	24" rigid spools at Dunlin Alpha and Cormorant Alpha	Full Removal
8	Trenched Pipeline	24" concrete coated rigid pipeline	Subject to full CA

Table 2.7 Decommissioning groups

Table 2.8 details the decommissioning options for the groups requiring further evaluation, as listed in Table 2.7.

Group	Option			
	Minimal Intervention	Major Intervention		Full Removal
2	Leave *In Situ* – No Intervention	-	-	Full Removal – Lift/Recover
3	Leave *In Situ* – No Intervention	-	-	Full Removal – Lift/Recover
4	Leave *In Situ* – Minimal Intervention	-	-	Full Removal – Lift/Recover
8	Leave *In Situ* – Minimal Intervention	Leave *In Situ* – Major Intervention (Full Rock Placement)	Leave *In Situ* – Major Intervention (Full Re-trench)	Full Removal – Cut and Lift

Table 2.8 PL5 pipeline decisions

2.3. Description of Decommissioning Activities

The recommendation from the CA is for surface laid ends of the pipeline to be cut and removed for recycling, leaving the remainder largely trenched below mean seabed level. In order to mitigate against potential snagging hazards, rock cover will be applied at the cut locations of the exposed pipeline ends and identified areas of spanning. Partially buried concrete mattresses will also be removed, together with the anode skids and spools at the Dunlin Alpha platform and the spools at the Cormorant Alpha platform.

Buried deposits (concrete mattresses and grout bags) and grout bags that continue to provide pipeline stability, to protect against movement and spans, will be decommissioned *in situ* and rock coverage will be applied to prevent snagging hazards. Any oilfield debris within the pipeline corridor will be recovered as part of debris clearance operations. Once complete, seabed clearance surveys will be conducted and used to initiate a monitoring regime with the regulator and its consultees.

Further descriptions of the decommissioning activities associated with the PL5 Pipeline DP are given below.

2.3.1. Decommissioning Strategy

The decommissioning strategy associated with the PL5 pipeline infrastructure is outlined in Figure 2.1. As shown, the operations are split into three broad areas:

- Dunlin Alpha operations;
- Cormorant Alpha operations; and
- Remedial activities and surveying.

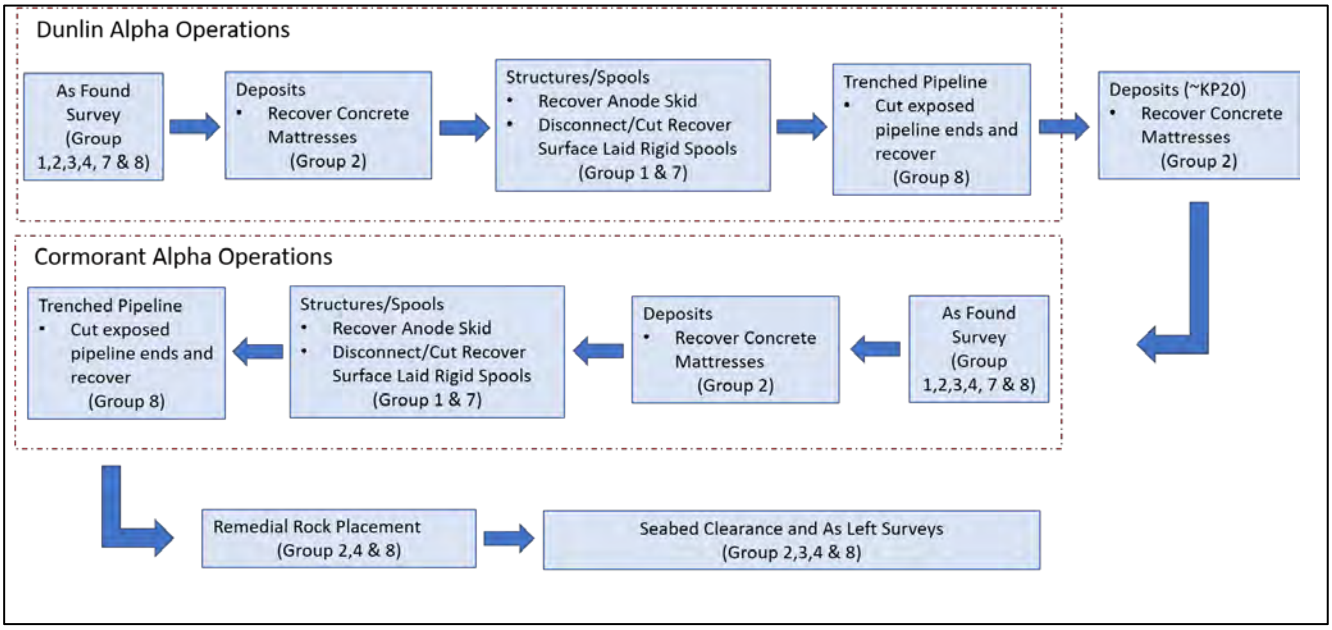


Figure 2.1 PL5 pipeline decommissioning strategy

Based on the nature of the activities and the vessel / equipment required, the strategy can be effectively implemented through the following vessel campaigns. Each campaign will have a discrete mobilisation, demobilisation and vessel spread.

2.3.1.1. *Campaign 1 – Dive Support Vessel (DSV) Campaign*

The first campaign involves three main scopes based on the location of works in order to minimise vessel transits. These scopes are:

- Operations at the Dunlin Alpha platform;
- Operations associated with deposit recovery at ~KP20.
- Operations at the Cormorant Alpha platform.

Prior to any decommissioning works, an as-found survey will be performed. The intervention works associated with Groups 1, 2, 7 and 8 will then be executed. Details of these activities are given below.

Group 2 – Partially Buried Deposits

The emerging recommendation associated with the partially buried deposits is to fully remove the partially buried deposits and recover them to shore for disposal/recycling. Where these deposits are removed there may be a requirement to remediate the seabed if a potential snag hazard remains. As a result, an allowance of 100Te of rock cover per mattress area has been assessed resulting in a total rock footprint of 800 m^2.

This decommissioning strategy refers to eight partially buried concrete mattresses, which cover the PL5 pipeline. The location of these mattresses (circled below) and the typical coverage observed during a recent survey are shown in Figure 2.2 and Figure 2.3 respectively.

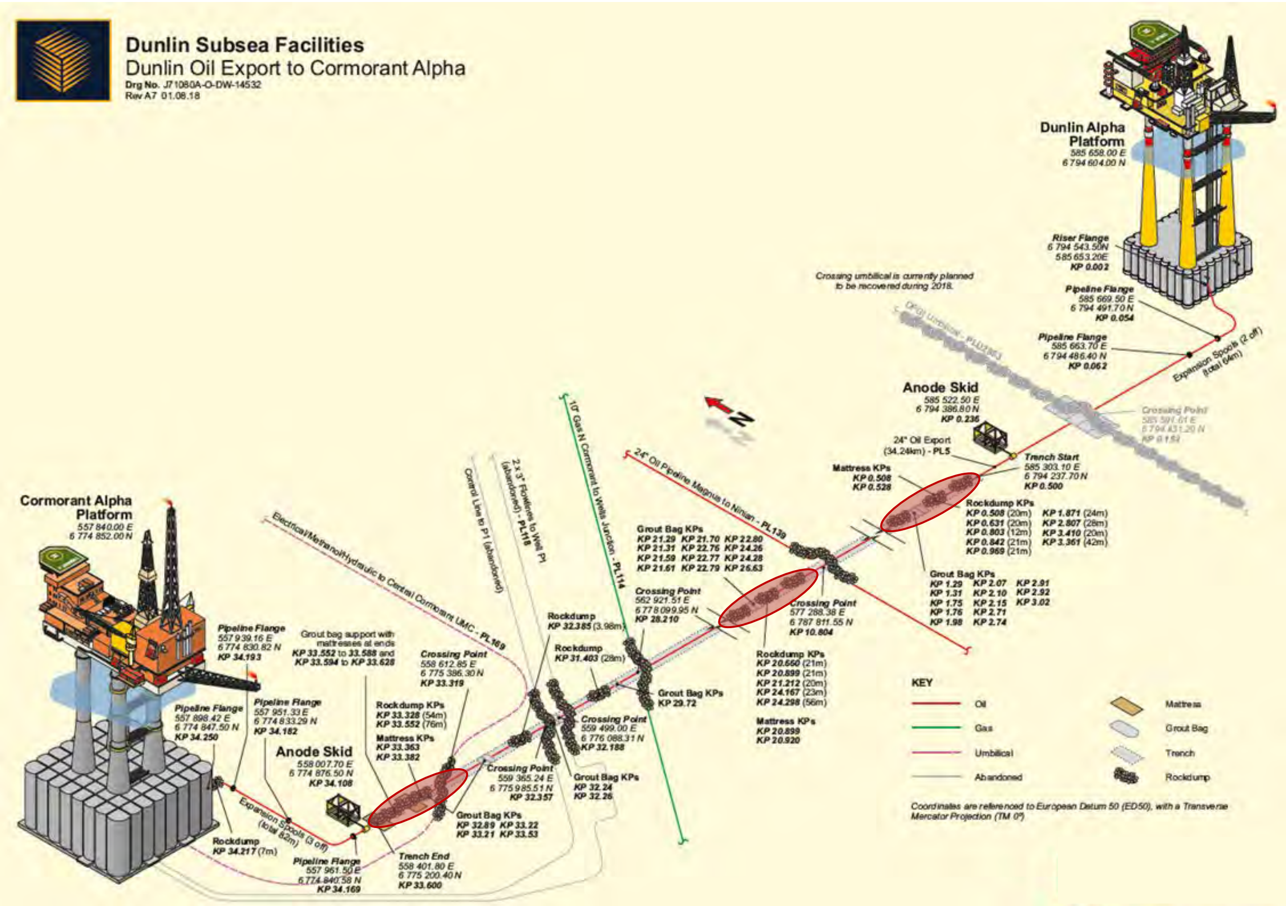


Figure 2.2 Location of partially buried mattresses

Figure 2.3 Typical mattress coverage - 2016 survey footage

To allow access for recovery, the deposits will be uncovered via suction dredging. This dredging will be highly localised and has been assessed within the footprint of the overtrawl activities (see Section 6).

The DSV will then be used to recover the deposits from the seabed. Examples of the typical lifting frames, baskets and mechanical grabs are given in the following Figure 2.4.

Figure 2.4 Examples of typical lifting equipment and mechanical grab devices

Once the mattresses have been recovered, remedial rock cover will be used to mitigate any potential snagging hazards. The placement will be carried out by an appropriate vessel and in accordance with industry standards. It will be the responsibility of the contractor to source the necessary rock and execute the onshore preparation works.

Groups 1 and 7 – Structures and Surface Laid Rigid Spools

The two anode skids (Group 1) and the Dunlin Alpha and Cormorant Alpha surface laid spools (Group 7) will be fully removed as part of the decommissioning works. A summary of this infrastructure is provided in Section 2.1.3. Further details on the spool sections to be recovered are provided in Table 2.9.

Description	Length (m)	OD (m)
Dunlin Alpha - Drop Down Spool	55.8	0.6096
Dunlin Alpha - Closing Spool	8.7	0.6096
Cormorant Alpha - Drop Down Spools	69	0.6096
Cormorant Alpha - Closing Spools	13	0.6096

Table 2.9 Description of recovered surface laid spools

The decommissioning methodology consists of mobilising a Construction Support Vessel (CSV) or DSV to firstly disconnect the structures from the pipeline and then use the on-board rigging equipment to lift the items off the seabed. Similar equipment to that shown in Figure 2.4 can be used for this purpose.

The structures will be returned to shore for final treatment and/or disposal. Recovering these items from the seabed will have an associated environmental impact in terms of seabed disturbance, and is assessed in Section 6.2 of this report.

Removal of the spools will result in drill cuttings disturbance. A separate study (Xodus, 2018c) has been performed to quantify the impact of this disturbance, the impact of which will be considered as part of the impact assessment (see Section 6.2).

Group 8 – Trenched Pipeline

As discussed above, the CA emerging recommendation associated with Group 8 is to decommission the pipeline *in situ* with some minor intervention works. The purpose of these intervention activities is to minimise the potential for snagging hazard post-decommissioning.

After the as-found condition of the pipeline is established, a DSV will be mobilised and used to cut the exposed pipeline ends at both Dunlin Alpha and Cormorant Alpha. The cut locations are estimated as approximately 300 metres from Dunlin Alpha and 650 metres from Cormorant Alpha. The cutting activities will have an inherent impact on the environment in terms of noise assessed later in this report (see Section 5). The cut pipeline section will then be recovered to a barge or pipehaul vessel using either a DSV or pipehaul and transferred to shore for disposal.

The PL5 pipeline location is shown Figure 2.5 with the physical pipeline parameters detailed in Table 2.10.

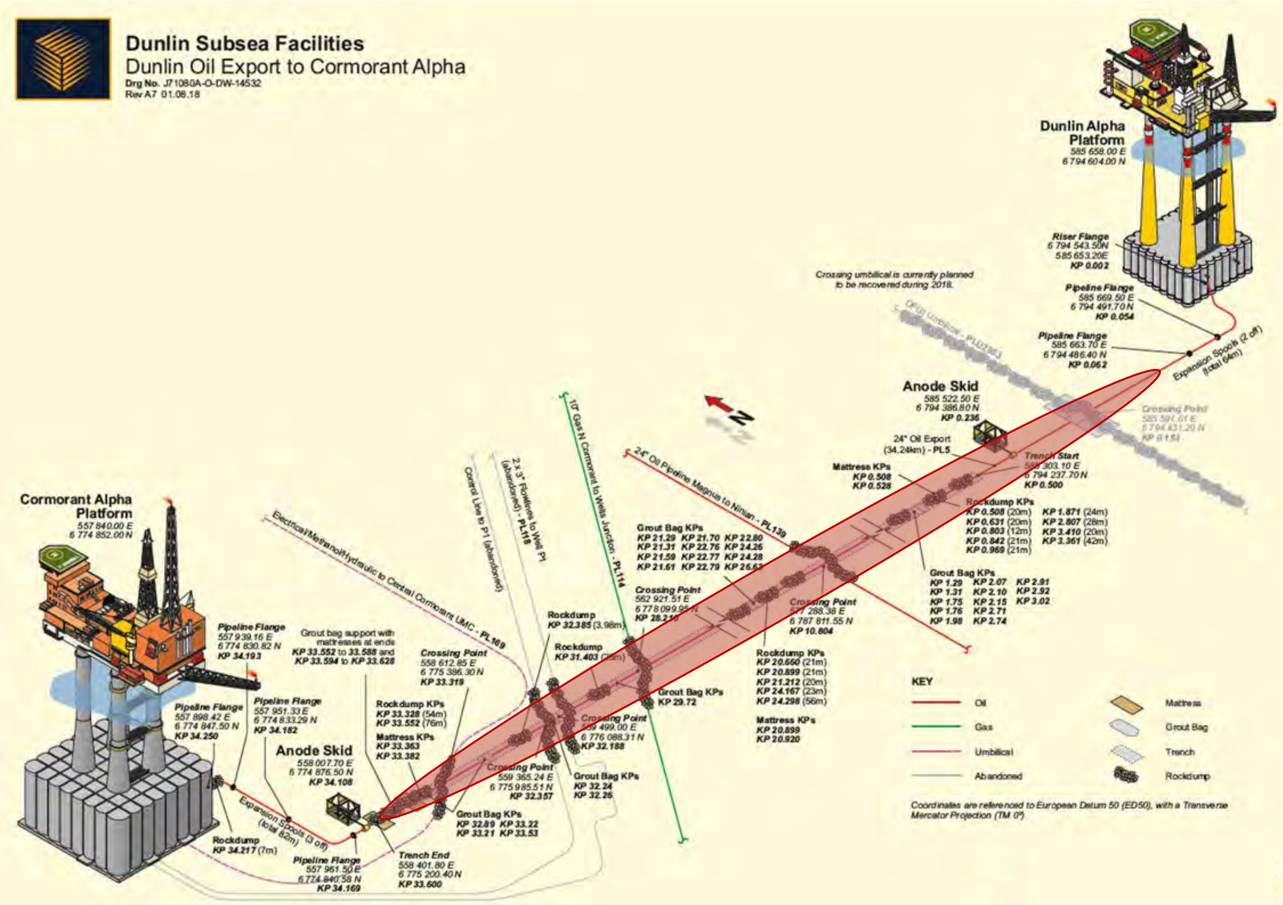


Figure 2.5 **Location of the Dunlin Alpha to Cormorant Alpha pipeline (PL5 pipeline)**

Parameter	Value
Nominal diameter	24-inch
Outer diameter	609.5 mm
Wall thickness	15.9 mm
Length	34.2 km
Weight	0.507 Te/m
Coatings	6.5 mm asphalt coating
	51 mm concrete coating

Table 2.10 **Dunlin Alpha to Cormorant Alpha pipeline (PL5 pipeline) design details**

A depth of burial survey was performed in 2016. The findings of the survey are summarised in Table 2.11 and Appendix B.

Parameter		Dunlin Spools		Pipeline		Cormorant Spools	
		(km)	%	(km)	%	(km)	%
Total length		0.065	100	34.218	100	0.082	100
Trenched 31.724 km							
Burial Height >0.6m ToP		0.000	0	1.131	3	0.005	6
Burial Height >0.3m < 0.6m ToP		0.000	0	4.526	13	0.008	10
Burial Height 0m < 0.3m ToP		0.011	18	12.549	37	0.009	11
Burial Height < 0m ToP Exposed		0.000	0	13.518	40	0.000	0
Un-Trenched 2.494 km							
Surface Laid – Out with pre-cut trench		0.049	82	1.117	3	0.058	73
Section of Pipeline Exposed	Less than 50% of pipeline diameter sits proud above trench	N/A	N/A	1.130	3	N/A	N/A
	50% or more of pipeline diameter sits proud above trench	N/A	N/A	0.115	0.5	N/A	N/A
Pipeline Buried in Rock-Cover		N/A	N/A	0.132	0.5	N/A	N/A

Table 2.11 Dunlin Alpha to Cormorant Alpha pipeline (PL5 pipeline) burial status

2.3.1.2. *Campaign 2 – Rock Placement Campaign*

In order to mitigate against potential snagging hazards, rock cover will be applied at the cut locations of the exposed pipe ends and identified areas of spanning. Rock cover will also be applied to the associated pipeline stabilising features (grout bags) where these continue to serve a purpose in protecting against pipeline movement and spans. In order to assess worst case seabed impact, Fairfield have assumed that rock will be placed to a depth of 0.6 m, where coverage is required. However, following discussions with statutory consultees, a more sensitive approach may be taken to the quantity of rock applied, which in some instances may be lower than 0.6 m depth of coverage from the top of the pipeline. This will avoid smothering of the surrounding environment and take into account the needs of other users of the sea by aiming to match the infilled trench to the level of the seabed in which it is sited and avoiding overspill wherever possible. In total, it is estimated that approximately 17,100 tonnes of rock will be used in addition to the 800 Te deposited as part of Group 2.

Application of rock will be carried out by a suitably qualified contractor who will be tasked with obtaining the required materials and executing any onshore preparations prior to mobilisation. The rock will be sourced from licensed facilities and its application will follow all industry best practice (such as the use of fall pipe for specific positioning). To determine the most appropriate grades and type of rock to be used, liaison will be undertaken with the Scottish Fishermen's Federation. JNCC will also be kept informed of these discussions. Verification of the seabed status will be undertaken following completion of the work to confirm that the profiles of rock cover are suitable for fishing gear.

2.3.1.3. *Campaign 3 – Seabed Clearance Surveys*

Following completion of decommissioning activities, verification that the area is clear of debris and obstruction that could interfere with future fishing operations is required. This is typically demonstrated by undertaking a survey along the pipeline corridor using trawl gear; a trawl sweep. However, the OPRED guidance notes on decommissioning recognise that the use of trawl gear may result in unnecessary environmental impact and that an alternative method to determine seabed clearance may be considered.

In order to consider the worst case environmental impact from the proposed decommissioning activities, Fairfield have assessed the impacts resulting from the use of trawl gear to demonstrate seabed clearance and assumed that a 200m corridor (100m either side of the pipeline) will be disturbed. This impact is assessed in Section 6 of this report. However, it should be noted that Fairfield plan to use geophysical survey methods, including ROV and Side Scan Sonar (SSS), to demonstrate debris clearance and identify potential snag hazards. A seabed clearance assessment will be submitted to OPRED for determining any requirement for further offshore works. Where necessary, overtrawl assessments will be undertaken to verify that no snag hazards exist.

Additionally, the results of the survey will be shared with the regulator and used to form the basis of the future monitoring strategy (see Section 2.4).

2.4. Post-Decommissioning Activities

Fairfield will work closely with the OPRED to determine the most appropriate monitoring programme which will be employed post-decommissioning. An initial, post-decommissioning survey will be undertaken to ascertain the as left status of any infrastructure decommissioned *in situ* and the current seabed state. The subsequent agreed monitoring programme will incorporate a close-out report process and a schedule of proposed monitoring survey requirements. The frequency of further surveys will be agreed with OPRED on a risk-based approach informed by the findings from each successive survey and any trends revealed. The surrounding environmental baseline conditions will be assessed for recovery in two post-decommissioning surveys, one at the end of the decommissioning process and the second at a time to be determined in discussion with the regulator.

2.5. Schedule

A high-level schedule associated with the decommissioning activities is presented in the draft Decommissioning Programme. Please note that this schedule is based on the offshore activities being executed in Q2/3 of 2019 for an estimated duration of 40 days.

3. Environmental and Societal Baseline

This baseline describes the physical, chemical, biological and socio-economic aspects of the receiving environment prior to decommissioning the PL5 pipeline to allow the potential activity/receptor interactions and environmental impacts to be appropriately evaluated.

3.1. Physical Environment

3.1.1. Weather and Sea Conditions

3.1.1.1. *Wind*

Prevailing winds in the project area come from the south and the south-west (Figure 3.1). Wind speeds in winter are typically between 6 – 11 m/s with wind speeds of 8 m/s or more recorded 60-65% of the time in winter and 22-27% of the time in summer. Gales (wind speed exceeding 14 m/s) are recorded over 30% of the time in the project area, however wind strengths of 17 -32 m/s are much less frequent in the area (DECC, 2016). The 1-year maximum wind speed over 1 hour is 31.1 m/s (PhysE, 2012).

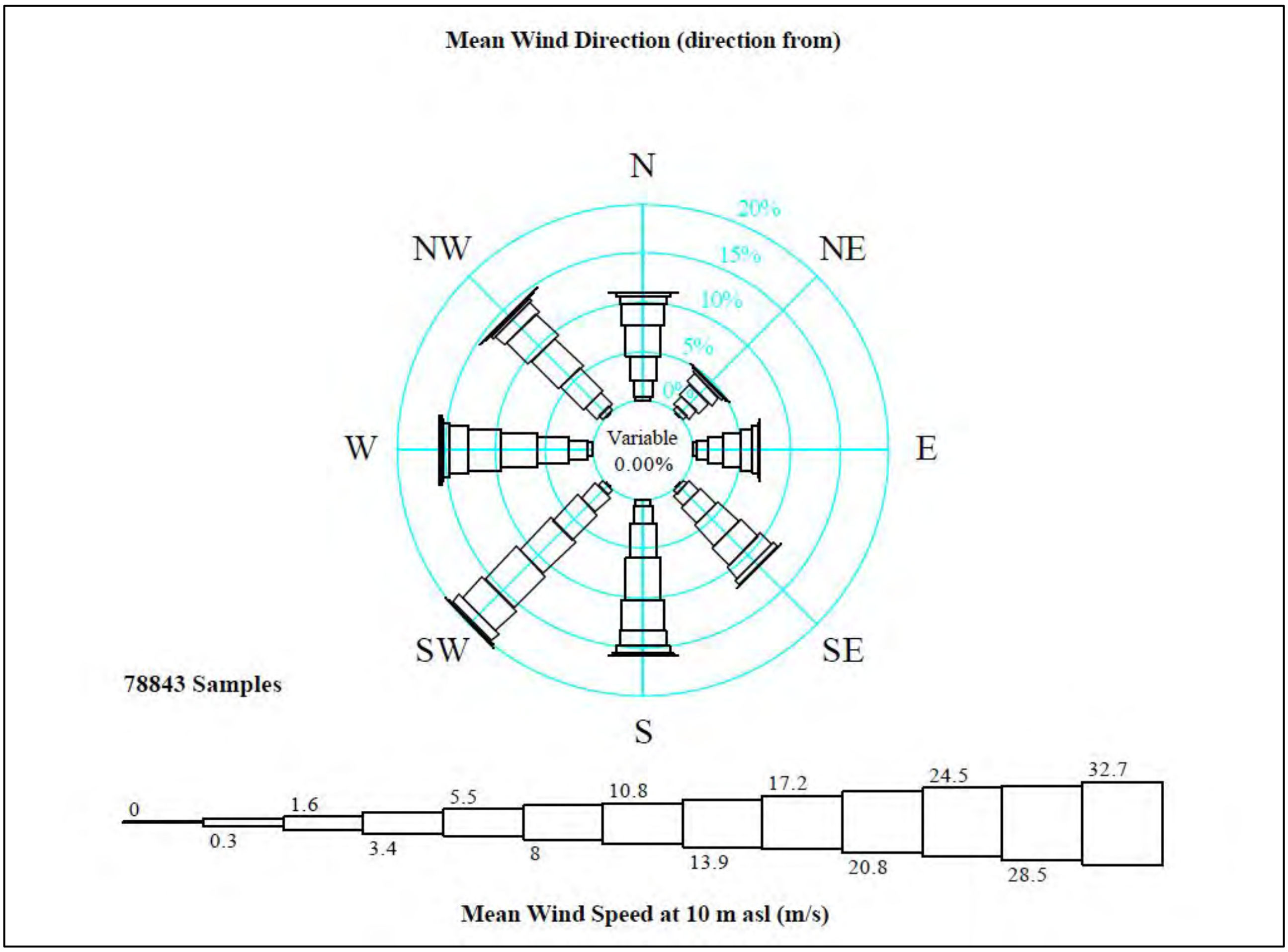


Figure 3.1 Wind rose for project area (Fugro, 2001)

3.1.1.2. *Currents and temperatures*

The mean significant wave height in the project area ranges between 2.71 – 3 m (NMPi, 2018).

Average current velocities in the project area are 0.5 m/s at the surface, decreasing to 0.2 m/s near the seabed (PhysE, 2012), with an average current speed through the water column of 0.46 m/s. The prevailing surface current in the area is in a southerly direction (Scottish Government, 2015).

Distinct density stratification occurs in the northern North Sea in the summer months at a depth of around 50 m and the thermocline becomes increasingly distinct towards deeper water in the north. This stratification breaks down in September as the frequency and severity of storms increases, causing mixing in the water column (DECC, 2016). The annual mean near-bed water temperature is 7.7 °C, and the annual mean surface temperature is 9.6°C (NMPi, 2018).

3.1.2. Bathymetry and Seabed Conditions

3.1.2.1. *Overview*

As part of preparation for the PL5 pipeline decommissioning project, and as part of earlier operation of the Greater Dunlin Area, the following surveys have been undertaken in recent years:

- Surveys at the Dunlin Alpha installation and eastern end of the PL5 pipeline:
    - Dunlin Field Pre-decommissioning Habitat Survey and Environmental Baseline Survey (EBS) (Fugro, 2016a);
    - Fairfield Pre-decommissioning Habitat Survey: Merlin Field and Merlin/Dunlin Tieback (Fugro, 2016b);
    - Fairfield Pre-decommissioning Habitat Survey: Osprey Field and Osprey/Dunlin Tieback (Fugro, 2016c);
    - Fairfield Pre-Decommissioning Habitat Survey: Dunlin A to Brent C Power Import Cable Route (Fugro, 2016d);
    - Merlin Pre-decommissioning Environmental Survey UKCS Blocks 211/23 (Fugro, 2017a);
    - Merlin Pre-decommissioning Cuttings Assessment Survey (Fugro, 2017b);
    - Osprey Pre-decommissioning Environmental Survey UKCS Block 211/23 (Fugro, 2017c);
    - Dunlin Alpha Power Import Cable Route Pre-decommissioning Environmental Survey UKCS Blocks 211/23 to 211/29 (Fugro, 2017d);
    - Dunlin Alpha Fuel Gas Import Pipeline Pre-decommissioning Environmental Survey UKCS Blocks 211/18 to 211/23 (Fugro, 2017e);
    - Fairfield Pre-decommissioning Habitat Survey: Dunlin Fuel Gas Import Pipeline (Fugro, 2016e);
    - Dunlin Alpha Fuel Gas Import Pipeline Pre-decommissioning Environmental Survey UKCS Blocks 211/18 to 211/23 (Fugro, 2017e);
    - Dunlin Fuel Gas Import Route Environmental Baseline Survey (Gardline, 2010e)
    - Dunlin Alpha Pre-decommissioning Environmental Survey UKCS Block 211/23 (Fugro, 2017f);
    - Dunlin Debris Clearance, 'mud mound' and Environmental Baseline Survey (Gardline, 2009a);
    - Osprey Debris Clearance, Habitat Assessment and Environmental Baseline Survey (Gardline, 2009b);
    - Skye to Dunlin Pipeline Route Survey - Survey Report (Gardline, 2010a);
    - Skye to Dunlin Pipeline Route Survey - Environmental Baseline Report (Gardline, 2010b);
    - Skye to Dunlin Pipeline Route Survey Phase 2 – Survey Report (Gardline, 2010c);

  - Skye Phase 2 Site, Habitat Assessment and Environmental Survey - Survey Report (Gardline, 2010d);
  - Skye 'Looksee 3' Site, Habitat Assessment and EBS Phase 2 - Environmental Baseline Report (Gardline, 2010e); and
  - UKCS Quad 211 Infield Environmental Survey - Environmental Baseline Report (Gardline, 2010f);
  - Dunlin Fuel Gas Import Route Environmental Baseline Survey (Gardline, 2010g);
  - Dunlin to NLGP Pipeline Route Survey (Gardline, 2010h);
  - Murchison Pre-decommissioning Environmental Survey (Fugro ERT, 2013).
- Surveys at the Cormorant Alpha installation and western end of PL5 pipeline:
  - Cormorant Alpha Environmental Monitoring Survey UKCS Block 211/26a (Fugro, 2014a);
  - Cormorant Underwater Manifold Centre Environmental Monitoring Survey UKCS Block 211/26a (Fugro, 2014b);
  - North Cormorant Environmental Monitoring Survey UKCS Block 211/26a (Fugro, 2013);
  - UKCS 211/26 Pelican Site and Environmental Survey – Survey Report (Gardline, 2009c);
  - NW Hutton Pre-decommissioning Seabed Survey (Gardline, 2014); and
  - Hutton Field Decommissioning Programme (not a survey report, but includes a summarised account of some survey information) (Kerr McGee, 2001).

The survey reports listed above were reviewed and results were summarised into a report prepared by Xodus Group in 2017 (Xodus Group, 2017). The results showed that the seabed characteristics and associated communities and habitats were fairly consistent and homogeneous across the area covered by the surveys detailed above. These results were discussed with stakeholders and consensus was reached that these data were representative of the wider area and subsequently no further survey data were required to be collected as part of the baseline review. The survey review for PL5 has been used to describe the benthic environment in this section. Due to the relatively good coverage of survey data over the proposed PL5 pipeline area, OPRED has dispensed Fairfield from carrying out further site surveys.

Survey locations are illustrated in Figure 3.2 below.

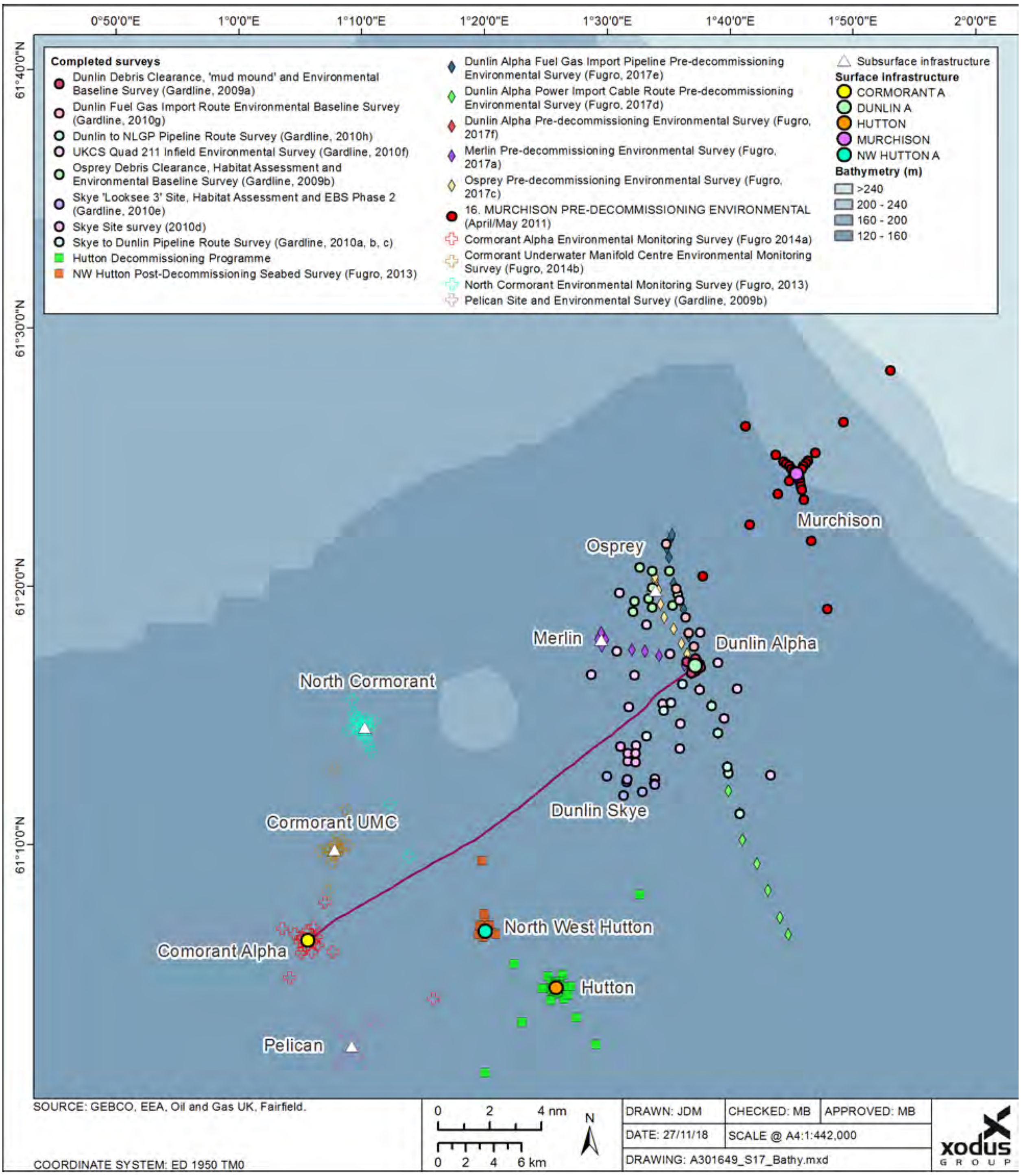


Figure 3.2 PL5 pipeline route and benthic surveys in its vicinity

3.1.2.2. *Bathymetry and Sediment Type*

Dunlin Alpha and Cormorant Alpha platforms and the whole of the PL5 pipeline route in between lie in water depths of approximately 150 m.

In general, the seabed characteristics appear uniform across the area of interest. Sediment types at the eastern end of the pipeline (Dunlin Alpha, Osprey, Merlin, Skye, Murchison) are predominantly fine to medium sand with a silt/clay (i.e. 'mud') content mostly <20%. Sediments are very similar towards the central region of the pipeline at North West Hutton and at the western end of PL5 pipeline at Cormorant Alpha, but appear to become very slightly finer and have a higher mud content. In all survey areas, it is apparent also that the sands contain admixtures of shell gravel and pebbles, typically resulting in them being described as poorly to very poorly sorted. All surveys also record the presence of occasional small boulders.

For the Hutton field, the Decommissioning Programme (Kerr McGee, 2001) reported that the field baseline survey carried out in 1979 found sediments to comprise very fine to fine sand with a silt content of 12–18%. In UK Benthos, there are chemical data available from more recent survey work carried out at Hutton in 2001; this indicates that sediment mud content varies between 10.2-22.5% at stations more than 500 m from the drilling centre. Overall, these figures are very similar to those recorded at Cormorant Underwater Manifold Centre (UMC) and North Cormorant.

According to data on modelled distributions of benthic habitats (UKSeaMap, 2016), the nature of the seabed is very uniform over this whole area of the northern North Sea (Table 3.1). Only two habitat types are predicted to occur in the region:

- European Union Nature Information System (EUNIS) A5.15 Deep circalittoral coarse sediment (UK biotope classification: SS.SCS.OCS Offshore circalittoral coarse sediment). Offshore (deep) circalittoral habitats with coarse sands and gravel or shell. This habitat may cover large areas of the offshore continental shelf although there is relatively little quantitative data available. Such habitats are quite diverse compared to shallower versions of this habitat and generally characterised by robust infaunal polychaete and bivalve species.

- EUNIS - A5.27: Deep circalittoral sand (UK classification: SS.SSa.Osa Offshore circalittoral sand). Offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands. Very little data is available on these habitats however they are likely to be more stable than their shallower counterparts and characterised by a diverse range of polychaetes, amphipods, bivalves and echinoderms.

Of these, it is clear that A5.27 Deep circalittoral sand is predicted to be prevalent over the whole PL5 pipeline route.

Data on the habitats actually observed from the survey reports considered (see Table 3.1) differ slightly from the predictions. However, these differences mainly relate to differences in water depth rather than differences in actual seabed type (there is very little difference in physical terms between A5.26 and A5.27 other than one is circalittoral, and the other is deep circalittoral). Also, surveyor differences inevitably occur in allocating habitat types to fit the data, particularly in offshore areas where the classification lacks detail and it can be difficult to obtain 'a good fit'. Overall, therefore, the biotopes allocated for surveys in the Dunlin area reflect sometimes poorly sorted circalittoral or deep circalittoral fine/medium muddy sand, whereas those in the Cormorant locale at the western of the pipeline route are similar but with a higher mud content (sandy mud, rather than muddy sand).

Parameter	Dunlin Alpha	Osprey	Merlin	Skye	Murchison	Cormorant Alpha	UMC	North Cormorant	Pelican	North West Hutton
Sediment	Fine-med sand	Fine-med sand	Fine sand	Fine sand	Fine-med sand	Fine-med sand	V. fine-fine sand	V. fine-fine sand	Sand	V. fine-fine sand
Silt/clay %	5.85-14%	6.17-14.1%	9.90 -14.4%	15.2-20%	<0.1-8.5%	9.48-19.1%	12.9-16.8%	15.2-31.3%	N/A	11.4-23.4%
Predicted habitat	A5.27	A5.27	A5.27	A5.27	A5.27	A5.27	A5.27	A5.27	A5.27	N/A
Observed habitat	A5.26 or A5.253	A5.26 or A5.253	A5.26 or A5.253	N/A	A5.45	A5.35	N/A	A5.376	N/A	N/A

Table 3.1 Seabed characteristics summarised from survey reports

3.1.2.3. *Sediment Hydrocarbon Content and Metal Content*

An environmental monitoring survey, including sediment contaminants analysis, was conducted around the Cormorant Alpha platform at the western end of the PL5 pipeline in May 2013 (Fugro, 2014a). At the eastern end of the PL5 pipeline, sediment contaminants analysis was conducted in the most recent pre-decommissioning environmental survey at Dunlin Alpha (Fugro, 2017f). Mean total hydrocarbon concentrations (THC) and mean metal concentrations recorded during these surveys are presented in Table 3.2 along with the background concentrations recorded in the northern North Sea.

The THC recorded at Cormorant Alpha in the surface of sediments ranged between 2.6 µg/g – 354 µg/g with a mean value of 21.6 µg/g. Station COR4 (the closest to the well centre, i.e. 110 m) recorded a value of 354 µg/g which increased the mean survey value above the background level of 8.13 µg/g for the North Sea (United Kingdom Offshore Operators Association (UKOOA), 2001), whilst 17 out of 21 stations recorded THC below the background value for the North Sea. Elevated levels of metals including barium, copper, manganese, lead and zinc were also recorded at station COR4, indicating an input of drilling-related discharges at this site. Total barium concentrations in the sediments ranged from 189 µg/g – 8,550 µg/g, with a mean of 1,400 µg/g. Only six out of 26 stations showed total barium concentrations below the background level for the North Sea, 327.84 µg/g (UKOOA, 2001). The stations located closest to the Cormorant Alpha platform (within 500 m) showed considerably higher concentrations in total barium than those located beyond 500 m. The high levels of total barium concentrations recorded at a number of stations were linked to the deposition of barites (used as weighing agents in drilling muds) on the seabed. Increased concentrations of other metals were recorded where sediment barium content was elevated, including arsenic, cadmium, copper, lead, strontium and vanadium. Barites often contain significant quantities of other trace metals therefore these metals could be associated with drilling muds (Fugro, 2014a).

THC recorded in the samples collected from around the Dunlin Alpha platform were highly variable. The highest THC were recorded at station DFC04, DFC05 and DFC10 (located between 250 m to 500 m south-east of the platform) where it ranged between 73.8 µg/g – 317 µg/g, which is above the background level of 8.13 µg/g for the North Sea. Lower THC values were recorded at the remaining stations, although they remained slightly elevated compared to the background North Sea level (they ranged between 13.8 µg/g – 30.9 µg/g at these stations). Metal concentrations in sediments were elevated at stations DFC04, DFC05 and DFC10, with particularly high barium concentrations at DFC05 and DFC10 (10,600 µg/g and 10,900 µg/g respectively) which indicated the high quantities of drilling mud at these stations.

Location	Reference	THC	Al	As	TBa	Cd	Cr	Cu	Fe	Hg	Li	Ni	Pb	Zn
Unit		µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Dunlin Alpha Platform	Fugro, 2017f	62.6	19,000	3.16	3,330	0.083	18	17.3	8,095	0.016	7.61	6.87	20.3	97.1
Cormorant Alpha Platform	Fugro, 2014a	21.6	2,660	4.20	1,400	0.09	11.6	12.7	5,930	0.06	13.3	6.11	14.8	125
Background concentrations for the northern North Sea														
UKOOA, 2001	mean (µg/g)	10.82	-	-	332.38	0.23	-	2.37	4,532.03	0.04	-	4.06	5.54	11.69
OSPAR, 2005	mean (µg/g)	-	-	15	-	0.2	60	20	-	0.05	-	30	-	90
	ND - values below detection limits; Blank - no data													

Table 3.2 Mean concentrations of total hydrocarbons and metals in sediments at each end of the PL5 pipeline

3.2. Biological Environment

3.2.1. Plankton

Planktonic assemblages exist in large water bodies and are transported simultaneously with tides and currents as they flow around the North Sea. Plankton forms the basis of marine ecosystem food webs and therefore directly influences the movement and distribution of other marine species.

In both the northern and central areas of the North Sea, the phytoplankton community is dominated by dinoflagellates of the genus *Ceratium* (*fusus, furca, lineatum*) and diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. In recent years the dinoflagellate *Alexandrium tamarense* and the diatom *Pseudo-nitzschia* (known to cause amnesic shellfish poisoning) has been observed in the area (DECC, 2016). Densities of phytoplankton fluctuate during the year, with sunlight intensity and nutrient availability driving its abundance and productivity together with water column stratification (Johns & Reid, 2001; DECC, 2016). In the 10-year period between 1997 and 2007, two main blooms were seen to occur in the northern North Sea: one in May, and a second in August before levels decrease through the winter months when light and temperature are less abundant (Sir Alister Hardy Foundation for Ocean Science (SAHFOS), 2015).

Zooplankton species richness is greater in the northern and central areas of the North Sea, than in the south and displays greater seasonality. Zooplankton in this area is dominated by calanoid copepods, in particular *Calanus* spp., *Eupahsusiid* spp., *Acartia*, and decapod larvae are also important to the zooplankton community in this region (DECC, 2016).

Calanus finmarchicus has historically dominated the zooplankton of the North Sea and is used as an indication of zooplankton abundance. Analysis of data provided by the Continuous Plankton Reader (CPR) surveys in the 10-year period between 1997 and 2007 shows a sharper spring increase in *C. finmarchicus* biomass in May in the northern North Sea compared to more southerly areas. This peak in numbers is 70% greater than seen in the central North Sea and 88% greater than the southern North Sea over the same period (SAHFOS, 2015). The increase is likely a reflection of the increased availability of nutrients and food (including phytoplankton) in spring. Overall abundance of *C. finmarchicus* has declined dramatically over the last 60 years, which has been attributed to changes in seawater temperature and salinity (Beare et al., 2002; FRS, 2004). *C. finmarchicus* has largely been replaced by boreal and temperate Atlantic and neritic (coastal water) species in particular, and a relative increase in the populations of *C. helgolandicus* has occurred (DECC, 2009; Edwards et al., 2010; Baxter et al., 2011).

3.2.2. Benthos

All survey reports generally commented on the uniformity of the infauna, both in quantitative statistical terms (calculated diversity and evenness indices were consistently moderate to high) and in qualitative terms (the species present, particularly the most abundant species with which infaunal datasets are characterised). In addition, the macrobenthos in each survey was invariably described as being similar to information described for this part of the northern North Sea in published academic papers (in particular Kunitzer *et al*., 1992; and Eleftheriou and Basford, 1989).

In broad terms, the infauna present as characterised by the most abundant species present appears very similar in all surveys at both ends of the PL5 pipeline route and also around both Hutton and North West Hutton sited to the south of the central section of PL5 pipeline. Species consistently appearing in the lists of most abundant taxa centre around the polychaetes, *Galathowenia oculata, Euchone incolor, Aonides paucibranchiata, Paradoneis lyra,* and the bivalve molluscs *Adontorhina similis* and *Axinulus croulinensis.* Interestingly, allocating the EUNIS biotope code A5.253 'Medium to very fine sand, 100-120 m, with polychaetes *Spiophanes kroyeri, Pectinaria (Amphictene) auricoma, Myriochele* sp.*, Aricidea wassi* and amphipods *Harpinia antennaria'* to the Dunlin Area surveys (Dunlin Alpha, Merlin, Osprey) (Fugro, 2016a to

2016d; Fugro 2017a to 2017f; Gardline, 2009a to 2009c; Gardline 2010a, 2010b, 2010c, 2010g, 2010h) illustrates the difficulties already highlighted. It can be seen that there appears to be little relationship between the main species found, and those named in the biotope title; however, other factors including habitat characteristics may have been given more prominence in this allocation. This is the reason that most offshore biotopes are identified to a higher level, where it is just the physical habitat characteristics that are considered and not the associated infauna.

The epifauna present in all areas is generally noted as sparse (in direct contrast to infaunal species) and typically features mobile species that have wide distributions throughout the North Sea. These include, for example, hermit crabs (usually *Pagurus* spp.), various starfish including *Asterias rubens*, *Porania pulvillus,* and *Luidia sarsi,* and sea urchins such as *Echinus acutus.* Other epifaunal taxa often depend on the presence of stones, boulders or other hard material, either to attach to (in the case of sessile forms such as some anemones, the polychaete *Spirobranchus* spp. and the Devonshire cup coral) or to use as cover (in the case of mobile species such as squat lobsters). Overall, there is little to distinguish between survey areas in terms of the epifauna recorded.

Data available in the National Biodiversity Network (NBN) Atlas and from the Marine Environmental Data and Information Network (Defra, 2010) illustrate that the species ocean quahog (*Arctica islandica*), listed as Priority Marine Feature (PMF) in Scottish waters and on the OSPAR (2008) List of Threatened and/or Declining Species and Habitats, is likely to occur in and around the PL5 pipeline route. The presence of this species is also confirmed in most of the survey datasets considered in this report. All occurrences of *Arctica islandica* in these records tend to be of small juvenile specimens in low numbers. However, ocean quahog is relatively well distributed in the North Sea (OSPAR, 2009a), and the project area is thus not a particularly important area for ocean quahog.

As a burrowing species that can switch between suspension and surface deposit feeding, the ocean quahog is thought to preferentially engage in suspension feeding, remain buried in the sediment with its inhalant and exhalant siphons exposed. It periodically buries itself further in the sediment, respiring anaerobically often for one to seven days (although the longest record is 24 days) before returning to the surface and can live for hundreds of years (Tyler-Walters and Sabatini, 2008).

3.2.3. Fish and Shellfish

DECC (2016) report that species diversity within the fish community is not as great in the central and northern North Sea as in the southern North Sea. DECC (2016) also report that the fish community between 100 and 200 m (i.e. within the depth bounds of the project area) is characterised by long rough dab (*Hippoglossoides platessoides*), hagfish (*Myxine glutinosa*) and Norway pout (*Trisopterus esmarkii*). Basking shark (*Cetorhinus maximus*), tope (*Galeorhinus galeus*) and porbeagle (*Lamna nasus*) are all also likely to occur in small numbers throughout the North Sea, and the common skate (*Dipturus batis*) occurs at low density throughout the northern North Sea. However, these species are considered to be rare in the waters surrounding the project area (DECC, 2016).

The fish populations in the project area are characterised by species typical of the northern North Sea. There are a number of spawning and nursery regions for commercially important fish and shellfish species that occur in the vicinity of the project area (Coull *et al*., 1998, Ellis *et al*., 2012). The project area is located within the spawning grounds of haddock (*Melanogrammus aeglefinus*), saithe (*Pollachius virens*), Norway pout , cod (*Gadus morhua*) and whiting (*Merlangius merlangus*) and the nursery grounds of anglerfish (*Lophiiformes*), cod , haddock, hake (*Merluccius merluccius*), horse mackerel (*Trachurus trachurus*), plaice (*Pleuronectes platessa*), sandeel (*Ammodytes tobianus*), saithe, sprat (*Sprattus sprattus*), whiting, Norway pout, mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*), spurdog (*Squalus acanthias*), herring (*Clupea* *harengus*) and ling (*Molva molva*). Information on spawning and nursery seasonality for the different species is detailed in Table 3.3 and the extent of the areas is illustrated in Figure 3.3, Figure 3.4 and Figure 3.5.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	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	S	S	S	S								
Haddock	N	SN	SN	SN	SN	N	N	N	N	N	N	N
Hake	N	N	N	N	N	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Horse Mackerel	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
Norway pout	SN	SN	SN	SN	N	N	N	N	N	N	N	N
Plaice	N	N	N	N	N	N	N	N	N	N	N	N
Sandeel	N	N	N	N	N	N	N	N	N	N	N	N
Saithe	S	S	S	S								
Sprat	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting		SN	SN	SN	SN	SN						
Key			S = Peak spawning			S = Spawning			N = Nursery			

Table 3.3 Fish spawning and nursery periods in the project area (Coull *et al*., 1998, Ellis *et al*., 2012)

Fisheries sensitivity maps produced by Aires *et al*. (2014), indicate that there is a low probability of aggregations of Group 0 fish (fish in their first year of life) occurring in the project area for all species investigated (Figure 3.4 and Figure 3.5).

The pre-decommissioning habitat assessment survey of the Dunlin field recorded ling, redfish (*Sebastes* sp.), unidentified cod-like fish (*Gadiformes* sp.), saithe and haddock (Fugro, 2016a).

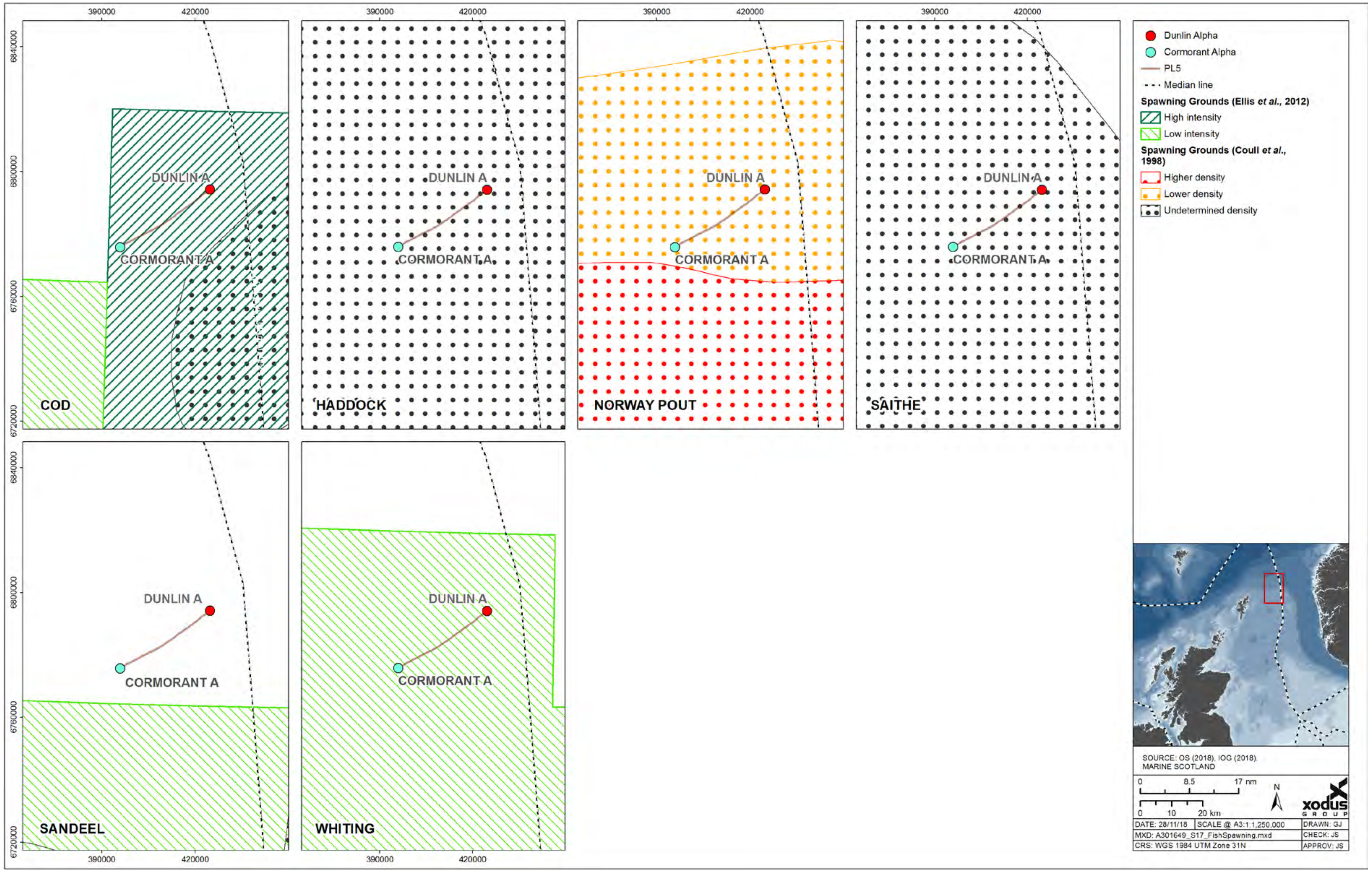


Figure 3.3 Fish spawning grounds around the project area (Coull *et al.*, 1998, Ellis *et al.*, 2012)

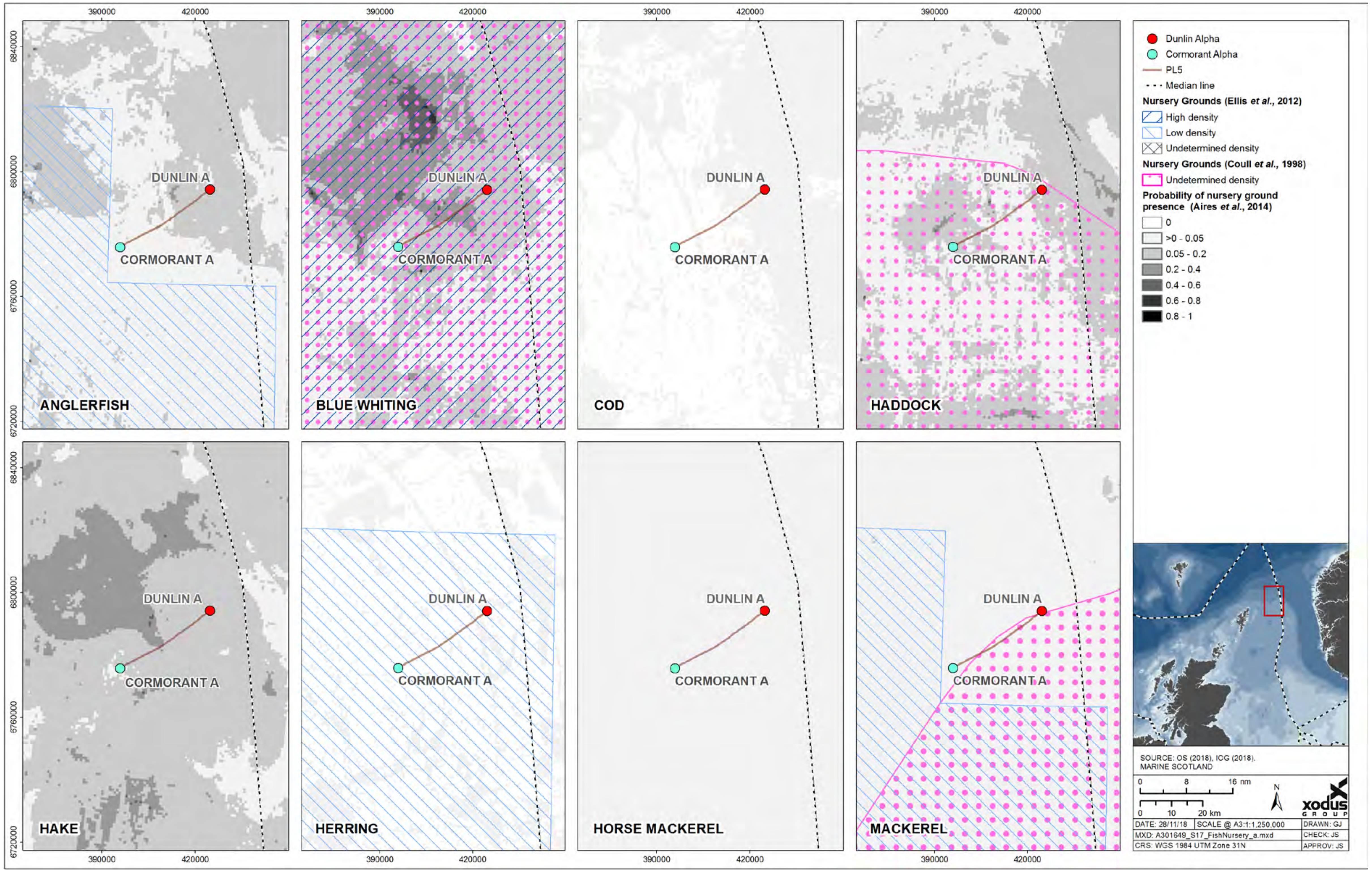


Figure 3.4 Nursery grounds for anglerfish, blue whiting, cod, haddock, hake, herring, horse mackerel and mackerel around the project area (Coull *et al*., 1998, Ellis *et al*., 2012)

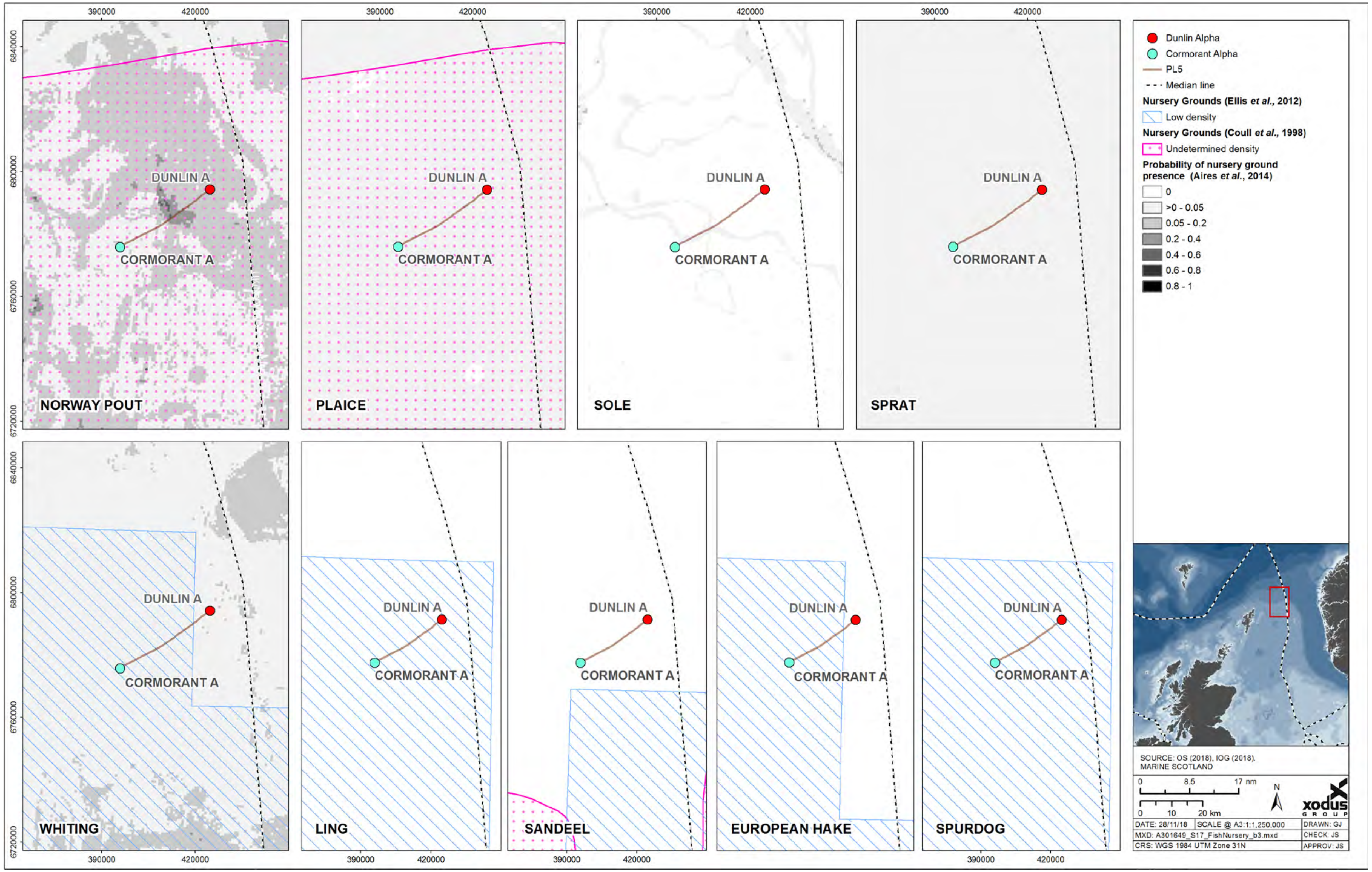


Figure 3.5 Nursery grounds for Norway pout, plaice, sole, sprat, whiting, ling, sandeel, hake and spurdog around the project area (Coull *et al*., 1998, Ellis *et al*., 2012)

3.2.4. Seabirds

The project area is important for northern fulmar (*Fulmarus glacialis*), northern gannet (*Morus bassanus*), great black-backed gull (*Larus marinus*), Atlantic puffin (*Fratercula arctica*), black-legged kittiwake (*Rissa tridactyla*), and common guillemot (*Uria aalge*) for the majority of the year (DECC, 2016). Manx shearwaters (*Puffinus puffinus*) are present in the vicinity of the project area between spring and autumn months. European storm petrels (*Hydrobates pelagicus*) are present during September and November. Great skua (*Stercorarius skua*), glaucous gull (*Larus hyperboreus*), Arctic skua (*Stercorarius parasiticus*) and little auk (*Alle alle*) are generally present in the northern North Sea in low densities for the majority of the year.

The seasonal sensitivity of seabirds to oil pollution in the immediate vicinity of the project area has been derived from the Joint Nature Conservation Committee (JNCC) Seabird Oil Sensitivity Index (SOSI) (Webb *et al.*, 2016), and is presented in Table 3.4, Figure 3.6 and Figure 3.7. At the eastern end of the PL5 pipeline, in Block 211/23, the SOSI is low between February and October, however there is no data for the month of May in Block 211/23 and surrounding blocks. Between November and January, the SOSI is high.

In Block 211/26 at the western end of PL5 pipeline, the SOSI is low year-round. The blocks directly adjacent to the east of Block 211/26, which PL5 pipeline crosses, show a medium vulnerability of seabirds to oil pollution.

Quad / Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
211/17	3*	5	5	5*	N	5*	5	5	N	N	3*	3
211/18	3*	5	5	5*	N	5*	5	5	5*	N	3*	3
211/19	3*	5	5	5*	N	5*	5	5*	N	N	3*	3
211/22	5	5	5	5*	N	5*	5	5	4	4*	4*	4
211/23	3*	5	5	5*	N	5*	5	5	5	5*	3*	3
211/24	5	5	5	5*	N	5*	5	5	5	5*	3*	3
211/27	5	5	5	5*	N	5	5	5	4	4*	5*	5
211/28	5	5	5	5*	N	5*	5	5	4	4*	5*	5
211/29	5	5	5	5*	N	5*	5	5	5	5*	5*	5
210/25	5	5	5	5*	N	5*	5	5	5	5*	5*	5
211/21	5	5	5	5*	N	5*	5	5	5	5*	5*	5
210/30	5	5	5	5*	5*	5	5	5	5	5*	5*	5
211/26	5	5	5	5*	5*	5	5	5	5	5*	5*	5
2/5	5	5	5	5*	5*	5	5	5	5	5*	5*	5
3/1	5	5	5	5*	5*	5	5	5	5	5*	5*	5
3/2	5	5	5	5*	5*	5	5	5	4	4*	5*	5
Key	1 = Extremely high	2 = Very high		3 = High		4 = Medium		5 = Low		N = No data		
* in light of coverage gaps, an indirect assessment of SOSI has been made												

Table 3.4 Seabird sensitivity to oil pollution in the project area (Webb *et al.*, 2016)

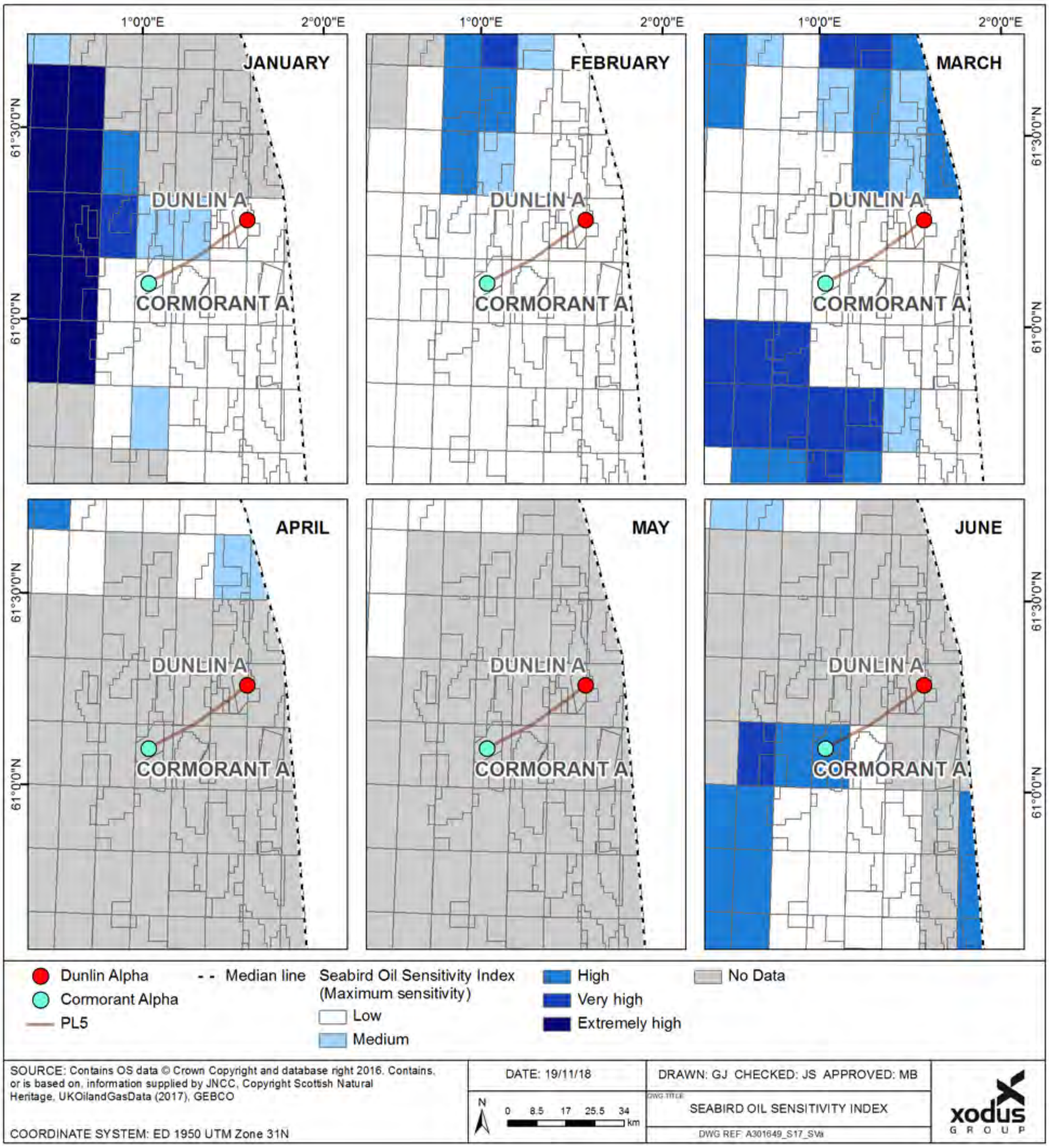


Figure 3.6 Seabird vulnerability within the vicinity of the project area (Webb *et al*., 2016)

Figure 3.7 Seabird vulnerability within the vicinity of the project area (Webb *et al*., 2016)

3.2.5. Cetaceans

Twenty-eight cetacean species have been recorded in UK waters from sightings and strandings. Of these, eleven species are known to occur regularly, while seventeen are considered rare or vagrant (DECC, 2016). Cetaceans regularly recorded in the North Sea include white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus)* (primarily in inshore waters), harbour porpoise (*Phocoena phocoena*), killer whale (*Orcinus orca*), minke whale (*Balaenoptera acutorostrata*), pilot whale (*Globicephala melas*), common dolphin (*Delphinus delphis*) and white-beaked dolphin (*Lagenorhynchus albirostris*) (Reid *et al.*, 2003). Risso's dolphin (*Grampus griseus*) and some large baleen whales are also occasionally sighted. Spatially and temporally, harbour porpoise, white-beaked dolphins, minke whales, killer whales and Atlantic white-sided dolphins are the most regularly sighted cetacean species in the North Sea (Hammond *et al*., 2001, Reid *et al*., 2003). The bottlenose dolphin is generally coastal in extent and thus is unlikely to be sighted in the vicinity of the project area with any regularity.

Occurrence of the most frequently recorded species is detailed in Table 3.5; the project area is not considered to be particularly important for any cetacean species.

Species	Description of occurrence
Harbour porpoise	Harbour porpoise are frequently found throughout the UK waters. They usually occur in groups of one to three individuals in shallow waters, although they have been sighted in larger groups and in deep water. It is not thought that the species migrate.
Killer whale	Widely distributed with sightings across the North Sea all year round; seen in both inshore waters (April to October) and the deeper continental shelf waters (November to March). May move inshore to target seals seasonally.
Minke whale	Minke whales usually occur in water depths of 200 m or less and occur throughout the northern and central North Sea. They are usually sighted in pairs or in solitude; however, groups of up to 15 individuals can be sighted feeding. It appears that animals return to the same seasonal feeding grounds.
Atlantic white-sided dolphin	White-sided dolphins show both season and inter-annual variability. They have been sighted in large groups of 10 - 100 individuals. They have been sighted in waters ranging from 100 m to very deep waters, but also enter continental shelf waters. They can be sighted in the deep waters around the north of Scotland throughout the year and enter the North Sea in search of food.
White-beaked dolphin	White-beaked dolphins are usually found in water depths of between 50 and 100 m in groups of around 10 individuals, although large groups of up to 500 animals have been seen. They are present in the UK waters throughout the year, however more sightings have been made between June and October.

Table 3.5 Occurrence of cetaceans likely to be most regularly observed in the project area (Hammond *et al*., 2001, Reid *et al*., 2003, Hammond *et al*., 2017)

3.2.6. Seals

Grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals will feed both in inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and yearly. Both species tend to be concentrated close to shore, particularly during the pupping and moulting season. Seal tracking studies from the Moray Firth have indicated that the foraging movements of harbour seals are generally restricted to within a 40 – 50 km range of their haul-out sites (Special Committee on Seals (SCOS), 2014). The movements of grey seals can involve larger distances than those of the harbour seal, and trips of several hundred km from one haul-out to another have been recorded (Sea Mammal Research Unit (SMRU), 2011). As the project area is located approximately 104 km offshore, these species may be encountered in the vicinity from time to time, but the project area is not of specific importance for these species. This is confirmed by the latest grey and harbour seal density maps commissioned by the Scottish Government which report the presence of grey and harbour seals in the project area as between 0 – 1 individual per 25 km^2 (Russell *et al*., 2017).

3.2.7. Conservation Areas

There are no designated or proposed sites of conservation interest in the project area. The closest designated marine protected area (MPA) network is the Pobie Bank Reef Special Area of Conservation (SAC), which lies 64 km to the south west of PL5 pipeline, off the east coast of Shetland (Figure 3.8). The site has been designated for its stony and bedrock rocky reefs (JNCC, 2013a). The closest Special Protection Area (SPA) is the Hermaness, Saxa Vord and Valla Field SPA which lies 104 km south west of the PL5 pipeline. The site is designated for supporting breeding populations of northern gannet, great skua and Atlantic puffin.

JNCC and the Scottish Natural Heritage (SNH) have put forward areas with PMF for designation as MPAs under the Marine (Scotland) Act (2010). The closest MPA to the project area is the Fetlar to Haroldswick Nature Conservation MPA (NCMPA). The site is approximately 106 km from the project area. The site is designated for a range of high energy habitats and species including horse mussel beds, kelp and seaweed communities and maerl beds (SNH, 2017). Details of the conservation sites in the vicinity of the project area are given in Figure 3.8.

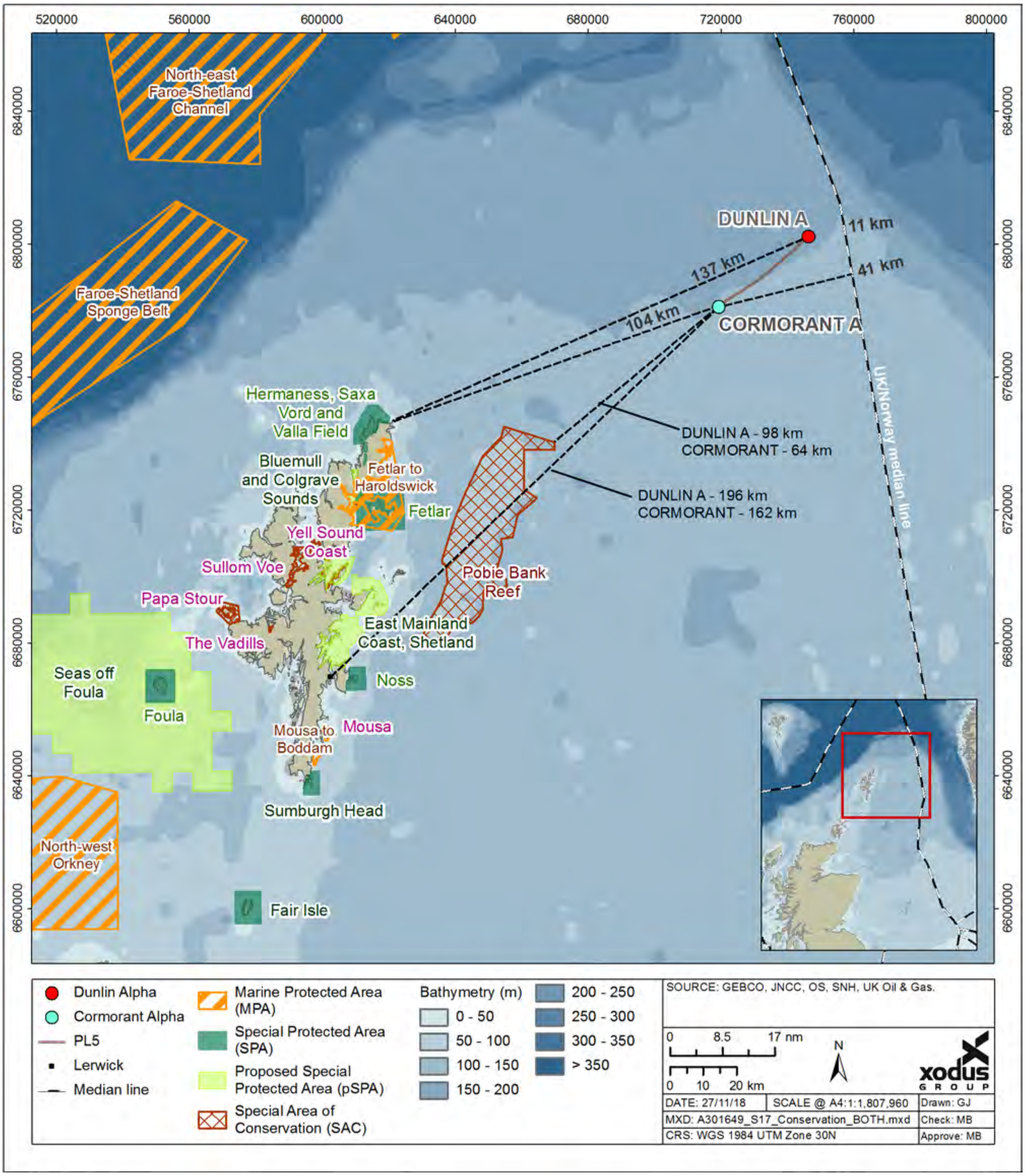


Figure 3.8 Sites of conservation importance

Description	Distance to project area (km)
Pobie Bank SAC	
Reefs are the primary reason for selection of this site. The stony and bedrock reefs of the site provide a habitat to an extensive community of encrusting and robust sponges and bryozoans and in the shallowest areas the bedrock and boulders also support encrusting coralline algae (JNCC, 2013a).	64
Hermaness, Saxa Vord and Valla Field SPA	
This site supports: • A population of European importance of the Annex I species red throated diver (*Gavia stellata*) during the breeding season; • Populations of European importance of the following migratory species during the breeding season: northern gannet, great skua and Atlantic puffin; and • At least 20,000 seabirds. During the breeding season, the area regularly supports 152,000 individual seabirds including common guillemot, black-legged kittiwake, European shag (*Phalacrocorax aristotelis*), northern fulmar, Atlantic puffin, great skua and northern gannet (JNCC, 2005a).	104
North East Faroe Shetland Channel NCMPA	
This is the largest designated MPA in Europe and the protected features are deep sea sponge aggregations, offshore deep-sea muds, offshore subtidal sands and gravel, continental slope and a wide range of features from the West Shetland Margin Palaeo-depositional, Miller Slide and Pilot Whale Diapirs that are considered to be ‘Key Geodiversity Areas’ (JNCC, 2017a).	114
Faroe-Shetland Sponge Belt NCMPA	
The protected features of this NCMPA are deep sea sponge aggregations, offshore subtidal sands and gravels, ocean quahog aggregations, continental slope, continental slope channels, iceberg plough marks, prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity Area and Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area (JNCC, 2016).	143
Fetlar to Haroldswick NCMPA	
This MPA supports a range of high energy habitats and species including horse mussel beds, kelp and seaweed communities and maerl beds. It encompasses over 200 km2 of important black guillemot (*Cepphus grylle*) feeding grounds. The protected features of the site are black guillemot, circalittoral sand and coarse sediment communities; horse mussel beds, kelp and seaweed communities on sublittoral sediment, maerl beds, shallow tide-swept coarse sands with burrowing bivalves and marine geomorphology of the Scottish shelf seabed (SNH, 2016).	106
Fetlar SPA	
The SPA comprises a range of habitats including species-rich heathland, marshes and lochans, cliffs and rocky shores. The principal areas of importance for birds are the northernmost part of the island and the south-western peninsula of Lamb Hoga. This site supports: • During the breeding season, a population of European importance of Arctic tern (*Sterna paradisaea*) and red-necked phalarope *(Phalaropus lobatus)*; • Populations of European importance of the following migratory species during the breeding season: dunlin (*Calidris alpina schinzii*), great skua and whimbrel (*Numenius phaeopus*); and • At least 20,000 seabirds. During the breeding season, the area regularly supports 22,000 individual seabirds including Arctic skua, northern fulmar, great skua, Arctic tern and red-necked phalarope (JNCC, 2005b).	109

Table 3.6 Conservation sites in the vicinity of the project area

The feature of conservation importance (FOCI) 'Sea-pens and burrowing megafauna' has been recorded approximately 104 km to the south-east of the project area (NMPi, 2018). Note that none of the Habitat Assessment reports have confirmed the presence of 'burrowed mud' habitat (which would include 'sea-pens and burrowing megafauna); rather, the potential presence of a burrowed mud habitat has been denied on the basis of the photographic evidence. Collectively, the data indicate that two species of sea-pen (*Pennatula phosphorea* and *Virgularia mirabilis*) are at least present in the area, and also that close inspection of the seabed shows the presence of burrows and mounds – indicative of burrowing megafauna. Stakeholders have in the past disputed assessments (in Environmental Impact Assessments carried out for various operators across the UKCS) that deny the presence of this type of feature with insufficient or flawed reasoning. Whilst it is possible that further survey work over the pipeline route might help clarify the presence or absence of this feature one way or the other, it is a situation where the law of diminishing returns applies, and such effort may be difficult to justify and could still be inconclusive.

The species ocean quahog, listed as PMF in Scottish waters and on the OSPAR (2008) List of threatened and declining habitats and species, is likely to occur in and around the PL5 pipeline route. Its presence has been confirmed in most of the survey datasets considered in this report. All occurrences of *Arctica islandica* in these records tend to be of small juvenile specimens in low numbers. However, it is relatively well distributed in the North Sea (OSPAR, 2009a), and the project area is not considered a particularly important area for ocean quahog.

European Protected Species (EPS) are a group of animals and plants protected by law throughout the EU by virtue of being listed in Annexes II and IV of the Habitats Directive 92/43/EEC. Cetaceans are the EPS most likely to be recorded in the region, even if only in low numbers. The European sturgeon (*Acipenser sturio*) and leatherback turtle (*Dermochelys coriacea*) are also classed as EPS and occur in UK waters, although the project area is located at the furthest extent of their ranges and their occurrence in any numbers is unlikely.

The European Union meets its obligations for the conservation of bird species under the Bern Convention and the Bonn Convention, by means of the Directive 2009/147/EC (Birds Directive). It provides a framework for the conservation of wild birds in Europe, and includes provisions for the identification of SPAs for rare and vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species, with particular attention to the protection of wetlands of international importance. Several species of seabird are known to use the project area, however, sensitivity is low to medium as discussed in Section 3.2.4.

Annex II species are protected under the EU Habitats Directive, which mandates that core areas of habitat these species rely upon must be protected under the Natura 2000 Network. The only species listed on Annex II of the European Commission (EC) Habitats Directive that is likely to occur in the vicinity of the project area with any regularity is the harbour porpoise. The harbour porpoise is the most common cetacean in UK waters, being widely distributed and abundant throughout the majority of UK shelf seas, both inshore and offshore. Due to the species' wide geographical distribution and the lack of knowledge with regards to their feeding and breeding habitats, there has been difficulty in selecting sites essential for their life and reproduction, as required under the Directive. Although potential calving grounds have been identified in the German North Sea (Sonntag *et al*., 1999) no such areas are currently recognised in UK waters; a number of sites have been designated as possible SACs for presence of harbour porpoise but none of these sites are located within the northern North Sea. Grey and harbour seals are also Annex II species but due to the distance from shore they are unlikely to be present in any significant numbers in the area.

Basking shark and spurdog are classed as vulnerable and the blue shark (*Prionace glauca*) as near threatened under the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. These three species may be encountered in the project area, however the area is not of specific importance for any of these species. In addition, basking sharks are protected under the Wildlife and Countryside Act 1981 (as amended).

3.3. Socio-Economic Environment

3.3.1. Commercial Fisheries

Fishing intensity in the project area is low (at the pipeline ends) to moderate (in the middle section of the pipeline) in comparison to other areas in the North Sea. This section describes the type of fishing vessels occurring in the area, the weight and value of fish landed in the UK and the fishing effort.

3.3.1.1. *Baseline Fishing Activity Analysis*

Fairfield commissioned a fisheries risk assessment study which included an analysis of the potential impact of the subsea infrastructure decommissioning options on commercial fisheries (Xodus, 2018b). As part of this study, the baseline fishing activity in the vicinity of the PL5 pipeline area was reviewed. The PL5 pipeline and the wider study area considered relevant for the proposed decommissioning activities, lies within International Council for the Exploration of the Sea (ICES) rectangle[2] 51F1, as shown in Figure 3.9.

A commercial fisheries risk assessment was commissioned to review all nationalities which fish within the vicinity of the PL5 pipeline infrastructure using data from Automatic Identification System (AIS) satellite tracking data (Anatec, 2018). The AIS data from fishing vessels recorded between March 2017 and February 2018 revealed that Norway was the main fleet present in the project area (42% of AIS), followed by the UK (29%), and France (24%), with the remainder being comprised of Germany, Faroes, Ireland, Sweden, the Netherlands and Denmark (Figure 3.9).

Whilst trawl gear use forms the predominant fishing type undertaken by UK vessels across the project area, this comprises mostly of demersal UK gears such as bottom trawls. Pelagic trawl gear is associated with a small number of UK vessels, but its use is more prolific with international vessels. Of the actively fishing national and international vessels, demersal gears contributed 70% of the total fishing activity, with static gear (mainly from Norway) likely targeting Monkfish and other high value demersal fish by means of static nets, contributing 26%, and the remainder of the total active fishing coming from pelagic gears (Anatec, 2018; Figure 3.10, Figure 3.11 and Figure 3.12). Pelagic species are often caught as a bycatch species by the demersal fisheries, thereby contributing to the revenue generated by such vessels. However, pelagic species, such as mackerel targeted by the UK fleet, while high in value, are still relatively low in terms of volume compared to other regions of the UKCS and are not considered the target fisheries within this area for the UK fleet. The landings in the last five years for mackerel are equivalent to only a small number of trips, as an individual pelagic vessel can regularly land 1,000 – 2,000 tonnes of mackerel per trip.

Published AIS data from the UK fishing fleet show that the number of fishing tracks recorded between 2007-2015 within 1 km^2 squares is low at the PL5 pipeline ends and moderate in the middle section of the pipeline, in comparison to other regions of the North Sea (Scottish Government, 2017) (Figure 3.13). Additionally, across the project area, UK fishing effort using mobile gears is considered low compared to other areas in the North Sea, averaging between 0 – 1 days of fishing effort per year for the period 2012 - 2016 (Figure 3.14).

To further inform this assessment, Scottish Fisherman's Federation (SFF) Services were contracted to carry out a consultation with relevant members of the fishing industry. SFF Services collected primary data by interviewing fishermen who utilise the waters around the PL5 pipeline. The vessel representatives interviewed provided output from their Global Positioning System (GPS) plotters to highlight the fishing areas within the study area that they used.

Fishing activity in the offshore areas was widely influenced during the reference period by the Cod Recovery Plan (CRP) and the Scottish Conservation Credit Scheme (SCCS). Through the duration of the CRP and

[2] ICES rectangles are a statistical grid system used to collate, analyse and visualise international fisheries data.

SCCS, the number of days at sea for fishing vessels was considerably reduced. This often resulted in vessels changing their working practice so as not to waste valuable days at sea on steaming to offshore grounds. As a result, steaming time was accounted for as fishing time, which therefore impacted on the grounds that vessels operated on. Coincidentally, at the ICES Benchmark Workshop on North Sea Stocks (WKNSEA 2015), presentations demonstrated that the largest biomass of adult cod in the North Sea was found in the Viking area (which encompasses the area relating to the Greater Dunlin Area).

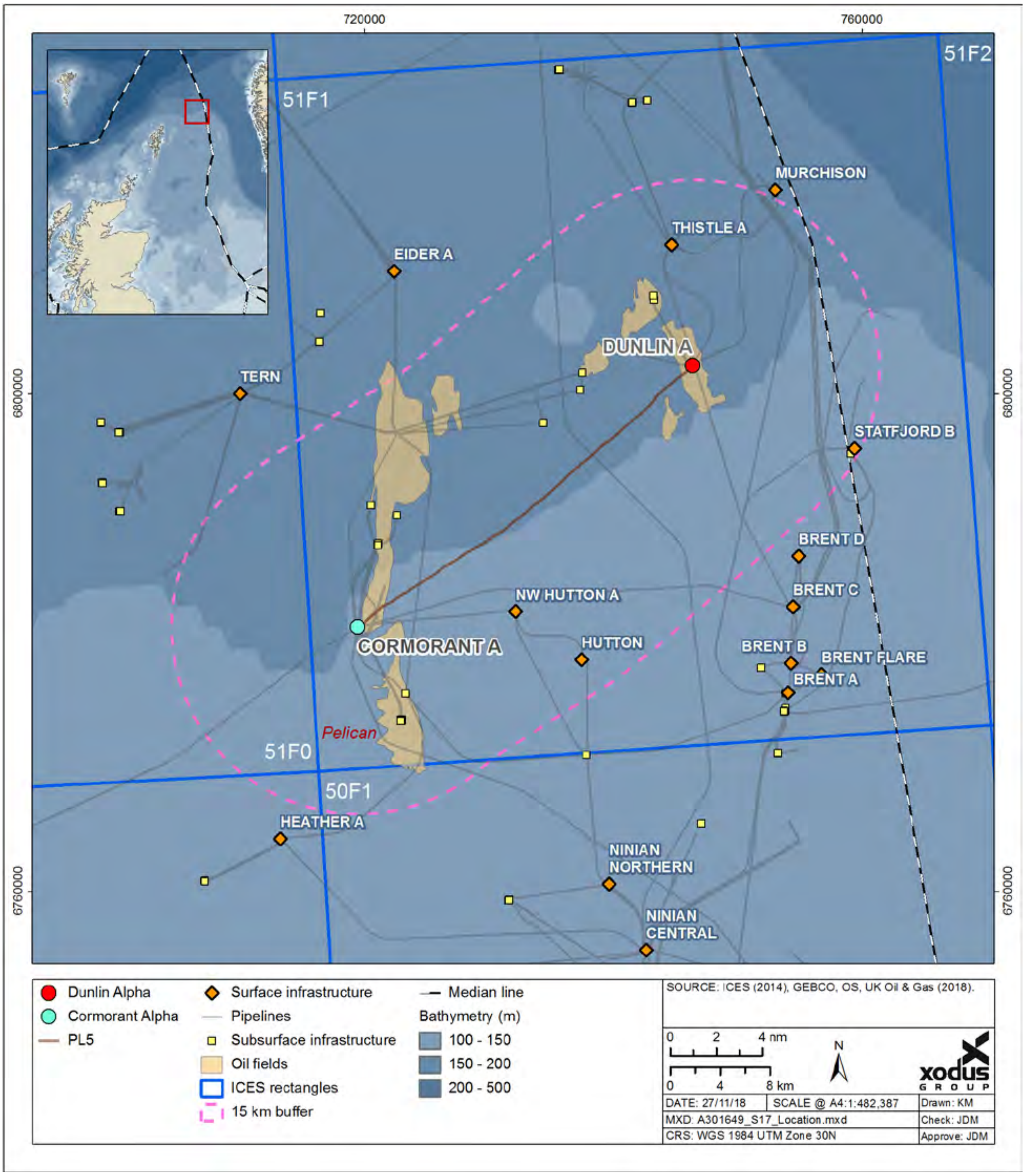


Figure 3.9 Baseline fishing activity study area: ICES Rectangle (Xodus, 2018b)

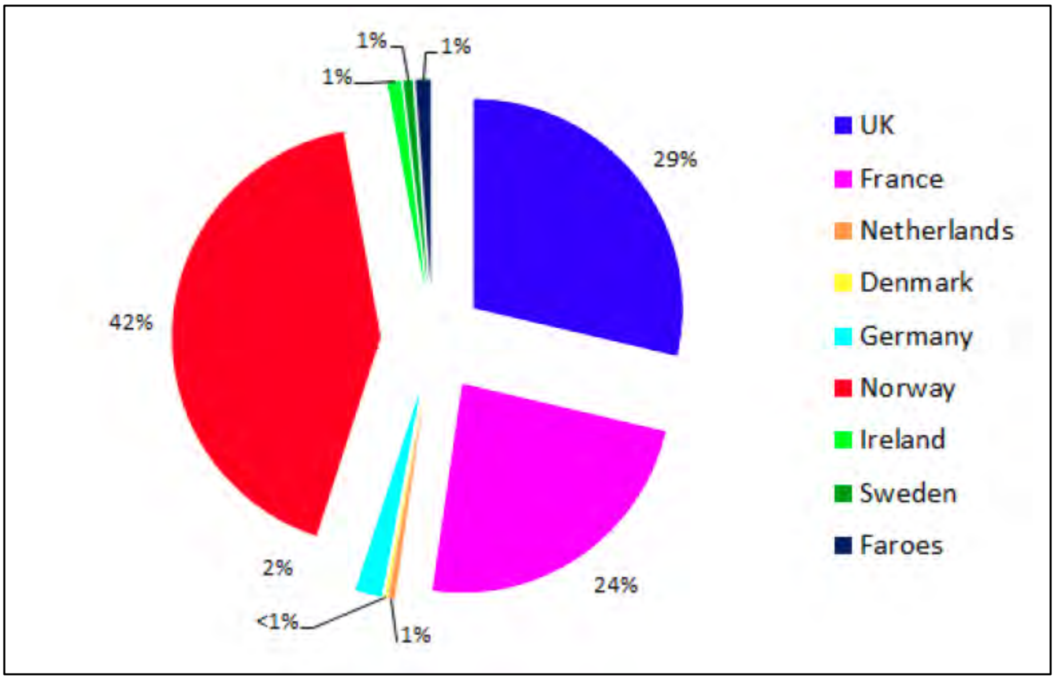


Figure 3.10 AIS nationality distribution (March 2017 – February 2018 (Anatec, 2018)

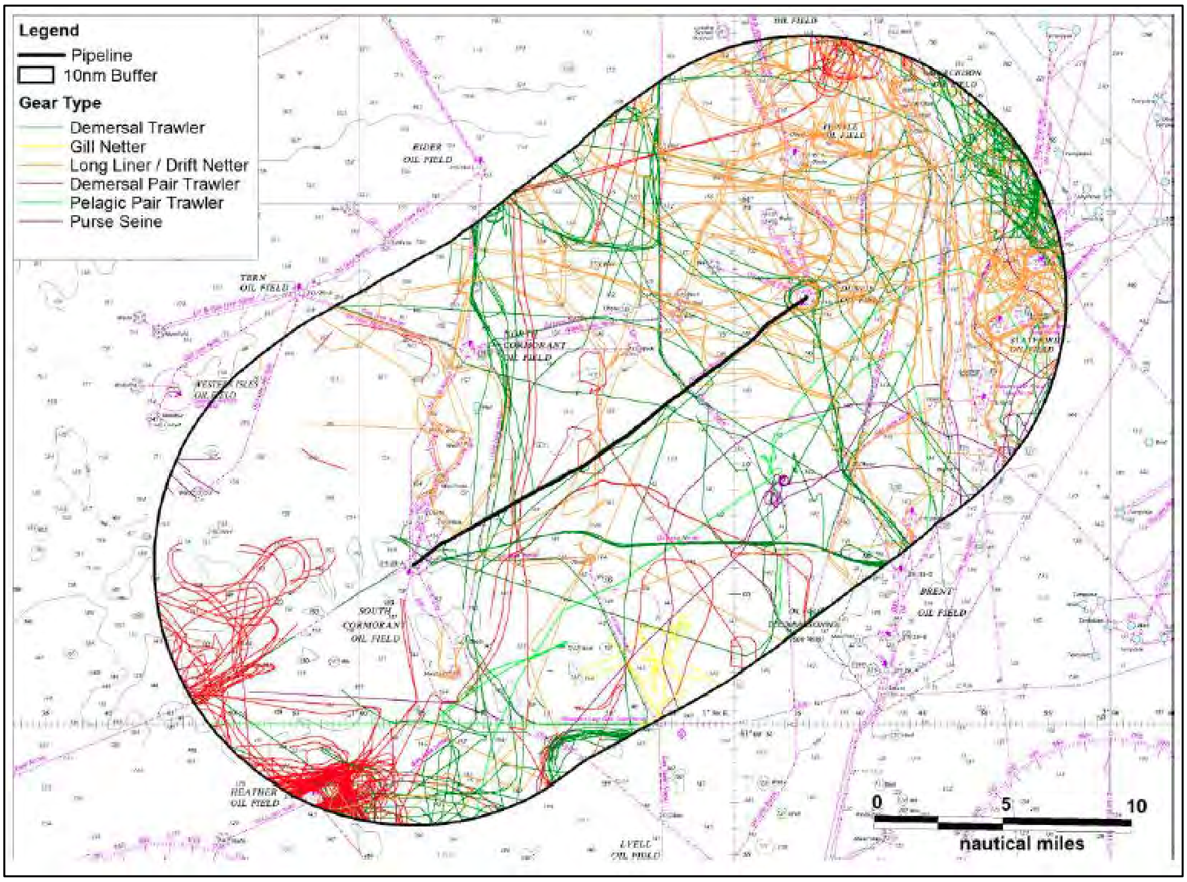


Figure 3.11 Fishing vessel activity over the period March 2017 – February 2018 (Anatec, 2018)

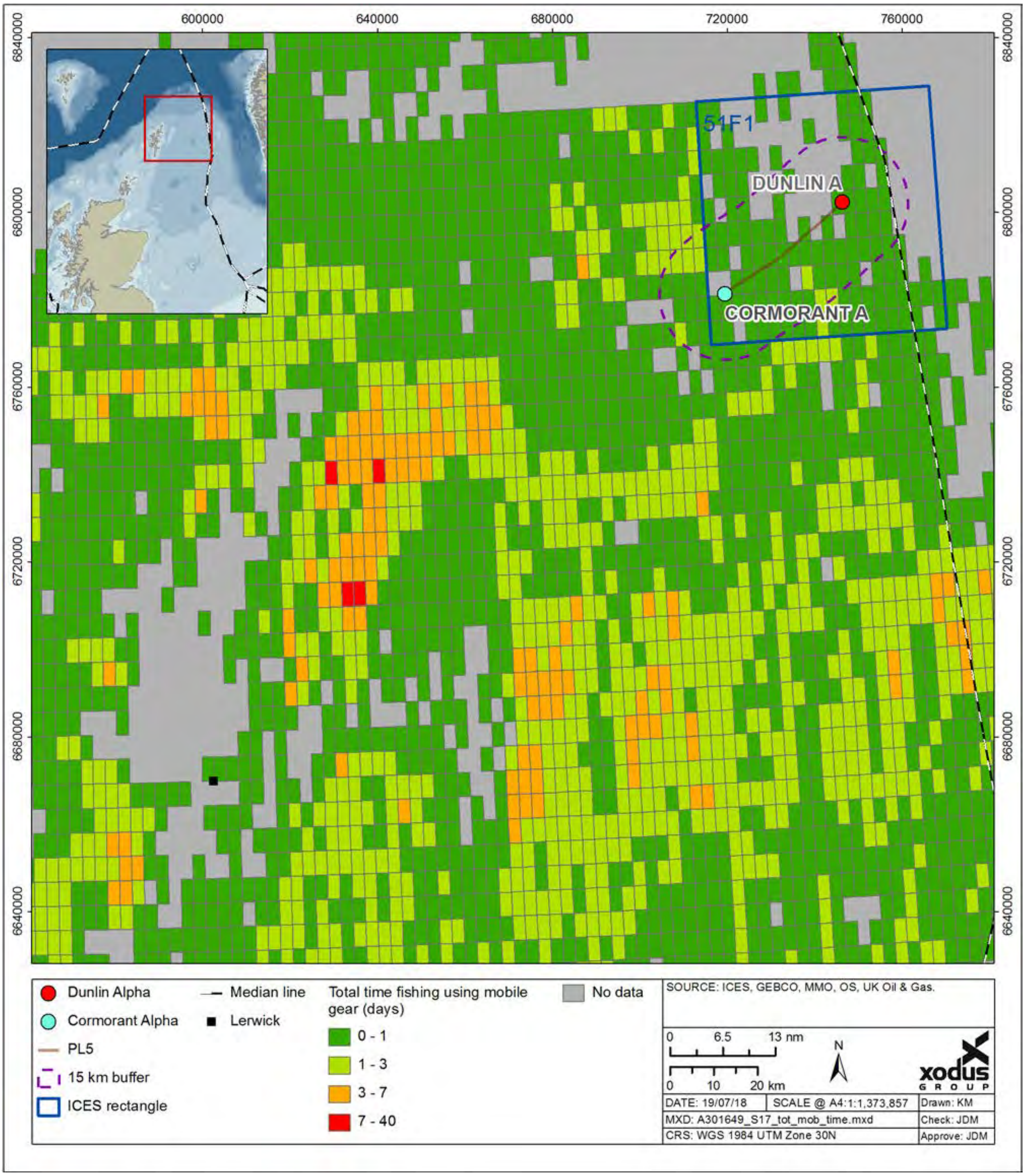


Figure 3.12 Relative distribution of fishing effort (time in days) of vessels using mobile gear (averaged across 2012 – 2016) (MMO, 2017)

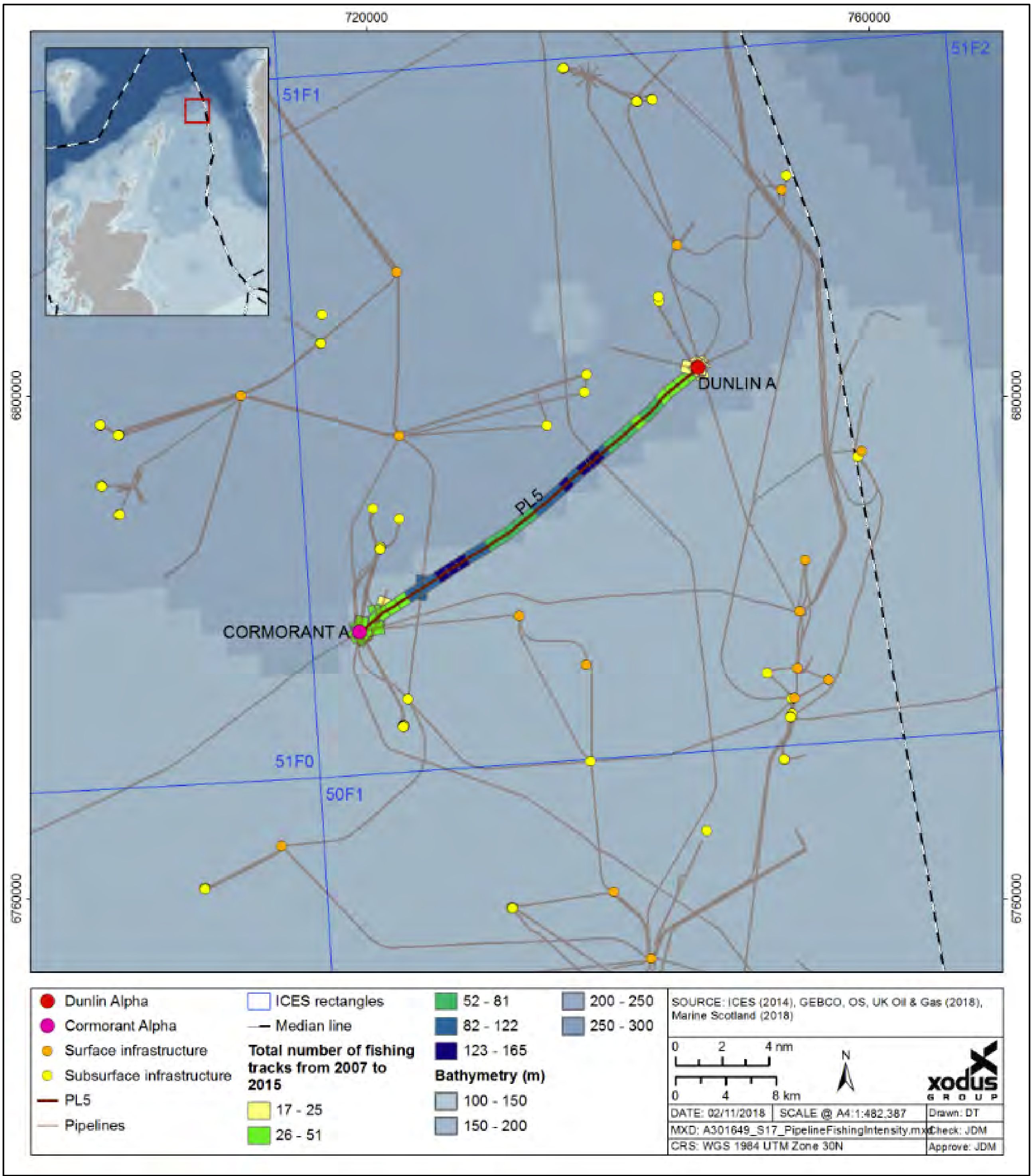


Figure 3.13 Fishing intensity along the PL5 pipeline for the period 2007 – 2018 (Scottish Government, 2017)

3.3.1.2. *Types of Fishery*

The PL5 pipeline is overtrawlable, however, the implementation of safety zones prohibits commercial fishing within 500 m of the Dunlin A and Cormorant A platforms, and their associated subsea infrastructure. Moreover, access within the 15 km study area surrounding the pipeline (depicted in Figure 3.9) is limited by a series of 500 m exclusion zones around neighbouring infrastructure. Between these exclusion zones there are two primary fisheries which operate within the surrounding region in the ICES rectangle 51F1:

- Demersal (whitefish); and
- Pelagic.

Figure 3.14 shows the average annual value and live weight of fish landed in the UK between 2012 – 2016. Demersal fisheries target species which occur on or near the seabed, whereas pelagic fisheries target species inhabiting the water column. The area surrounding the Dunlin and North Cormorant, South Cormorant and Pelican fields (Figure 3.9 and Figure 3.12) is used by pelagic and demersal trawl fisheries, with the demersal fishery being most productive in terms of the value and liveweight (tonnage) of landings. Some shellfish species are landed from within ICES rectangle 51F1 in trawls, though the value and tonnage is comparatively very low (i.e. near zero).

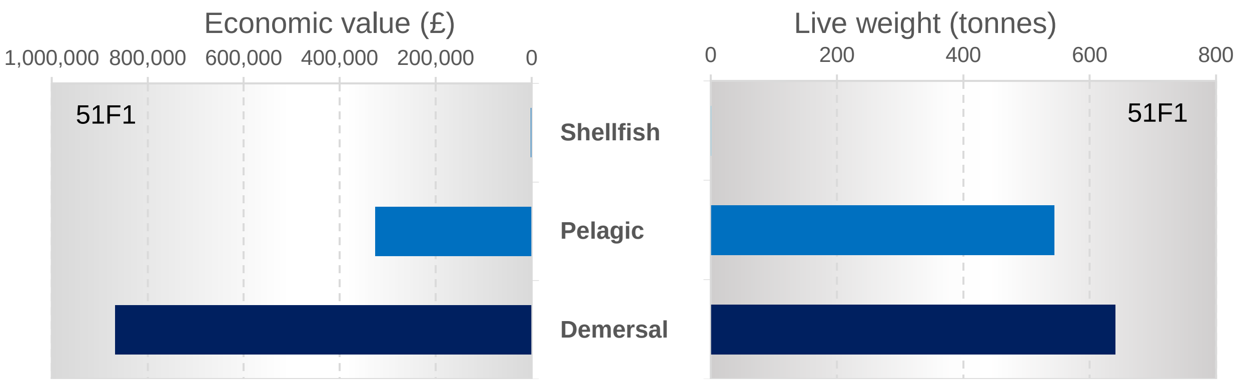


Figure 3.14 Annual economic value and liveweight tonnage from ICES rectangle 51F1 (averaged across 2012 – 2016) (Scottish Government, 2018).

3.3.1.3. *Fishery Value*

Kafas et al. (2012) report the Greater Dunlin Area as being at the northern extent of a large band of higher value demersal fishing effort which stretches from the Outer Hebrides in the west, around Orkney and Shetland and down into the southern North Sea. Kafas et al. (2012) also report the Greater Dunlin Area being at the eastern-most extent of a large band of higher value pelagic fishing area that runs from the northern North Sea out to the west of the Outer Hebrides. The ICES Workshop on North Sea Stocks (WKNSEA) reported that the wider 'Viking' area, which covers the northeast North Sea of which Dunlin is a part, as an area with the largest biomass of adult cod in the North Sea (ICES, 2015).

Saithe is the key commercial species landed from ICES rectangle 51F1 for both value (40%) and weight (52%). However, this is of relatively low value when compared to total landings into Scotland; landings of this species from ICES rectangle 51F1 comprise only 0.1% of the value (£) of 2016 landings into Scotland.

Although the average pelagic landings indicate it to be both of high value and high tonnage (Figure 3.14) when this is put in context of an individual years landings of the UKCS this actually represents a relatively small proportion, approximately 1% (e.g. in 2015, mackerel landings alone represented 213,490 tonnes at a value of £136.2M in which 1,379 tonnes were reported from ICES rectangle 51F1. In the subsequent two years no landings were reported).

Data from the Scottish Government (2018) offer insights into the proportion of time spent fishing and average value of landings within ICES Rectangle 51F1 each year. The average fishing effort (days spent fishing) by UK vessels more than 10 m in length within ICES Rectangle 51F1 over the period 2012 - 2018 was 102.8 days per calendar year (Table 3.7). This data covers UK vessels over 10 m in length and non-UK vessels over 15m in length landing in the UK.

Year	Within ICES Rectangle 51F1			Throughout the UK	
	Total fishing effort (days)	Average value of landings (£)	Average quantity (Te)	Average value of landings (£)	Average quantity (Te)
2012	90	£22,249	14.4	£70,763	59.3
2013	183	£47,416	39.1	£108,642	107.7
2014	100	£60,288	71.3	£102,561	99.2
2015	103	£57,886	74.3	£99,452	96.8
2016	62	£42,113	51.7	£113,752	77.6
2017	79	£27,526	18.2	£107,996	85.0
Annual average	103	£42,913.00	44.8	£100,527.67	87.6

Table 3.7 Summary statistics of total annual fishing effort by UK vessels and average value and quantity of landings by species from UK/ non- UK vessels landing in UK, (Scottish Government, 2018)

3.3.1.4. *Gear*

Trawl gear is the primary fishing gear type used in ICES rectangle 51F1 by UK vessels (Scottish Government, 2018). Trawls include demersal trawls (including seabed contact) and midwater trawls (i.e. pelagic) which operate within the water column. Fishing activity by gear type recorded between March 2017 – February 2018 shows that the three main fleets utilising the project area as fishing ground (Norway, UK, France, as described in Section 3.3.1.1) between them use mainly demersal gear with a total of 70 and 78 fishing days using this gear for the UK and France, respectively. However, Norway uses mostly static gear as it accumulated over 70 days fishing using this gear type, and below 50 days fishing using demersal gear (associated with pelagic landings) (Figure 3.15).

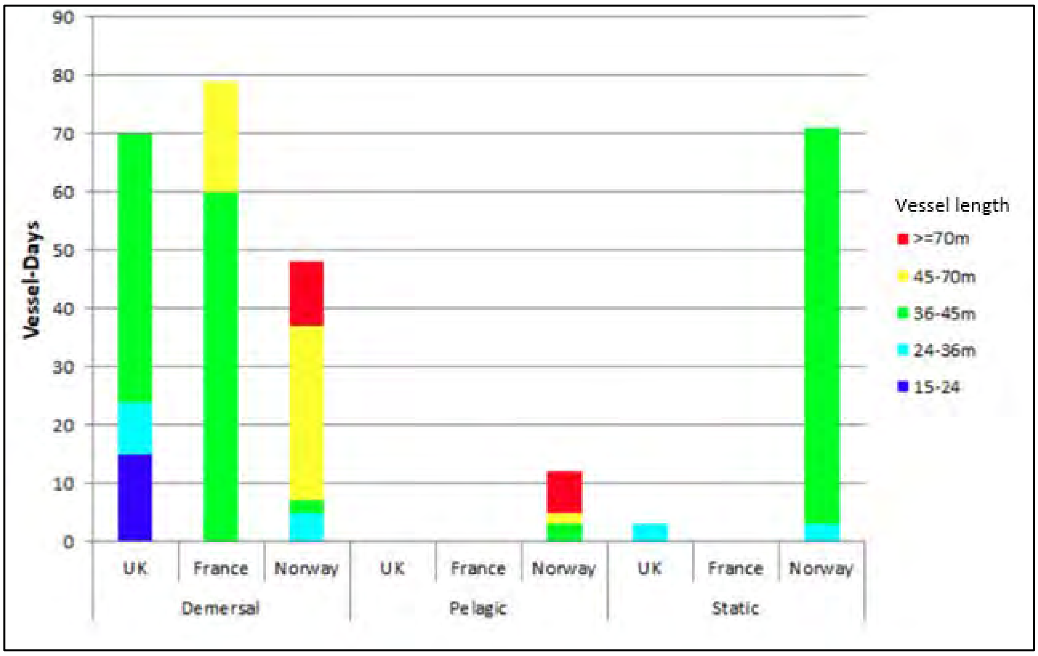


Figure 3.15 Vessel activity by gear type, nationality and length distribution over the period (March 2017 – February 2018)

3.3.1.5. *Seasonality*

Analysis of mean fishing effort indicates that fishing activity is concentrated in the spring and early summer months. Total monthly fishing effort ranged from 5 to 66 days from all vessels fishing within ICES Rectangle 51F1 within a given month. Mean fishing effort ranged from approximately 15.6 to 30.6 days per month (Scottish Government, 2018).

Monthly distributions of landings data from the Marine Management Organisation (MMO) suggest that landings value (£) is highest in autumn, with the trendline peaking in October and November, though only for the 2014 and 2015 fishing years when mackerel was the predominant catch species. The data suggests that mackerel landings, which are historically infrequent and unpredictable for this region, are likely to be influencing the dramatic climb in landings value data for those months (Xodus, 2018b). If those irregular mackerel landings are discounted, a more accurate trend of fishing activity becomes apparent. Fishing peaks during the spring and summer months, and falls during the autumn and winter as weather conditions worsen.

3.3.2. Oil and Gas Activity

The planned decommissioning activities are located in an area of extensive oil and gas development. There are a number of installations located within the vicinity of the project area, as illustrated in Figure 3.9 and detailed in Table 3.8.

Installation	Distance from PL5 pipeline (km)	Direction from PL5 pipeline
Tern	20.6	NW
Cormorant North	11.1	NW
Eider A	21.5	NW
Thistle A	9.8	N
Murchison (Decommissioned)	15.6	NE
Statfjord B	14.6	E
Brent D (Decommissioned)	17.2	SE
Brent C	20.0	SE
Hutton (Decommissioned)	12.3	SE
NW Hutton A (Decommissioned)	6.2	S
Heather A	18.1	SW

Table 3.8 Installations nearby PL5 pipeline installation

3.3.3. Military Activity

There are no charted military Practice and Exercise Areas (PEXAs) and Unexploded Ordinances (UXOs) in the vicinity of the project area (DECC, 2016). Shipping Activity

The North Sea contains some of the world's busiest shipping routes, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic. North Sea oil and gas fields also generate moderate vessel traffic in the form of support vessels (DECC, 2016). An average of between 0.1 to 5 vessels per week pass the vicinity of the project area with the majority of traffic consisting of small to medium sized cargo ships and tankers (MMO, 2014). Other vessels that pass within the vicinity of the project area include dredging or underwater operation vessels and fishing vessels.

3.3.4. Renewables

There is no renewable energy activity in the vicinity of the project area; the closest potential renewable site is a Draft Plan Option for tidal energy, at Muckle Flugga (north of Shetland), located approximately 120 km south-west of Block 211/23.

3.3.5. Cables and pipelines

There are no cables in the vicinity of the project area other than the Dunlin Power Import cable (running from the Dunlin Alpha platform to the Brent Charlie platform). In addition to the pipelines associated with the PL5 pipeline infrastructure (Figure 3.9), pipelines in the vicinity of the project area include Thistle A to Dunlin Alpha, Murchison oil export pipeline, Magnus to Brent A, Statfjord B spur, Brent C to Penguin, Brent C to Cormorant A and Thistle to Murchison spur. The PL5 pipeline route also crosses two abandoned pipelines, including the control line to P1 and the 2 x 3" flowlines to well P1. The Dunlin Fuel Gas Import (DFGI) umbilical (PLU2853) may also be in place but is being recovered in 2018.

3.3.6. Archaeology

There are no designated wreck sites in the vicinity of the project area (DECC, 2016). There is a non-designated wreck record to the north of Block 211/23, in which the PL5 pipeline eastern end is located (NMPi, 2018).

4. EA Methodology

4.1. Identification of Environmental Issues

The main objective of the Environmental Issues Identification (ENVID) process is to identify the key potential environmental issues requiring discussion and assessment, and to agree practicable measures (mitigation) to eliminate or minimise harm to the environment.

An ENVID has taken place based on:

- Known potential environmental issues specifically related to the project area. These are already well understood due to the amount of environmental work that has been conducted during the broader decommissioning project's lifetime;
- An ENVID workshop, which brought together informed judgement of environmental practitioners and project engineers; and
- Stakeholder engagement through screening workshops and consultation meetings.

The ENVID process was kept under review throughout the environmental impact assessment, with mitigation revised as understanding of the project increased and as consultation continued. The key issues that were assessed in this EA are therefore a combination of issues identified as significant during the early ENVID process (including ENVID workshop, the output of which is detailed in Appendix A), issues of importance raised by consultees, and issues that have become clearer with enhanced project definition. Issues that have not been described in this EA were screened out; details of which issues were screened out and why are included in the ENVID output in Appendix A.

4.2. Stakeholder Engagement

4.2.1. Engagement Strategy

Since March 2016, PL5 has featured in the broader engagement activity for the Greater Dunlin Area (covering subsea and platform decommissioning as a whole). The engagement for the pipeline has been largely based on sharing project expectations, approach and specific considerations with partners, regulatory authorities, statutory advisers, and statutory consultees. Beyond this, no pipeline-specific queries were raised at or after the two stakeholder workshops (November 2017 and May 2018) other than a request for liaison on type and grade of rock cover to include the JNCC as well as the SFF.

4.3. EA Methodology

4.3.1. Overview

The decision process related to defining whether or not a project is likely to significantly impact on the environment is the core principle of the environmental impact assessment process; the methods used for identifying and assessing potential impacts should be transparent and verifiable.

The method presented here has been developed by reference to the Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010), the Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines (Tyler-Walters *et al*., 2004) and guidance provided by SNH in their handbook on environmental impact assessment (SNH, 2013) and by the Institute of Environmental Management and Assessment (IEMA) in their guidelines for environmental impact assessment (IEMA, 2015, 2016).

Environmental impact assessment provides an assessment of the environmental and societal effects that may result from a project's impact on the receiving environment. The terms impact and effect have different definitions in environmental impact assessment and one drives the other. Impacts are defined as the changes resulting from an action, and effects are defined as the consequences of those impacts.

In general, impacts are specific, measurable changes in the receiving environment (volume, time and/or area); for example, were a number of marine mammals to be disturbed following exposure to vessel noise emissions. Effects (the consequences of those impacts) consider the response of a receptor to an impact; for example, the effect of the marine mammal/noise impact example given above might be exclusion from an area caused by disturbance, leading to a population decline. The relationship between impacts and effects is not always so straightforward; for example, a secondary effect may result in both a direct and indirect impact on a single receptor. There may also be circumstances where a receptor is not sensitive to a particular impact and thus there will be no significant effects/consequences.

For each impact, the assessment identifies a receptor's sensitivity and vulnerability to that effect and implements a systematic approach to understand the level of impact. The process considers the following:

- Identification of receptor and impact (including duration, timing and nature of impact);
- Definition of sensitivity, vulnerability and value of receptor;
- Definition of magnitude and likelihood of impact; and
- Assessment of consequence of the impact on the receptor, considering the probability that it will occur, the spatial and temporal extent and the importance of the impact. If the assessment of consequence of impact is determined as moderate or major, it is considered a significant impact.

Once the consequence of a potential impact has been assessed it is possible to identify measures that can be taken to mitigate impacts through engineering decisions or execution of the project. This process also identifies aspects of the project that may require monitoring, such as a post-decommissioning survey at the completion of the works to inform inspection reports.

For some impacts significance criteria are standard or numerically based. For others, for which no applicable limits, standards or guideline values exist, a more qualitative approach is required. This involves assessing significance using professional judgement.

Despite the assessment of impact significance being a subjective process, a defined methodology has been used to make the assessment as objective as possible and consistent across different topics. The assessment process is summarised below. The terms and criteria associated with the impact assessment process are described and defined; details on how these are combined to assess consequence and impact significance are then provided.

4.3.2. Baseline Characterisation and Receptor Identification

In order to make an assessment of potential impacts on the environment it was necessary to firstly characterise the different aspects of the environment that could potentially be affected (the baseline environment). The baseline environment has been described in Section 3 and is based on desk studies combined with additional site-specific studies such as surveys and modelling where required. Information obtained through consultation with key stakeholders was also used to help characterise specific aspects of the environment in more detail.

Where data gaps and uncertainties remained (e.g. where there are no suitable options for filling data gaps) as part of the environmental impact assessment process these have been documented and taken into consideration as appropriate as part of the assessment of impact significance (Section 4.3.5). Overall the survey data cover a large area around the proposed PL5 pipeline route (Figure 3.2), therefore OPRED has dispensed Fairfield from carrying out further site surveys.

The environmental impact assessment process requires identification of the potential receptors that could be affected by the project (e.g. marine mammals, seabed species and habitats). High level receptors are identified within the impact assessments (Section 5 and Section 6).Impact Definition

4.3.3. Impact Magnitude

Determination of impact magnitude requires consideration of a range of key impact criteria including:

- Nature of impact, whether it be beneficial or adverse;
- Type of impact, be it direct or indirect etc.;
- Size and scale of impact, i.e. the geographical area;
- Duration over which the impact is likely to occur i.e. days, weeks;
- Seasonality of impact, i.e. is the impact expected to occur all year or during specific times of the year e.g. summer; and
- Frequency of impact, i.e. how often the impact is expected to occur.

Each of these variables are expanded upon in Appendix B, Table B.1 to Table B.4 provide consistent definitions across all environmental impact assessment topics. In each impact assessment, these terms are used in the assessment summary table to summarise the impact, and are enlarged upon as necessary in any supporting text. With respect to the nature of the impact (Table 4.1), it should be noted that all impacts discussed in this EA are adverse unless explicitly stated.

Nature of impact	Definition
Beneficial	Advantageous or positive effect to a receptor (i.e. an improvement).
Adverse	Detrimental or negative effect to a receptor.

Table 4.1 Nature of impact

4.3.3.1. *Impact Magnitude Criteria*

Overall impact magnitude requires consideration of all impact parameters described above. Based on these parameters, magnitude can be assigned following the criteria outlined in Table B.5. The resulting effect on the receptor is considered under vulnerability and is an evaluation based on scientific judgement.

4.3.3.2. *Impact Likelihood for Unplanned and Accidental Events*

The likelihood of an impact occurring for unplanned/accidental events is another factor that is considered in this impact assessment. This captures the probability that the impact will occur and also the probability that the receptor will be present.

4.3.4. Receptor Definition

4.3.4.1. *Overview*

As part of the assessment of impact significance it is necessary to differentiate between receptor sensitivity, vulnerability and value. The sensitivity of a receptor is defined as ‘the degree to which a receptor is affected by an impact’ and is a generic assessment based on factual information, whereas an assessment of vulnerability, which is defined as ‘the degree to which a receptor can or cannot cope with an adverse impact’, is based on professional judgement taking into account a number of factors, including the previously assigned receptor sensitivity and impact magnitude, as well as other factors such as known population status or condition, distribution and abundance.

4.3.4.2. *Receptor Sensitivity*

These range from negligible to very high and definitions for assessing the sensitivity of a receptor are provided in Table B.6.

4.3.4.3. *Receptor Vulnerability*

Information on both receptor sensitivity and impact magnitude is required to be able to determine receptor vulnerability as per Table B.7.

It is important to note that the above approach to assessing sensitivity/vulnerability is not appropriate in all circumstances and in some instances professional judgement has been used in determining sensitivity. In some instances, it has also been necessary to take a precautionary approach where stakeholder concern exists with regard to a particular receptor. Where this is the case, this is detailed in the relevant impact assessment in Section 6.

4.3.4.4. *Receptor value*

The value or importance of a receptor is based on a pre-defined judgement based on legislative requirements, guidance or policy. Where these may be absent, it is necessary to make an informed judgement on receptor value based on perceived views of key stakeholders and specialists. Examples of receptor value definitions are provided in Table B.8.

4.3.5. Consequence and Significance of Potential Impact

4.3.5.1. *Overview*

Having determined impact magnitude and the sensitivity, vulnerability and value of the receptor, it is then necessary to evaluate impact significance. This involves:

- Determination of impact consequence based on a consideration of sensitivity, vulnerability and value of the receptor and impact magnitude;
- Assessment of impact significance based on assessment consequence;
- Mitigation; and
- Residual impacts.

4.3.5.2. *Assessment of Consequence and Impact Significance*

The sensitivity, vulnerability and value of receptor are combined with magnitude (and likelihood, where appropriate) of impact using informed judgement to arrive at a consequence for each impact, as shown in Table B.9. The significance of impact is derived directly from the assigned consequence ranking.

4.3.5.3. *Mitigation*

Where potentially significant impacts (i.e. those ranked as being of moderate impact level or higher in Table B.9) are identified, mitigation measures must be considered. The intention is that such measures should remove, reduce or manage the impacts to a point where the resulting residual significance is at an acceptable or insignificant level. For impacts that are deemed not significant (i.e. low, negligible or positive in Table B.9), there is no requirement to adopt specific mitigation. However, mitigation can be adopted in such cases to ensure impacts that are predicted to be not significant remain so. Section 6 provides detail on how any mitigation measures identified during the impact assessment will be managed.

4.3.5.4. *Residual Impacts*

Residual impacts are those that remain once all options for removing, reducing or managing potentially significant impacts (i.e. all mitigation) have been taken into account.

5. Initial Impact Assessment (Screening)

An initial screening of the impacts and receptors was undertaken as part of the ENVID process. The results of the ENVID including those environmental and societal impacts which were screened in for further assessment in this EA are summarised in the Sections below. Only those impacts which are relevant to the decommissioning activities recommended by the CA workshop have been described. A copy of the resulting ENVID Matrix is supplied in Appendix A.

5.1. Aspects Taken Forward for Further Assessment

As identified in the ENVID Matrix (Appendix A), the key potential impacts identified for assessment in the EA Report included: seabed disturbance; residual risk of legacy materials and discharges to sea. As outlined in Section 7 the Fairfield waste management strategy defines project specific waste management mitigation measures to ensure impacts from the management of hazardous, non-hazardous and radioactive wastes and marine growth are negligible.

The resulting environmental impacts requiring assessment are detailed below:

- Risks to other users from materials decommissioned *in situ*;
- Seabed disturbance;
- Discharges to sea; and
- Waste management.

5.2. Aspects to be Screened Out from Further Assessment

This section outlines the aspects which may be impacted by the project activities but are not deemed significant and do not warrant further assessment in the EA report. The justification for screening these aspects out is provided in Table 5.1.

Aspect	Proposed mitigation/control measures	Justification for screening out
Light pollution	• Lighting directed below the horizontal plane unless required for a technical or safety reason.	Activities are offshore and should not pose significant impact to communities onshore. In terms of impact to marine life offshore, the planned period of activities is most likely to be during the summer months. This would be when hours of daylight are at their longest and effects from light pollution would be minimised. However, some of the activities might occur during winter. With daylight getting shorter during winter, more artificial light pollution would be expected and therefore constitutes the worst-case scenario. The proposed activities will be short in duration and not significantly different to general vessel operations associated with offshore oil and gas maintenance traffic and other vessel traffic transiting or using this area.

Aspect	Proposed mitigation/control measures	Justification for screening out
Noise and vibrations (e.g. pipeline cutting, vessel noise) causing injury or disturbance	• Adoption of JNCC guidance for minimising the risk of injury to marine mammals from offshore activities which produce noise (e.g survey vessels, drilling etc) (JNCC, 2017b). • Planning to minimise vessel use (both duration and number of vessels). • Suitable technology for cutting pipework will be selected to ensure effectiveness while minimising duration, disturbance and risk of requiring the activity to be repeated.	No use of explosives. All cutting operations will be via mechanical means and be of short duration. Noise associated with vessel traffic is limited and not anticipated to be significantly above the current background levels. These noise sources are generally not classed as significant in relation to decommissioning projects especially considering the short duration of the proposed project. During screening MBES surveys were considered to be standard operations and therefore, these are not considered to be a significant noise contributor.
Discharges to sea – Routine vessel discharges	• Contractors who meet the following would be targeted for use: – Contractors are International Organisation for Standardisation (ISO) 14001 approved. – International Maritime Organisation (IMO)'s Ballast Water Management Convention, including Ballast water plan and log book – Treatment to IMO/ International Convention for the Prevention of Pollution from Ships (MARPOL) standards. – Compliance with Fairfield's Marine Assurance Standards. – Hazardous material (Hazmat) checklist. – No planned discharge to sea during preparation activities.	These discharges are within the routine operations of vessels and no expected discharges outside of these permitted activities.

Aspect	Proposed mitigation/control measures	Justification for screening out
Atmospheric emissions	• Low sulphur fuels where possible. • Monitor fuel use. • Contractor selection and maintenance programmes. • Emissions according to Air Quality Standards and within limits set under MARPOL. • Use of MARPOL-compliant vessels. • Campaign/ logistic to share vessels optimising vessels to minimise use. • Demonstration of BAT. • Vessel assurance surveys. • Scheduling/ design to optimise opportunities to use resources more efficiently. • Estimates are based on a total life cycle assessment.	A review of previous decommissioning ES and EAs shows that atmospheric emissions are generally concluded to have no significant impact and are usually extremely small in the context of UKCS/global emissions, especially when considering subsea decommissioning scopes such as these proposed for PL5 pipeline. The majority of emissions relate to the vessel time or the hypothetical remanufacture of material decommissioned *in situ*. As the decommissioning activities proposed are of such short duration this aspect is not anticipated to result in significant impact. The carbon dioxide (CO_2) emissions estimated to be generated by the recommended decommissioning option is 47,483.6 Te, this equates to approximately 0.03% of the total UKCS vessel emissions (excluding fishing vessels) in 2014 (BEIS, 2017). Considering the above, atmospheric emissions do not warrant further assessment.
Energy use		Fuel use during decommissioning activities is occurring in the context of the removal/decommissioning vessel operations. Such use of resources is not typically an issue of concern as the activities are a one-off operation and must be undertaken to meet regulatory requirements. The recommended option represents the scope with minimum emissions and energy use possible while complying with decommissioning the infrastructure in a safe manner.
Dropped objects	Fairfield's Environmental Management System in place. Procedures will be in place to reduce the potential for dropped objects. Training and awareness of contractors will be required. Lift planning will be undertaken to manage risks during lifting activities, including the consideration of prevailing environmental conditions and the use of specialist equipment where appropriate. All lifting equipment will be tested and certified. Procedures will be put in place to make sure that the location of any lost material is recorded and that significant objects are recovered where practicable.	Dropped object procedures are industry standard and there is minimal risk of objects dropping on live infrastructure. All efforts will be made to recover any materials that are dropped. In the unlikely event of an item being unrecoverable, then this would be discussed with the regulator. Notifications issued to relative industry bodies of location and nature of object. Seabed clearance assessment would be undertaken to ascertain risk posed and monitor going forward, remediating if required.

Aspect	Proposed mitigation/control measures	Justification for screening out
Displacement/ exclusion of vessels during decom activities	United Kingdom Hydrographic Office (UKHO) standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings. Consultation will be undertaken with relevant authorities, stakeholders and organisations.	The presence of a small number of vessels (six) during the decommissioning activities will be relatively short-term (approximately 40 days). Activity will occur using similar vessels to those currently deployed for oil and gas operational activities. Other sea users will be notified in advance of activities occurring (e.g. survey equipment deployment or diving/recovery operations), meaning those stakeholders will have time to make any necessary alternative arrangements for the very limited period of operations. Consideration has been given to the potential cumulative effects of operational and decommissioning activities associated with neighbouring oil and gas infrastructure. There is potential for there to be some decommissioning activity being undertaken at a number of installations in the area (nearest being Osprey/ Merlin fields). The exact timeframe of the project is not available and maybe subject to change. However, it should be noted that these installations have maintenance and support vessel activity on a regular basis during their operation which would cease during decom and be replaced by the decommissioning activities. As such there is unlikely to be a noticeable difference in vessel activity during this period. A review of previous decommissioning ESs and EAs shows that some projects indicate a greater potential issue with short-term vessel presence, but those largely relate to project-specific sensitive locations or the use of large vessels such as heavy lift vessels, which is not the case for this decommissioning project. Considering the above, temporary presence of vessels does not need further assessment.

Aspect	Proposed mitigation/control measures	Justification for screening out
Onshore dismantling yards – noise, emissions, light, dust etc	None proposed over those that the dismantling yard employs as per their normal operations.	All licensed onshore yards at which decommissioned material will be handled already deal with potential environmental issues as part of their existing site management plans. There is anticipated to be no change in potential for impact as a result of any of the material proposed for recovery. Whilst the yard(s) are yet to be selected, they will be in the UK or Europe. They will be selected on the basis that they can demonstrate the ability to handle the materials landed. Fairfield's procedures require suitably approved facilities, including site visits, review of permits and management processes. Additionally, the OPRED Decommissioning Guidance and advice from Decom North Sea suggest scoping out onshore related issues. As a result, this will not be considered further outside the documentation of Fairfield's waste management strategy.
Waste management	Minimal material to shore. Use of Fairfield's waste management strategy. Target of 95-98% ferrous and non-ferrous metals would be recycled of material when brought to shore, minimising landfill use.	There may be instances where infrastructure returned to shore is contaminated and cannot be recycled, but the weight/volume of such material is not expected to result in substantial landfill use (Total weight of decommissioned material is 621 Te with a worst case of 349 Te to landfill (56%). The greatest proportion is in relation to concrete mattresses, however if mattresses can be recycled or reused the tonnage to landfill will be significantly reduced. Considering the above, resource use does not warrant further assessment.
Socioeconomic – impacts on health, well-being, standard of living, structure or coherence of communities or amenities from near-shore and onshore operations e.g. business and jobs, noise, light or pollution, dust, road traffic.	None planned.	Due to the infrastructure being subsea and having no manned employment requirements the net benefit to employment comes from the associated offshore decommissioning scope and subsequent processing onshore for either recycling or landfill. However, given the small-scale nature of both the offshore and onshore decommissioning activities this is not likely to be a significant contributor to sustained employment in the sector. Given the small-scale nature of the decommissioning project, no significant impacts from noise or light emissions and road traffic generated during the project activities are anticipated.

Table 5.1 Aspects to be screened out from further assessment

6. Impact Assessment

As identified in the ENVID Matrix (Appendix A), the key potential impacts identified for assessment in the EA Report included: residual risk of legacy materials, seabed disturbance and discharges to sea.

6.1. Residual Risk to Other Users from Materials Decommissioned *In Situ*

Infrastructure decommissioned *in situ* may pose potential risks to other sea users who utilise the seabed over time. The most notable threat is the risk of snagging fishing gears, such as nets, against exposed infrastructure (e.g. deburied infrastructure or spans along pipeline). For commercial fisheries, snagging can mean the loss of expensive gears and catch or, worse, the loss of life if a vessel is capsized.

6.1.1. Description and Quantification of Risk

To quantify the risk of snagging associated with the decommissioning of the PL5 pipeline infrastructure *in situ*, it is important to review the usage patterns of other sea users and assess the depth of burial of the subsea infrastructure decommissioned *in situ* (Section 3.3.1). Fairfield has undertaken a safety risk to fishermen assessment and the following sections present the findings of this assessment (Anatec, 2018).

The PL5 pipeline has been demonstrated to be relatively stable within its original trench. Where any sections are cut during decommissioning activities small volumes of rock will be deposited to protect the end of the pipework. Rock will also be deposited to minimise snagging risks from pipeline spans and pipeline support deposits (Xodus, 2018c). As a worst case, Fairfield have considered rock cover on these sections of the pipeline to achieve a 0.6 m depth of cover. The deposition of rock would ensure these areas remain accessible to fishing gear, and rock cover would be appropriately graded to allow fishing gear to trawl across to without snagging.

A post-decommissioning survey will be undertaken along the full length of the pipeline corridor using geophysical survey methods, including ROV and Side Scan Survey (SSS). The survey will provide a profile of the pipeline/seabed interface in order to identify potential snag risks, as well as identify any remaining oil field debris. As a worst case, Fairfield have considered that overtrawl surveys will also be required along the full length of the pipeline. However, Fairfield propose to use the results from geophysical surveys to inform the seabed clearance assessment, which will be submitted to OPRED to demonstrate that no snagging risks have been created. Where necessary, overtrawl assessments will be undertaken to further verify that no snagging hazards exist. Any identified snagging hazards will be remediated with rock if required.

Appropriate monitoring and remediation will take place to ensure that the pipeline remains stable and buried. As such, the decommissioning *in situ* of the PL5 pipeline would present no significant long-term snag risk.

6.1.2. Mitigation Measures

A number of mitigation measures will be employed to reduce the residual impact on other users of the sea from infrastructure decommissioned *in situ*:

- The PL5 pipeline is currently shown on Admiralty Charts and appears on the FishSafe system. Once decommissioning activities are completed and seabed clearance certification obtained, updated information on the PL5 subsea area will be provided to OPRED and the relevant authorities to identify infrastructure which remains *in situ*;
- The infrastructure decommissioned *in situ* will be buried to a sufficient depth and spot rock cover applied to any exposed areas and cut ends;
- A post-decommissioning survey will identify any debris on the seabed within a 50 m corridor of the pipeline decommissioned *in situ*. A remotely-operated vehicle (ROV) support vessel may be deployed

to recover large items of oilfield debris whilst chain mats are likely to be deployed to clear smaller items of oilfield debris

- Any objects dropped during decommissioning activities will be removed from the seabed as appropriate;
- The post-decommissioning survey will confirm the depth to which the *in situ* decommissioned pipeline and associated stabilisation material is buried below the seabed as appropriate;
- A seabed clearance assessment will be undertaken and submitted to OPRED to demonstrate completion of decommissioning activities. Where required, an appropriate vessel will be engaged to carry out overtrawl assessments to verify that the seabed has been left in a condition that does not present a hazard to commercial fishing activities.; and
- Fairfield recognises its responsibility for ongoing monitoring of infrastructure left i*n situ*. The frequency of the monitoring that will be required will be agreed with OPRED and future monitoring will be determined through a risk-based approach based on the findings from each subsequent survey. During monitoring, the 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.

6.1.3. Cumulative Impact Assessment

Fishing effort in the vicinity of the PL5 pipeline infrastructure is considered low to moderate compared to the wider area of the North Sea, as shown in Figure 3.11. Considerably more effort is focused elsewhere across the wider northern North Sea, specifically targeting *Nephrops* grounds in the Fladen Ground. Baseline fishing activity analysis undertaken by Anatec (2017) indicates that there are demersal fishing vessels within 10 NM of the Greater Dunlin Area only once every two days, and that there are only, on average, approximately 0.3 crossings of infrastructure per day in the Greater Dunlin Area (109 crossings in the period July 2015 – June 2016). Site specific analysis undertaken in 2018 (Anatec, 2018) confirmed an average of 1.6 vessels per day being recorded in the study area with the busiest months in September and February (recording 2-3 vessels per day). Considered alongside the relatively low levels of shipping activity in the vicinity of the PL5 pipeline infrastructure, the wide expanse of seabed available to fishing vessels, it is not anticipated that the pipeline will be subject to heavy fishing (Figure 3.11).

As all infrastructure will either be removed or decommissioned *in situ* in an overtrawlable condition, there is expected to be no cumulative impact (with regards to exclusion from areas) with other structures decommissioned as part of the PL5 decommissioning project, or indeed with other North Sea decommissioning projects.

6.1.4. Transboundary Impact Assessment

As PL5 pipeline is located beyond the UK's 12 NM limit, EU and non-EU vessels are also currently permitted to fish in the area, subject to management agreements including, for example, quota allocation and days at sea. Anatec (2018) reports vessels of Norwegian origin to be present in the PL5 pipeline area (with 42% of vessels). In addition, 24% of vessels were from France with a small number of other vessels registered in Denmark, Germany, Netherlands, Ireland, Sweden and Faroe Islands. Of the demersal trawlers actively fishing in the study area, 24% were of Norwegian origin and 40% were of French origin. It was also shown that the majority (59%) of vessels crossing the subsea infrastructure were of Norwegian origin (Anatec, 2018). Despite this, the vessel presence is still regarded as relatively low and, combined with the removal of some elements of the pipeline and stabilisation materials, as well as the overtrawlable nature of the infrastructure that is decommissioned *in situ*, there is no mechanism by which significant transboundary impacts could occur.

6.1.5. Residual Impact

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Commercial Fisheries	Low	Low	Low	Minor
Rationale				
The information in the socio-economic environment description (Section 3.3) has been used to assign the sensitivity, vulnerability and value of the receptor as follows. Commercial fisheries have some tolerance to short-term interference (thus low sensitivity) and, given the low fishing effort in the area, there is unlikely to be an impact during the decommissioning activities or in terms of longer-term snag risk or exclusion (thus low vulnerability). In addition, the type of fishing gear deployed is known to regularly use rock-hopper gear and be heavier duty due to the size of vessels working the area therefore it is less susceptible to snagging. On the basis of the estimated catch values from the project area, the value is defined as Low. In terms of magnitude, due to the historical stability of the pipeline combined with the *in situ* decommissioning leaving the seabed in an overtrawlable condition, the magnitude is considered to be minor relative to complete removal of all seabed structures. Combining these rankings, the impact significance is defined as negligible and thus not significant.				
Consequence		**Impact significance**		
Low		Not significant		

6.2. Seabed Disturbance

The PL5 pipeline decommissioning activities have the potential to impact the seabed in the following ways:

- Direct impacts through:
    - Removal of the pipeline ends and pipeline protection infrastructure;
    - Removal of spools and anode skids;
    - Rock placement for span remediation; and
    - Overtrawls by chain mats along the entire length of PL5 pipeline.
- Indirect impacts through:
    - Re-suspension and re-settling of sediment; and
    - Disturbance of drill cuttings material.

6.2.1. Description and Quantification of Potential Impact

In order to assess the impacts of the proposed operations, the area of potential disturbance must be quantified. Both direct and indirect impacts will occur as a result of the project activities. Direct impacts are those occurring within the area of contact between the subsea installations and the seabed, whilst indirect impacts are typically caused by the resuspension and re-settling of sediments disturbed by the project activities.

The area of direct and indirect disturbance expected for each activity is presented in Table 6.1. The indirect impact area presented in Table 6.1 encompasses the direct impact area, since areas subject to direct impact will also be subject to resuspension and re-settling of sediments. Areas where decommissioning activities overlap have been accounted for, ensuring that the extent of potential for impact is not unrealistically overestimated. Moreover, the calculations below provide an estimate of worst case environmental impacts resulting from seabed clearance surveys via trawl sweeps. As outlined in Section 2.3.1.3, Fairfield are committed to minimising potential seabed impacts by employing non-invasive geophysical survey methods (i.e. MBES, SSS) where appropriate. The assumptions to calculate these areas impacted are presented below the table.

Activity	Assumptions	Direct impact (m^2)	Indirect impact (m^2)
Removal of spools	64 m at Cormorant 82 m at Dunlin 609.5 mm diameter spools	0	89
Decommissioning of pipeline	609.5 mm diameter pipeline 300 m at Dunlin 650 m at Cormorant	0	10,079
Removal of anode skids (x 2)	3.3 m length x 2.7 m width	0	169
Remediation of spans and pipeline stabilising features (grout bags)	100 Te Rock cover / span 16,900 m^2 total footprint	16,900	16,900
Rock cover at pipeline ends	100 Te Rock cover / End 200 m^2 total footprint	200	200
Mattress removal (x 8)	100 Te Rock cover / mattress 800 m^2 total footprint	800	800
Total from decommissioning operations above		**17,900**	**28,237**
Overtrawls		**6,843,600**	**7,527,960**

Table 6.1 Estimate of direct and indirect impact areas

The impact area estimates have been based on the following assumptions:

- Where structures sitting on the seabed are removed, there is considered to be no direct impact since the seabed directly under the structure being removed is experiencing no additional impact. However, there is expected to be an indirect impact due to re-suspension of sediments around the structure as it is removed;
- Where seabed sediments are disturbed by placing material on the seabed (e.g. rock placement) the area of direct impact is assumed to be equal to the area of the operation or item's physical footprint;
- Where buried pipelines are removed via cut and lift method, there is considered to be a direct impact within a 1 m corridor along the length of the removed pipeline, and an indirect impact due to re-suspension of sediments;
- The area of indirect impact (due to sediment re-suspension and re-settlement) is assumed to be equal to the area of the item removed or placed, plus a 10 m radius. Bottom current speeds at Dunlin are in the order of 0.2 m/s, and the seabed sediments and presence of visible faunal tracks indicate the seabed environment is quiescent. Re-suspended sediments are therefore expected to re-settle within 10 m of the point of disturbance. Although finer particles may remain suspended for some time before resettling, the relatively low bottom currents suggest they will not be carried far;

- For mattresses, sand bags, grout bags and concrete blocks, which may be covered in some sediment, the area of indirect impact is assumed to be twice the direct area to ensure the potential disturbance is not underestimated;
- It is assumed as a worst case that a 200 m corridor centred over the pipeline will be overtrawled to verify seabed clearance. The indirect impact area for overtrawls is assumed to be equal to the direct area plus an additional 10 m radius to allow for sediment re-settlement;
- During decommissioning work at Dunlin Alpha, the pipeline PL5 pipeline spools will be removed. Removal of PL5 pipeline spools will result in the resuspension of cuttings pile material, and therefore the release of contaminants. The extent of the cuttings pile sediment re-settlement on the seabed has been modelled (Xodus, 2018d). Assuming that 7.5 m^3 of cuttings pile sediments (circa 18.8 te) will be re-suspended in the worst-case scenario, the redistributed pile is predicted to be 1,700 m long and 160 m wide at the 0.01 mm contour. It is assumed overtrawls will disturb an area of drill cuttings equal to the area of the accumulation, and the disturbed cuttings will settle within 10 m of the accumulation boundary; and
- Review of Table 6.1 shows that the main cause of direct and indirect disturbance will be as a result of the overtrawls, which at a worst case will directly disturb an area of approximately 6.84 km^2 and indirectly disturb 7.53 km^2.

6.2.2. Direct Disturbance of Seabed Habitats

6.2.2.1. *Mechanism of potential impact*

Direct interaction by physical disturbance can cause mortality or displacement of benthic species in the potential impact zone. Potential direct impact to the seabed would primarily occur from the placement of rock over exposed ends of lines for remediation of free spans, and from overtrawling.

There may also be some small scale highly localised suction dredging required should any concrete mattresses or the pipeline require excavation if partially buried, which will require the deployment of an ROV mounted dredger. However, this will be within the assessed footprint of the overtrawling activity and therefore has not been considered separately.

The sites of all the decommissioning direct impacts may also be subject to potential overtrawling, therefore to avoid double-counting, the total area of direct impact quoted here corresponds to the area covered by overtrawling. It is estimated that a maximum of approximately 6.84 km^2 of seabed could be directly impacted during overtrawling operations, and this is the main focus of the assessment. Other activities are however discussed below where they are considered to present different impacts.

As described in Section 6.1.1, the impacts associated with overtrawling the full length of the PL5 pipeline have been assessed as a worst case. However, the OPRED guidance notes on decommissioning recognise that the use of trawl gear may result in unnecessary environmental impact and that an alternative method to assess seabed clearance may be considered. It is therefore Fairfield's intention to minimise environmental impact by assessing the findings from non-intrusive geophysical surveys to verify that no snagging risks have been created, and identify areas that may require further overtrawl assessment. For example, as a result of completed decommissioning activities.

6.2.2.2. *Rock Placement*

Approximately 17,900 m^2 of additional rock will be placed as a result of the proposed decommissioning activities in order to protect cut pipeline ends and remove potential snag hazards. Impacts associated with this will include direct mortality through crushing of non-mobile benthic fauna, displacement of mobile benthic fauna and permanent loss of natural habitat. Environmental surveys undertaken at Dunlin, Cormorant and in the wider area show that the natural seabed in the project area is well represented in the wider area (Section 3.1.2), meaning the rock placement area comprises a relatively small proportion of the available similar habitat. The same surveys reveal a diverse faunal community, suggesting there is good scope for replacement of individuals that may be lost through the placement of rock. Mortality and displacement of benthos are therefore not expected to have significant effects at the population level. Whilst the loss of natural habitat will be a permanent impact, it is not expected to be significant when set against the area of similar natural habitat available in the wider area (e.g. Gardline, 2010b), and the freeing-up of seabed surface habitat (approximately 10,368 m^2) through removal of the selected PL5 pipeline infrastructure.

6.2.2.3. *Overtrawls*

The main potential mechanism of direct disturbance will come from overtrawling at the end of decommissioning activities. Impacts from the overtrawling may include mortality and injury, arising from crushing of benthic and epibenthic fauna that cannot move away, as well as disturbance of motile fauna as they move away from the area of disturbance. The sediment structure, including burrows of any animals present, will be disturbed. However, the scale of these impacts is small when compared to commercial trawling in the North Sea. A commercial trawler with a 15 m wide beam trawl trawling at 4 km/h would take approximately 4 days and 18 hours to cover the entire PL5 pipeline overtrawl area. Average fishing effort in ICES rectangle 51F1 between 2010 and 2014 was 102 days per year. In this context, the scale of the area of impact from the overtrawls is small and, unlike commercial fishing, will not occur on repeated occasions over many years.

The disturbance will occur within two main habitat complexes, as identified in Section 3.1.2; EUNIS biotope complex 'Deep circalittoral coarse sediment' (A5.15) and 'Deep circalittoral sand' (A5.27). Tyler-Walters *et al.* (2004) reported tolerance, recoverability and sensitivity related to disturbance of offshore biotope complexes. The biotopes that sit within these complexes have sensitivity information available to describe them:

- '*Glycera lapidum, Thyasira* spp. and *Amythasides macroglossus* in offshore gravelly sand' shows low sensitivity to surface abrasion and medium sensitivity to smothering;
- '*Hesionura elongata* and *Protodorvillea kefersteini* in offshore coarse sand' shows low sensitivity to surface abrasion, but there is no evidence to conclude on the sensitivity to smothering;
- '*Maldanid* polychaetes and *Eudorellopsis deformis* in offshore circalittoral sand or muddy sand' presents a medium sensitivity to surface abrasion with a medium level of resilience, however it is not sensitive to light smothering; and
- '*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand' has a medium level of sensitivity to surface abrasion with a medium level of resilience, and a low sensitivity to smothering.

It is expected that some damaged individuals will recover *in situ*, and lost individuals will be replaced by recruitment from the surrounding area. The seabed in the area is relatively homogenous with a diverse fauna and represents a good source of larvae and migrating adults to support population recovery.

While the presence of ocean quahog was confirmed in most of the survey datasets considered in this report, these records tend to be of small juvenile specimens in low numbers (Section 3.2.2). As a burrowing species, it is likely that any specimens that are buried by overtrawling will be able to recover to the surface rather than succumbing to anoxia. Ocean quahog is thought to be tolerant of increased suspended sediment levels. It is expected that it will be able to maintain its position in the sediment, and may temporarily switch to deposit feeding whilst disturbed sediment settles out (Tyler-Walters and Sabatini, 2008). This species is therefore considered to be moderately tolerant to smothering.

Hiddink et al. (2006) modelled the recovery time for benthic communities following disturbance by beam-trawling in the southern and central North Sea, which indicated that mud habitats on average took longer to recover (approximately 4 years) than higher energy sand and gravel areas (approximately 2 years). The project area is located in the northern North Sea, in deeper waters than the communities investigated by Hiddink et al. (2006), however the seabed energy is likely to be the important factor. Bottom currents in the project area are low and the seabed is predominantly sand, indicating a probable recovery time in the middle of the quoted range. Based on the information above, trawling will impact habitats in the project area, but impacts will be local and recovery is likely to occur within a matter of a few years.

6.2.3. Indirect Disturbance of Seabed Habitats

The proposed activities may also lead to the smothering of benthic species and habitats due to sediment suspension and re-settlement (indirect disturbance). The estimated area of indirect impact is approximately 7.52 km^2, which represents the entire direct impact area with a 10 m radius within which sediments may settle. As stated in the direct impacts section above, this area is negligible compared to the area of ICES rectangle 51F1 which is continually disturbed via other users of the sea without significant effect to the habitats/ species currently found there.

Indirect impacts will be increased suspended sediment load and re-settlement of sediments. The creation of higher than normal loads of sediment suspended in the water column and the subsequent re-settling of that sediment have the potential for negative impacts on habitats and species through burial and/or smothering. This may particularly affect epifaunal species (Gubbay, 2003) with the degree of impact related to individuals' ability to clear particles from their feeding and respiratory surfaces (e.g. Rogers, 1990).

There is evidence that the biotopes listed under the habitat complexes 'Deep circalittoral coarse sediment' (A5.15) and 'Deep circalittoral sand' (A5.27) have a low sensitivity to smothering, apart from the biotope *'Hesionura elongata* and *Protodorvillea kefersteini* in offshore coarse sand' (listed under the A5.15 habitat) for which there is no evidence to conclude on sensitivity to this type of pressure (Ashley, 2016; De Bastos, 2016; Tillin & Ashley, 2016; Tillin, 2016). Species characterising these biotopes are expected to be exposed to, and tolerant of, short-term increases in turbidity following sediment mobilization by storms and other events. There may be an energetic cost expended by species to either re-establish burrow openings, to self-clean feeding apparatus or to move up through the sediment, though this is not likely to be significant. Most animals will be able to re-burrow or move up through the sediment within hours or days.

With regard to the settlement of re-suspended sediments, the infaunal community is adapted to fluctuations in sedimentation levels and not likely to be particularly sensitive to temporary and localised increases. Tillin and Budd (2016) report on the abilities of buried fauna to burrow back to the surface. Results indicate bivalves are able to burrow between 20 – 50 cm depending on species and substrate. The abilities of the Dunlin fauna to recover to the sediment surface will depend on the species and the burial depth, but as overtrawling is not expected to result in deep burial, success should generally be high.

The Department for Environment, Food and Rural Affairs (Defra, 2010) states that generally impacts to the benthic environment arising from sediment re-suspension are short-term (over a period of a few days to a few weeks). Impacts on benthic habitats and species in the project area will be localised and are not expected to result in changes to the benthic community in the long-term.

6.2.4. Disturbance of Drill Cuttings

Disturbance of the Dunlin Alpha cuttings will result in re-distribution of some of the contents of the accumulation onto the surrounding seabed, along with entrained contaminants. This disturbance may occur to a small degree during removal of seabed structures, but the main mechanism of disturbance would potentially be during the overtrawls at the end of the decommissioning activities. However, as discussed in Section 6.2.1 above, Fairfield plan to use geophysical survey methods, where appropriate, to prevent unnecessary environmental impacts.

A cuttings disturbance modelling study (Xodus, 2018d) was undertaken to assess the extent of sediment re-suspension after disturbance of drill cuttings during the PL5 pipeline spool removal activities. The model predicts that a small plume of particulate and dissolved material travelling in a southerly direction will form near the seabed. The impact on the water column is small and short-lived, returning to baseline after just 1.3 days. A visible pile of redeposited cuttings of 400 m long and 50 m wide (to the 0.1 mm contour) is predicted to form to the south of Dunlin Alpha. A maximum thickness of 16 mm is predicted to occur at the discharge location (i.e. on top of the existing pile).

The predicted limited extent of disturbance is corroborated by the observations of several instances of cuttings pile disturbance reported in OSPAR (2009b), which were as follows:

- High intensity overtrawling of a cuttings accumulation in 70 m water depth resulted in spread of contamination, but not be at a rate likely to pose wider contamination or toxicological threats to the marine environment;
- Dredging of the North-West Hutton platform cuttings pile (much larger than the small accumulation at Dunlin) including repeated dredge backflushes resulting in significant re-suspension of cuttings material showed:
    - Drifting of re-suspended material was low during operations;
    - Hydrocarbon concentrations on dredged cuttings were similar to those on undisturbed cuttings, and whilst levels of alkylphenol ethoxylates and barium were higher in the dredge-recovered water at the platform topsides, hydrocarbon levels in the water remained low, indicating that the majority of hydrocarbons remained bound to the cuttings and did not become free in the dredged water;
    - Corroborating the above, hydrocarbons were not increased significantly in the seawater samples from monitoring stations as a result of the dredging, and there was no detectable oil in the plumes generated during the trial; and
    - There were no visible indications of an oil sheen at the surface, and little discernible effect was seen in the water column more than 100 m from the dredging operations.
- Use of high-pressure water jets to clear oil-based mud cuttings from the Hutton Tension Leg platform, causing significant re-suspension of cuttings, had no major effect on the spatial distribution of cuttings contamination, or on biological communities located more than 100 m from the original platform location.

The investigations at North West Hutton and the Hutton Tension Leg Platform suggest that release of hydrocarbons into the water column from disturbed drill cuttings is minimal, and the majority of hydrocarbons present would remain bound to the cuttings (OSPAR, 2009b). On this basis, the potential impact on receptor groups is likely to be minimal; this is described for the key groups in Table 6.2. It should be noted that although the emphasis here is on drill cuttings disturbance by overtrawls (since that activity represents the greatest potential for interaction with the cuttings), the assessment is equally applicable to any disturbance of the cuttings that may occur during the removal of the PL5 pipeline infrastructure.

Receptor group and discussion of potential impact
Plankton
The International Association of Oil and Gas Producers (IOGP, 2016) cites a number of sources indicating the impacts of drill cuttings discharge on plankton are negligible. Recorded deleterious effects on phytoplankton are generally attributed to light attenuation due to suspended solids. The majority of the disturbed material is expected to re-settle almost immediately, and material disturbed at the seabed (at 150 m depth) is unlikely to interact with the photic zone. No impacts on plankton are expected.
Benthic fauna
Toxicity Xodus Group (2018b) indicated that the majority of the drill cuttings present at Dunlin are composed by an aged oil-based mud (OBM) at the surface, a non-degraded OBM below, and a water-based mud at the bottom of the pile. The drill cuttings disturbance generated by the PL5 pipeline spool removal was modelled by Xodus Group (2018b) for Fairfield and predicted that a small plume of particulate and dissolved material traveling in a southerly direction will form near the seabed. The impact on the water column is small and short-lived, returning to baseline after just 1.3 days. A pile of redeposited cuttings of 400 m long and 50 m wide (to the 0.1 mm contour) is predicted to form to the south of Dunlin Alpha. A maximum thickness of 16 mm is predicted to occur at the discharge location (i.e. on top of the existing pile). Toxicity of synthetic-based mud to benthic organisms is, as summarised by Neff *et al*. (2000), generally low. Neff *et al*. (2000) conclude that a proportion of observed harmful effects are probably due to nutrient enrichment and subsequent anoxia in affected sediments. Hydrocarbon concentrations at Cormorant Alpha was on average 21.6 µg/g, and 62.6 µg/g at Dunlin Alpha. Neff *et al*. (2000) suggest that if the majority of the THC is made up of synthetic-based mud, toxic effects are unlikely. Reference to the OSPAR (2006) THC ecological effects threshold of 50 µg/g suggests there may be a limited impact. This apparent discrepancy arises in that the term ‘THC’ incorporates all types of hydrocarbon material, and toxic effects vary widely within the hydrocarbon grouping. Groups which tend to cause toxicity include polycyclic aromatic hydrocarbon (PAHs), which are hydrocarbons containing rings of only carbon and hydrogen atoms. The OSPAR Coordinated Environmental Monitoring Programme (CEMP) identified nine PAHs of specific concern. At Cormorant Alpha, the sediment total 2 to 6 ring PAH concentrations in surface sediments ranged from 0.046 µg/g to 1.49 µg/g (mean 0.216 µg/g), which is lower than the background concentrations measured across the northern North Sea (0.292 µg/g, UKOOA, 2001) (Fugro, 2014a). Only four stations out of 21 showed PAH concentrations higher than the background level for the northern North Sea (Fugro, 2014a). The total 2 to 6 ring PAH levels in the majority of the surface sediments collected from the Dunlin Alpha platform area in 2016 ranged from 0.119 µg/g to 4.78 µg/g (mean 0.759 µg/g) which was above the background concentrations of the northern North Sea. However, only three sampling stations out of ten showed PAH concentrations higher than the background value for the North Sea (Fugro, 2017f). The mean concentrations of the specific PAH CEMP listed compounds (OSPAR, 2009b) recorded in the sediments at Cormorant Alpha collected as part of the 2013 survey were all below the effect range low (ERL) thresholds (Fugro, 2014a). Those recorded in the sediments from station DFC05 at Dunlin Alpha (Fugro, 2017f) exceeded the ERL threshold concentrations indicating that ecological affects would be expected at this location. However, the results recorded for the other sediments collected during the 2016 survey were all well below the ERL values (Fugro, 2017f). These results suggest the cuttings accumulation has low potential for toxic impact outside of the existing cuttings pile, even if resuspended.

Receptor group and discussion of potential impact
At both ends of the PL5 pipeline, the majority of the most abundant taxa are considered hydrocarbon-intolerant. During the 2016 survey at Dunlin (Fugro, 2017f), the fauna was considered impoverished at the cuttings accumulation in terms of individuals and taxa present compared to the surrounding area, with cuttings samples presenting a greater percentage of polychaetes than in the wider field samples. Only one other station located at the platform end of the gas import pipeline route, station DPI01 was found to have an impacted community comprising of high numbers of secondary colonisers (e.g. *Chaetozone setosa*). These results suggest that the impact of the cuttings can be identified out to at least 200 m to east of the Dunlin Alpha platform. The surveys at both ends of the pipelines indicated that the most common species included *G. oculata*, *E. incolor*, *A. paucibranchiata*, *P. lyra* and the bivalve molluscs *A. similis* and *A. croulinensis*, which are all considered to be hydrocarbon intolerant (Hiscock *et al*., 2005, Rygg and Norling, 2013). The chemical determinants within the Dunlin Alpha and Cormorant Alpha cuttings (silt/clay, THC, N-Alkanes, PAHs, metals) were found to affect benthic communities within the cuttings samples. The predominant biotope identified across the Dunlin cuttings was broadly similar to SS.SMU.OMu.CapThy ('*Capitella* sp and *Thyasira* spp in organically enriched offshore circalittoral mud and sandy mud', EUNIS code A5.374). The station closer to the Cormorant Alpha platform (100 m) also revealed a low variety of species and the dominance of *Capitella* sp. (Fugro, 2014a). The available information regarding the toxicity of the cuttings accumulation, as well as the macrofaunal community present indicates that the accumulation is having a slight effect on the composition of the benthos, but is not causing any major community changes. Faunal composition at stations over 200 m from the Dunlin Alpha platform, and over 100 m from the Cormorant Alpha platform, was similar to that at more distant stations. This suggests that the faunal community at Dunlin is reasonably stable and tolerant of the contaminants in the area. It is therefore likely that re-settling of small amounts of cuttings around the fringes of the existing accumulation will not cause community level changes through toxicity. Whilst disturbance of the drill cuttings will result in some spreading of contaminated material over a small additional area, it is deemed unlikely to result in significant toxic effects. ***Burying*** IOGP (2016) reports a threshold drilling fluid/cuttings burial depth causing mortality of benthic organisms of 0.65 cm. Given that only a small proportion of material is expected to re-settle outside the original cuttings accumulation boundaries and that a maximum thickness of 16 mm is predicted to occur at the discharge location it is not expected that surrounding sediments will be buried to depths greater than 0.65 cm, and therefore no adverse effects on fauna, from burial by re-settling cuttings accumulation material, are expected. ***Anoxia*** In addition to toxicity and burial, drill cuttings can impact the benthos through anoxia caused by a combination of organic enrichment (which increases the biochemical oxygen demand) and introduction of fine sediments (which restricts oxygen penetration into sediments). The Fugro (2017b) survey conducted at the Merlin field indicated that the grab samples from the cuttings accumulation were anoxic below the surface, with a characteristic odour of hydrogen sulphide and a black sediment colouration (also indicative of hydrogen sulphide) below 5 mm sediment depth. Laboratory analysis showed that the total organic matter (TOM) content of the samples taken from the cuttings accumulation was comparable to samples taken from the surrounding area and the pipeline route (which were not anoxic). Further analysis indicated that the low toxicity oil-based fluid (LTOBM) portion of the organic material is weathered (Fugro, 2017b). While it was not possible to identify the degree of weathering to the synthetic-based mud it is likely that it too will have undergone weathering since the initial cuttings deposition. The low TOM content of the samples in conjunction with the weathering of the LTOBM and the relatively diverse infauna suggests the majority of the organic enrichment in the top layer of the accumulation has already been metabolised and the sediment is undergoing recovery. The presence of a diverse (if reduced) fauna in the cuttings accumulation samples indicates that anoxia is not currently having a significant

Receptor group and discussion of potential impact
impact on the fauna at the accumulation. The potential for re-settling of disturbed material to cause organic enrichment and subsequent anoxia of the surrounding sediments is therefore likely to be limited. In conclusion, the small amount of material likely to be moved outside the existing cuttings accumulation area, the expected low toxicity of the cuttings, and the limited potential for smothering and anoxia suggest there will be no significant impacts on the benthos from disturbance of the cuttings accumulation (whether by overtrawl or other interaction during removal of the seabed infrastructure).

Table 6.2 Potential impacts on receptor groups as a result of drill cuttings pile disturbance

6.2.5. Mitigation Measures

Fairfield will select one or more appropriate subsea contractors in line with its commitments to management of environmental impact. As part of this, Fairfield will require the contractor(s) to ensure that seabed interaction occurs in a controlled manner. For example, rock will be placed using a vessel with a flexible fall pipe, assisting with positional accuracy and controlling the spread of the material. Additionally, the localised cutting of the pipeline ends will be controlled by diver or ROV.

The drill cuttings pile at Dunlin Alpha is at the heart of the safety zone which is expected to remain in place for the ‘above sea level’ life of the installation, estimated at several centuries. Safety zones are marked on Admiralty charts and FishSAFE plotter files, highlighting the presence of the installations to other users of the sea, notably fishermen. The location of the drill cuttings at the centre of the safety zone around Dunlin Alpha will assist in reducing the likelihood of overtrawling occurrences to almost zero during this period, over which Fairfield will undertake geophysical survey methods to verify seabed clearance in order to prevent unnecessary environmental impacts resulting from overtrawls, and will discuss options with OPRED to ensure that seabed clearance surveys are acceptable.

6.2.6. Cumulative Impact Assessment

DECC (2016) specifies that impacts are considered cumulative only if:

- The physical or contamination “footprint” of a predicted project overlaps with that of adjacent activities; or
- The effects of multiple sources clearly act on a single receptor or resource (for example a fish stock or seabird population); or
- Transient effects are produced sequentially.

There are several oil and gas production facilities within the vicinity of the Dunlin subsea area. The Dunlin and the Cormorant subsea infrastructure are due to be decommissioned as part of the PL5 pipeline decommissioning project. Potential impacts from the Dunlin, Merlin and Osprey decommissioning operations are expected to act on the same receptors as the PL5 pipeline operations and there is the potential for cumulative impact with the Dunlin, Merlin and Osprey operations if the DPs overlap in time.

Commercial fishing produces significant physical disturbance “in a UKCS context, the contribution of all other sources of disturbance are minor in comparison to the direct physical effects of fishing” (DECC, 2016). The physical footprint of the PL5 pipeline decommissioning operations is not likely to overlap with fishing activity while decommissioning activity is ongoing since the area experiences low fishing activity and fishing vessels will be advised not to enter the operations area. Overtrawls at the ends of PL5 pipeline could be considered to target the same receptors as fishing vessels, although the intent with the overtrawls is not to remove any fauna from the seabed, and the only impact will be direct injury or mortality from the trawl mat. The PL5 pipeline decommissioning effects are expected to be transient, and fishing events are expected to be intermittent (the PL5 pipeline area is not considered to be of high importance relative to surrounding area, as described in Section 3.3.1).

Commercial fishing may begin immediately after decommissioning activities have finished and could therefore qualify as a sequential transient event. The PL5 pipeline decommissioning operations could be expected to produce cumulative impacts with commercial fishing. However, the main potential impact mechanism at PL5 pipeline will be conducted over a few days (overtrawls), so that the impact will be spread temporally and spatially. Overtrawling over the entire length of PL5 pipeline will cover a maximum area of approximately 6.84 km^2. The seabed area covered by overtrawls at all three locations is likely to equate to impacts created by just a few days' fishing effort. As such, overtrawls are not expected to contribute to a significant cumulative impact, and the use of geophysical survey methods will provide further mitigation.

In UKCS waters there are approximately 174 "potentially significant" cuttings piles (OSPAR, 2009c), all of which fall below the OSPAR threshold values for persistence and rate of loss of oil to the water column. As UKCS oil and gas infrastructure is decommissioned over the coming years, these cuttings piles may be subject to disturbance either during decommissioning operations or by future commercial fishing activity. The available literature indicates that even extensive disturbance of large cuttings piles, results in minimal impacts that are indistinguishable at distances greater than 100 m from the disturbance location. Given the potential spatial extent of any disturbance will be so limited, it is considered unlikely that the cumulative impacts of UKCS cuttings pile disturbance will be significant.

6.2.7. Transboundary Impact Assessment

The Offshore Energy SEA 3 for UKCS waters (DECC, 2016) states that seabed impacts from oil and gas operations are unlikely to result in transboundary effects and, even if they were to occur, the scale and consequences of the environmental effects in the adjacent state territories would be less than those in UK waters and would be considered unlikely to be significant. Although the Dunlin Alpha end of the PL5 pipeline infrastructure is close (12 km) to the UK/Norway median line, direct seabed impacts will be limited to the immediate footprint of the overtrawls, and indirect impacts from sediment re-suspension and re-settlement will not travel more than a few metres. Significant transboundary impacts are therefore not expected.

6.2.8. Protected Sites

Any potential seabed impacts associated with the PL5 pipeline decommissioning project will not occur within any protected site of the MPA network, including SPAs, SACs and NCMPAs. In addition, any seabed impacts do not spread sufficiently far to interact with any protected areas. As such, there is considered to be no Likely Significant Effect on any MPAs and hence no impact on conservation objectives or site integrity.

6.2.9. Residual Impact

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Seabed habitat and benthos	Low	Low	Negligible	Minor

Rationale
The information in the environment description (Section 3) has been used to assign the sensitivity, vulnerability and value of the receptor as follows. Data on sensitivity of the dominant benthic species present in the area is sparse, but there is good data on the sensitivity of the biotope complexes present. Biotope tolerance (resistance) to direct disturbance ranges from medium to low and ability to recover or adapt ranges from high to medium. Tolerance is therefore characterised as low and ability to recover as medium, giving a receptor sensitivity of low. The impact is not likely to affect long term function of the benthic system or the status of the benthic population. There will be no noticeable long-term effects above the level of natural variation experienced in the area. Receptor vulnerability is therefore deemed to be low. There is no specific value or concern about the site, which supports biotopes that are abundant across the wider area. The value of the receptor is therefore deemed to be negligible. Overtrawls are expected to directly impact a maximum of approximately 6.84 km^2 of seabed. The impact is expected to be temporary, with recovery within a matter of a between 0 – 5 years. The seabed in the area is reasonably homogenous, and the available habitat is extensive, with the impact affecting a small proportion of the total available habitat. The geographical extent of the impact is therefore deemed to be local. The impact will have a defined start and end point, and is likely to be intermittent over the course of several days, with the point of impact moving around the development area. The magnitude of the impact is therefore deemed to be minor.

Consequence	Impact significance
Low	Not significant

6.3. Discharges to Sea

The decommissioning of the PL5 pipeline infrastructure has the potential to introduce material, such as hydrocarbons, plastics or metals, into the marine environment.

6.3.1. Description and Quantification of Risk

The following sections outline the potential discharges associated with the decommissioning activities, degradation of materials decommissioned *in situ* and any unplanned/ accidental events.

General vessel activities are not anticipated to discharge any contaminants and Fairfield will ensure its contractors employ industry best practice and all vessels are MARPOL compliant. All pipework will be flushed to an acceptable level of cleanliness prior to decommissioning activities commencing, reflecting current guidance from OPRED and the Health and Safety Executive. The decommissioning guidelines encourage operators to utilise the Offshore Petroleum Activities (Oil Pollution Prevention and Control (OPPC)) Regulation 2005 Guidance Notes in the first instance when assessing the potential for discharges to sea during operations. These operations have therefore been assessed as low impact and are discontinued from further assessment.

6.3.1.1. *Potential Discharges During Decommissioning Activities*

Pipeline releases

The pipeline will be both pigged and flushed during cleaning which should remove the majority of contaminated material. Any residual traces of produced water, hydrocarbons, scale, metal oxides and other trace elements from the formation fluids are therefore expected to be low, although precise quantification is difficult to specify.

During the cutting of the pipeline ends there may be a small release of any residual material held within the pipeline. As previously mentioned the volume of any residual material is expected to be low across the entire pipeline and will have been flushed to an acceptable level of cleanliness. Therefore, as the pipeline cuts will only be at either end, any release will be equal to or less than typical licensed produced water discharges and will dissipate before it reaches the surface with no long-term persistence expected.

The pipeline left *in situ* will degrade overtime and contaminants contained within the pipeline material (e.g. coating) will be released. Releases are expected to occur in very small quantities and over a long period of time. Additionally, since the pipeline coating is covered with a concrete coating, the pathway for contaminant releases will be limited. Given the small quantities of contaminants expected to be released and the long-term degradation of the pipeline left *in situ*, no significant impacts are anticipated.

Drill Cuttings Disturbance at Pipeline Ends

Approximately 16 m of the PL5 pipeline spools are buried beneath the Dunlin Alpha cuttings pile, located to the south of the CGBS. Removal of PL5 pipeline spools will result in the resuspension of cuttings pile material, and therefore the release of contaminants. Fairfield commissioned Xodus Group to model the dispersion of this material to understand any impact on the local environment.

The discharges from the cuttings disturbance scenario were modelled using the ParTrack module within Sintef's Dose-related Risk and Effect Assessment Model (DREAM) (included in Marine Environmental Modelling Workbench (MEMW) software). Dispersion of particulates and dissolved material in the water column and settling behaviour were assessed primarily in the immediate vicinity of Dunlin Alpha (Xodus, 2018d).

The following assumptions were made:

- Resuspension of 7.5 m^3 (equivalent to 18.8 Te) material with the contaminant concentrations as indicated by the cuttings pile samples DCP01 (0.5 m depth) and DCP04 (surface; Fugro, 2017);
- No dredging or excavation will be undertaken prior to the removal of the spools; and
- The spools will be pulled through the cuttings pile vertically.

These assumptions are thought to be conservative and represent the worst-case scenario.

The model predicts that a small plume of particulate and dissolved material travelling in a southerly direction will form near the seabed. The impact on the water column is small and short lived, returning to baseline after just 1.3 days. A pile of redeposited cuttings of up to 400 m long and 50 m wide (to the 0.1 mm contour) is predicted to form to the south of Dunlin Alpha. A maximum thickness of 16 mm is predicted to occur at the discharge location (i.e. on the existing cuttings pile). The risk to the sediment in the worst-case scenario is predicted to be low, returning to near baseline after 160 days.

Operations may be required to disturb a minimal amount of drill cuttings at Cormorant Alpha. However, any potential drill cutting disturbance resulting from spool removal at the Cormorant Alpha end would be significantly less than disturbance at Dunlin Alpha due to the limited extent of coverage. As a result, any potential environmental impact associated with the removal of the Cormorant Alpha spools would be insignificant and, due to the distance between the platforms, cumulative impacts are very unlikely.

In summary, no significant, long-lived impact on the seabed or water column is predicted to occur due to the resuspension of sediment during removal of the PL5 pipeline spools from beneath part of the Dunlin Alpha cuttings pile.

6.3.1.2. *Degradation Related Discharges*

Structural degradation of the pipeline will be a long process caused by corrosion leading to the eventual collapse under its own weight. During this process, degradation products derived from the exterior and interior will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity. On the basis that the pipeline has been flushed and cleaned prior to decommissioning, the primary degradation products will originate from the following components:

- Pipeline residual contents (hydrocarbons, scale, treated flushing water);
- Steel;
- Sacrificial anodes (zinc and aluminium);
- Concrete; and
- Plastic (coating and mattress material).

The potential impacts associated with these degradation products are summarised below.

Metals

It is expected that metals will be released into the sediments and water column during the breakdown of the steel and sacrificial anodes. The toxicity of a given metal varies between organisms for several reasons, including their ability to take up, store, remove and detoxify these metals (Foden et al, 2009). Concentrations of the metals in the marine environment are not expected to exceed acute toxicity levels at any time due to their slow release over decadal timescales. However chronic toxicity levels may be reached for short periods within interstitial spaces of the sediments or in close proximity to the degrading pipeline. At these levels, metals act as enzyme inhibitors, adversely affecting cell membranes, and can damage reproductive and nervous systems. Changes in feeding behaviour, digestive efficiency and respiratory metabolism can occur. Growth inhibition may also occur in crustaceans, molluscs, echinoderms, hydroids, protozoans and algae (Foden et al, 2009). It is expected that any toxic impacts will be short lived and localised with minimal potential to impact populations of marine species. The potential for uptake and concentration of metals would also be limited to the local fauna and due to the slow release of these chemicals is not likely to result in a significant transfer of metals into the food chain.

Along the buried pipeline corridor there may be accumulations of metals in the sediments. The metals are likely to form bonds with the sediments, making them less bioavailable to marine organisms (Kennish, 1997). It is anticipated that failure of the pipelines due to through-wall degradation would only begin to occur after many decades – of the order of 60-100 years (MPE, 1999). The area that could be biologically impacted is expected to likely be limited to a few metres on either side of the pipeline or steel structure. The slow release of the metals associated with the pipeline steel is expected to have a negligible impact on the local environment.

Concrete

There are a number of mattresses which are buried in the sediment or under rock which will be decommissioned *in situ*. Any concrete remaining *in situ* is expected to degrade over centuries. The degradation products will be the aggregates (sand and gravel) used in the concrete and the reacted cement compounds, predominantly calcium carbonate. These degradation products are relatively chemically inert and similar in nature to the natural material within the local sediments. Impacts on benthic fauna are likely to be negligible due to the small area impacted.

Plastics

The PL5 pipeline incorporates plastic materials within its coating, as part of the matrix material within the concrete mattresses and as the structural material for the construction of the grout bags. Over time these materials are likely to gradually fragment and disperse as microplastics (defined as particles in the range of 1 µm to 5 mm) or nanoplastics (defined as particles in the range of 1 nm to 1 µm). There is virtually no information on weathering of plastics at sea, especially those submerged in seawater or sediment beyond the direct influence of photo/ultraviolet degradation (MPE, 1999).

The coating material (which also contains bitumen) on the pipeline is extremely thin (1-3 mm) and is bonded to the steel and covered by the subsequent concrete coating. This material would need to be ingested via particulate matter to be biologically available. However, due to the slow rate of degradation and the state burial there is likely to be limited opportunities for organisms to access this intermittently released material. Plastics in general have been considered non-toxic in the marine environment (HSE, 1997). As no micro-organisms have evolved to utilise the chemically resistant polymer chains as a carbon source, plastics can be expected to persist in the environment for centuries (GESAMP, 2015). While there has been much reporting on the issue of plastics in the marine environment, particularly in recent years, very little is known about the fate and impacts of its breakdown products (e.g. (Hylland and Erikson, 2013) and (HSE, 1997). Adverse effects of microplastics on marine organisms can potentially arise from physical effects, including the physical obstruction or damage of feeding appendages or digestive tract or other physical harm. In addition, microplastics can act as vectors for chemical transport into marine organisms causing chemical toxicity (Hylland and Erikson, 2013).

The plastics within the inventory being decommissioned *in situ* will be either contained within the pipeline trenches and buried or buried underneath rock cover so, once degradation becomes evident, it is likely to be many years before significant dispersal of breakdown products into the wider marine environment occurs. As concluded above for metals, it is not expected that this will add significantly to the risk of impact from plastics in the marine environment now or in the future.

6.3.1.3. *Accidental Events*

Potential sources of accidental releases from vessel operations include:

- Release of fuel during bunkering operations whilst the vessel is in port;
- Release of hydraulic oils from ROV or tools; and
- Release of fuel inventory (e.g., as a result of collision, grounding or fire).

Release of fuel during bunkering operations in port, if it were to occur, would be likely to be observed quickly, with spill response procedures initiated to stop the release and mitigate the impacts. Any hydraulic oil release during operations (such as ROV or tool use) would be likely to comprise a small volume of hydrocarbons which would not have the capacity to result in environmental impact in an open sea situation. Release of a vessel fuel inventory is therefore considered to be scenario of greatest concern and is thus considered in more detail below.

The likelihood of a vessel fuel inventory release is dependent on several factors including the seaworthiness of the vessel, the quality of vessel procedures, adherence to those procedures, sea conditions, water depth and density of shipping in the area. The vessels used for the PL5 pipeline decommissioning operations will undergo auditing to ensure seaworthiness and quality of procedures as detailed in the mitigation measures in

Section 6.3.2. The PL5 pipeline lies in deep water, excluding the possibility of grounding, and vessel activity is low, reducing the possibility of a collision between vessels.

Behaviour of Hydrocarbons at Sea

Fairfield has commissioned modelling of the instantaneous release of the entire fuel inventory of a vessel operating at the Dunlin Alpha platform to inform the PL5 pipeline decommissioning project. The scenario parameters are presented in Table 6.3, Table 6.4 and Table 6.5. The results of the modelling are summarised in Table 6.6.

Stochastic modelling indicated that a release of 3,500 m^3 of fuel at the Dunlin Alpha platform would result in a small area of visible surface oiling. The probability of surface oiling exceeding 0.3 µm is illustrated in Figure 6.1. The 0.3 µm threshold is the thickness above which an iridescent (rainbow coloured) sheen is visible. As shown in Figure 6.1 and Table 6.6, there is a maximum 10 – 20% probability that a sheen exceeding 0.3 µm will cross the UK/Norway transboundary line. There is zero probability of the fuel arriving to a UK shoreline during six months of the year and very low probability in the other six months (between 1 and 5%).

Oil type	ITOPF[3] group	Specific gravity	Viscosity (temperature)	Pour point (°C)	Wax content (%)	Asphaltene content (%)
Marine diesel	II	0.843/36.4	3.9 (13°C)	-36	No data	No data

Release source	Fuel inventory	**Release volume**	3,500 m^3
Justification for worst case volume		Loss of entire marine diesel inventory	
Latitude	61° 19’ 26.397” N	**Longitude**	01° 32’ 48.20” E
UKCS block	211/23a	**Type of release**	Surface
Release duration	1 hour	**Release depth**	0 m below sea level
Total simulation time	20 days	**Persistence duration**	20 days
Release rate	Instantaneous	**Total release**	3,500 m^3

Table 6.3 Modelling oil type and release scenario

Number of simulations	25 per season	**Release period**	Multi-year statistic (Seasonal)
Total number of simulations		In excess of 100	
Oil spill modelling software used		OSCAR (Marine Environmental Modelling Workbench v8.0.1)	

Table 6.4 Modelling simulation details

[3] International Tanker Owners Pollution Federation

Metocean parameters			
Air temperature	Variable (6°C - 17°C)	**Sea temperature**	Variable (8.6°C – 13.2°C)
Wind data (years covered)	2008 – 2014	**Wind data reference**	European Centre for Medium-Range Weather Forecasts
Current data (years covered)	2008 – 2014	**Current data reference**	Hybrid Coordinate Ocean Model

Table 6.5 Modelling MetOcean parameters

Shortest time to reach and probability (≥1%) of surface oil (≥0.3 µm) crossing median line				
North Sea coastal states	**Dec – Feb**	**Mar – May**	**Jun – Aug**	**Sep – Nov**
Norwegian Waters	6 hours	6 hours	6 hours	6 hours
	10 – 20%	10 – 20%	10 – 20%	10 – 20%
Shortest time and probability (≥1%) for arrival of fuel to the shore after 20 days				
Shetland	No arrival	No arrival	1 – 5%	1 – 5%
	N/A	N/A	9 days	6 days
Norway	No arrival	1 – 5%	No arrival	1 – 5%
	N/A	13 days	N/A	18 days

Table 6.6 Modelling surface and shoreline oiling predictions

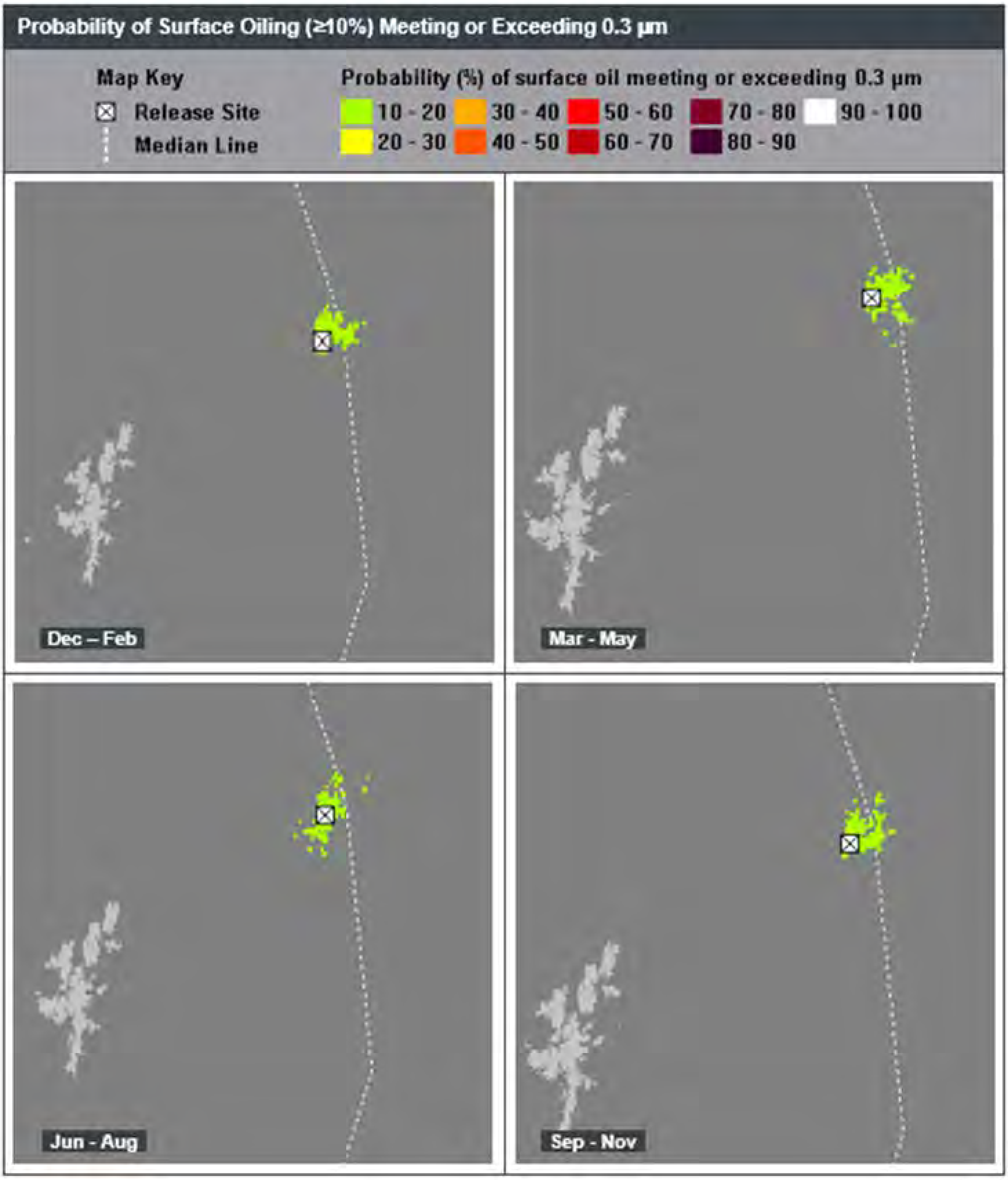


Figure 6.1 Stochastic modelling probability of sea surface oiling (>0.3 µm thickness)

6.3.1.4. *Environmental Vulnerability to Accidental Releases*

Environmental vulnerability is a function of both the likelihood of impact (as considered in previous sections) and the sensitivity of the environment. Offshore and coastal vulnerabilities need to be considered separately as different parameters will apply.

There may be impacts on plankton in the immediate area of the release for the duration of the release due to the dissolution of aromatic fractions into the water column (Brussaard *et al*., 2016). Such effects will be greater during a period of plankton bloom and during fish spawning periods. Contamination of marine prey including plankton and small fish species may then lead to aromatic hydrocarbons accumulating in the food chain. These could have long-term chronic effects such as breeding failure in fish, bird and cetacean populations. This may affect stocks of commercially fished species. The relatively small size of any release in comparison to the available habitat and the widespread populations of plankton and small fish is expected to limit the significance of these impacts.

Juveniles and eggs are potentially the fish life-stages most vulnerable to hydrocarbon releases. As outlined in Section 3.2.3, a number of commercially important pelagic and demersal fish species are found in the vicinity of the PL5 pipeline infrastructure. Sixteen species are expected to use the project area for spawning and/or nursery grounds at various times of the year. However, any accidental release is not expected to result in significant impacts on fish spawning or recruitment success as the maximum release volume is small and the available spawning and nursery areas are very large.

In a nature conservation context, seabirds are the group at greatest risk of harm due to surface oil pollution in the offshore environment (JNCC, 2011). The most familiar effect of oil pollution on seabirds is the contamination of plumage, resulting in the inability to fly and loss of insulation and waterproofing, which alone may cause death. Individuals surviving these primary impacts are prone to ingest toxins whilst preening in attempts to remove contamination; this may result in secondary toxic effects.

The seasonal vulnerability of seabirds to surface pollutants in the immediate vicinity of the PL5 pipeline infrastructure, derived from JNCC block-specific data, suggest that seabirds in this area have a low vulnerability to surface pollution, although some of the blocks exhibit high vulnerability at certain times of the year (see Section 3.2.4). The magnitude of any impact will depend on the number of birds present, the percentage of the population present, their vulnerability to hydrocarbons and their recovery rates from oil pollution. Modelling suggests that the area of sea surface contaminated by hydrocarbons in the event of a spill will be small, with a low (10 – 20%) probability of a surface sheen exceeding 0.3 µm extending outside of the project area.

Cetaceans are also present in the vicinity of the PL5 pipeline infrastructure (see Section 3.2.5). The potential impact of an accidental release will depend on the species and their feeding habits, the overall health of individuals before exposure, and the characteristics of the hydrocarbons. Baleen whales are particularly vulnerable whilst feeding, as oil may adhere to the baleen if the whales feed near surface slicks (Gubbay and Earll, 2000). Cetaceans are pelagic (move freely in the oceans) and migrate. Their strong attraction to specific areas for breeding or feeding may override any tendency cetaceans have to avoid hydrocarbon contaminated areas (Gubbay and Earll, 2000). It is considered unlikely that a population of cetaceans in the open sea would be affected in the long-term.

The likelihood of an accidental hydrocarbon release impacting the coastal environment is a function of the likelihood of such an event occurring and the probability of the hydrocarbon beaching. The level of impact is also directly related to the volume of the hydrocarbons released, the volume of hydrocarbon beaching, the composition of the beached hydrocarbons, and the type of beach and receptors present on the shore at the time of beaching. Based on the available modelling of the fuel inventory being released at the Dunlin Alpha platform, it is considered highly unlikely that any vessel inventory release associated with PL5 operations would reach a UK shoreline (zero probability for six months of the year and between 1 and 5% for the other six months).

6.3.2. Mitigation Measures

The following provides an overview of proposed measures that either reduce the probability of an accidental release, or reduce the consequences:

All PL5 pipeline infrastructure will be pigged and flushed of hydrocarbons prior to as low as reasonably practicable (ALARP) levels prior to commencing decommissioning operations;

- Vessels will be selected which comply with IMO/Maritime and Coastguard Agency (MCA) codes for prevention of oil pollution;
- Guard vessels will be used during decommissioning operation to warn other users of active operations in the area;
- Vessel pre-mobilisation audits will be carried out and will cover:
    - Review of spill prevention and response procedures;
    - Procedural controls;
    - Bunkering and storage arrangements;
    - Vessel condition certificates;
    - Vessel maintenance records;
    - Evidence of crew competency; and
    - Certification of equipment.
- Vessel personnel will be given full training (by Fairfield or the contractor(s) as appropriate) in chemical release prevention and actions to be taken in the event of an accidental chemical release;
- Operational procedures onboard vessels will include use of drip trays under valves, use of pumps to decant lubricating oils and use of lockable valves on storage tanks and drums;
- Shipboard Oil Pollution Emergency Plans (SOPEPs) including modelling and appropriate response planning will be in place where appropriate;
- The Dunlin Alpha Oil Pollution Emergency Plan, will be adhered to within the confines of the PL5 pipeline Project area;
- AIS and other navigation controls will be used to reduce collision risk;
- Simultaneous operations (SIMOPs) will be actively identified and managed;
- Hoses and connections will be visually inspected prior to use; and
- Tool box talks will highlight the importance of minimising the likelihood of an accidental release occurring; and
- At detailed engineering stage, potential hydrocarbon releases will be identified and necessary measures will be included within work procedures and appropriate discharge volumes consented by the regulator.

6.3.3. Cumulative Impact Assessment

It is important to consider the potential for cumulative impacts to arise from accidental events generated by the project acting in conjunction with accidental events generated by other projects or activities occurring in the area.

Decommissioning of the Merlin and Osprey production and water injection clusters, the Dunlin subsea infrastructure and the Dunlin Alpha platform may overlap temporally and geographically with the decommissioning activities for PL5 pipeline. The overlapping execution of these projects will result in higher than normal vessel densities in the area, increasing the risk of a vessel collision (two moving objects striking each other) or collision (a moving object striking a stationary object). Mitigation measures, including identification and management of SIMOPS and use of AIS, are considered to reduce this additional risk to ALARP. An alternative would be to conduct decommissioning operations consecutively instead of concurrently, however it is considered that the increased cost associated with doing this would be grossly disproportionate to the reduction of risk achieved.

Any accidental hydrocarbon release at the PL5 pipeline project area is expected to dissipate within days. It is considered very unlikely that additional accidental releases from other sources would occur in the same timeframe and produce a cumulative impact.

6.3.4. Transboundary Impact Assessment

There is a low probability that an accidental hydrocarbon release in the project area would cross into the Norwegian sector. Modelling of a release at Dunlin Alpha suggested that the probability of a surface sheen extending into Norwegian waters was no more than 10 – 20%. If released hydrocarbons did cross the transboundary line the volumes would be small, with limited scope for environmental impact.

As outlined in Section 6.3.1.3, fuel released is not predicted to reach a Norwegian shore with a greater probability than between 1 and 5% for six months of the year – there is zero probability of fuel arriving at shore for the other six months. The maximum volume of fuel that could arrive at any shoreline is predicted to be approximately 1% of that released.

In the event of an accidental hydrocarbon release entering Norwegian waters, it may be necessary to implement the Norway-UK Joint Contingency Plan (NORBRIT) Agreement. The NORBRIT Agreement sets out command and control procedures for pollution incidents likely to affect both parties, as well as channels of communication and available resources. The MCA Counter Pollution and Response Branch also have agreements with equivalent organisations in other North Sea coastal states, under the Bonn Agreement 1983.

6.3.5. Protected Sites

This section considers the potential for accidental events related to the project to impact upon the conservation objectives (and ultimately site integrity) of important protected sites, specifically SPAs, SACs, and NCMPAs. The output of the accidental hydrocarbon release modelling described in Section 6.3.1.3 has been compared against the location of SPAs, SACs, and NCMPAs to determine where there is considered to be the potential for interaction.

6.3.5.1. *Direct Interaction with Coastal Sites*

As outlined in Section 6.3.1.3, fuel released is not predicted to reach shore in the UK with a greater probability than between 1 and 5% for six months of the year – there is zero probability of fuel arriving at shore for the other six months. The maximum volume of fuel that could arrive at any shoreline is predicted to be approximately 1% of that released. Considering the very low probability and the very low volumes involved, direct interaction with any coastal or onshore protected sites is not expected.

6.3.5.2. *Direct Interaction with Receptors from Coastal Sites found Offshore*

In addition to direct interaction with a site (i.e. hydrocarbons crossing the boundary of a site), it is necessary to acknowledge that qualifying features of some sites are mobile (e.g. seabirds and marine mammals) and that some individuals may forage or move through the area within which an accidental release has occurred. In terms of marine mammals for which sites are designated, the southern North Sea candidate SAC, for which harbour porpoise is the proposed qualifying feature, is located over 600 km south of the PL5 pipeline project area. Harbour porpoise are highly mobile, and records exist of individuals travelling over 1,000 km (JNCC, 2013b). It is not expected however that individuals associated with the southern North Sea candidate SAC will occur in the project area in sufficient numbers during any limited period over which a release would take to disperse to have a significant impact on the harbour porpoise population associated with the candidate SAC.

Sites designated for bottlenose dolphin, harbour seal and grey seal are present along the east coast of Scotland, however the distance of the sites from the project suggests no individuals from these sites will occur in the project area and they are therefore excluded from further assessment.

It would be very difficult to assign seabirds identified within the project area to specific SPAs. For many species, once breeding is complete, individuals are no longer restricted to foraging within certain distances (i.e. foraging ranges) from their breeding colony as there is no longer any requirement to return to eggs or chicks. Furness (2015) defines biologically appropriate, species-specific, geographic non-breeding season population estimates for seabirds. For a number of key species there is strong evidence that once birds leave the breeding colony they become widely dispersed over large distances, often intermingling with birds from other breeding colonies (typically of the same species) and in some cases birds that have migrated from overseas breeding colonies (Furness, 2015). Consequently, the potential for an accidental vessel inventory release along the PL5 pipeline route to have population level impacts on birds from any single SPA is much reduced. Potential impacts on birds from protected sites during the non-breeding season (i.e. when they are offshore) are therefore expected to be negligible.

6.3.5.3. *Direct Interaction with Offshore Sites*

For direct interaction with offshore sites without a land component, surface occurrence of released hydrocarbon within the site is taken as an indication that the site has the potential to be impacted. Modelling suggested that in a fuel inventory release scenario, the probability of a surface sheen 0.3 µm thick extending outside of the project area would not exceed 10% and even then, would not extend much beyond the project area (Figure 6.1). The closest protected site to the project area is the Pobie Bank SAC, which is 65 km away at the closest approach. This site is designated for seabed features that would be unaffected by a limited volume of fuel oil being present on the surface. Diesel oil is not as sticky or viscous as so called ‘black oils’, so when it does beach it tends to be quickly washed off and dispersed by tidal washing and waves (United States National Oceanic and Atmospheric Administration (NOAA), 2015). It is therefore considered unlikely that there would be a significant impact on any offshore protected sites.

6.3.5.4. *Protected Species*

There are several species that are known or expected to occur in the area which are protected but not associated with a site designation. Potential impacts on these species are discussed below.

The ocean quahog is a PMF and is also on the OSPAR List of Threatened and/or Declining Species and Habitats. This species is known to occur in the area at low densities as detailed in Section 3.2. However, the project area is not thought to be particularly important for the species. Ocean quahog is a benthic species, and since the majority of any released hydrocarbon is expected to remain at the surface it is considered unlikely that an accidental release from a vessel near the PL5 pipeline infrastructure would have a significant impact on the ocean quahog population in the area.

Basking sharks, spurdog and blue shark are all on the IUCN Red List; basking sharks are also protected under the Wildlife and Countryside Act 1981 (as amended). All three species are expected to occur in the area, although not in numbers that are important in a population context, especially for the limited period over which a release would take to disperse. It is not expected that a release from a vessel near the PL5 pipeline infrastructure would have a significant impact on any of these three species.

6.3.6. Residual Impact

Receptor	Sensitivity	Vulnerability	Value	Magnitude
Seabirds	High	Low	Very high	Minor

Rationale

The information in the environment description (Section 3) has been used to assign the sensitivity, vulnerability and value of the receptor as follows.

The worst case accidental event during PL5 pipeline decommissioning operations is expected to be the release of a vessel fuel inventory, expected to comprise a maximum of 3,500 m^3 of fuel oil. Direct impacts may occur in the event of a release, the most serious of which could be the oiling of seabirds at the surface. Impacts are expected to be short-term and local, although there is a low probability of a localised transboundary impact. The frequency of the impact is expected to be a one-off. The likelihood of a vessel inventory release in the vicinity of PL5 pipeline is considered very low. The likelihood that seabirds will be in the area in high numbers during the summer months when the vessels will be operating is high, although the number of seabirds present is expected to be low during most months (especially so during the summer months when they are breeding onshore and feeding nearshore). Taking all this into account, the impact magnitude is expected to be minor.

Seabirds are especially sensitive to surface oil pollution as it affects both their ability to fly and the effectiveness of their insulation. Receptor sensitivity is therefore expected to be high. It is however considered unlikely that there will be sufficient seabirds affected by a release in the vicinity pf the PL5 pipeline infrastructure to cause population-level impacts, and receptor vulnerability is therefore considered to be low.

It is likely that seabirds from the coastal SPAs on Shetland as well as other protected sites will use the PL5 pipeline area. In addition, the majority of species expected to use the PL5 pipeline area are protected under the Birds Directive (2009/147/EC). The receptor value is therefore considered very high.

Seabirds are considered highly sensitive to surface oil pollution and are considered to be very high value receptors. Seabird vulnerability to an accidental release in the vicinity of PL5 pipeline infrastructure is considered low. The likelihood of a vessel inventory release near PL5 pipeline is considered to be very low. Should an accidental release occur there are likely to be visible impacts on seabirds. The severity of these impacts will depend on the time of year and the number of seabirds using the area, however even during periods of high seabird density, the small size of any potential release means that the consequences are likely to be local in extent. In combination, these factors indicate a low consequence level and the impact is therefore considered not significant.

Consequence	Impact significance
Low	Not significant

7. Waste Management

The duty of care with regards to appropriate handling and disposal of waste rests with Fairfield. In order to enable Fairfield to manage waste appropriately, it is necessary to first understand the types and sources of waste. A description of the PL5 pipeline subsea infrastructure to be decommissioned is provided in Section 2.1 and a summary of the types and quantities of materials associated with the project is provided in Table 7.1.

Item	Description	Approximate weight (Te)
Metals	Ferrous (steel)	7,995
	Non-ferrous (e.g. copper, aluminium, zinc, indium)	54
Concrete	Aggregates (mattresses, grout bags, sand bags)	8,512
Plastic	Rubbers, polymers	925 (Note 1)
Hazardous substances	Residual fluids (hydrocarbons, chemicals, control fluid)	N/A (Note 2)
	Naturally occurring radioactive material (NORM)	N/A (Note 2)
Total		17,486

Note 1 - May contain some hazardous materials but in extremely low quantities

Note 2 - There may be small volumes of residual fluids remaining in the pipeline post-pigging and flushing, however this cannot be quantified as yet as no sections of pipeline have been recovered from the pipeline during its operation. In terms of NORM contamination, again this cannot be quantified until material is recovered however, sampling from operational flushing activities indicates negative results for NORM which suggests either no or only trace contamination below any detectable levels.

Table 7.1 PL5 pipeline subsea material summary

The estimated total weight of subsea materials associated with the PL5 pipeline Decommissioning Programme is 17,486 Te.

Section 7.1 describes the regulatory control of waste material whilst Section 7.2 outlines the types and quantities of materials to be decommissioned. Section 7.3 details the measures that will be in place to ensure waste is appropriately managed.

7.1. Regulatory Control

The EU's Revised Waste Framework Directive (Directive 2008/98/EC) was adopted in December 2008. The aim of the directive is to ensure that waste management is carried out without endangering human health and without harming the environment. Article 4 of the directive also states that the waste hierarchy shall be applied as a priority order in waste prevention and management legislation and policy.

The Waste (Scotland) Regulations 2012 control the generation, transportation and disposal of waste within the European Union and the shipment of waste into and out of the EU. It covers controlled waste, duty of care, registration of carriers and brokers, waste management licensing, landfill, hazardous waste, producer responsibility, packaging waste, end-of-life vehicles, waste electrical and electronic equipment and the trans-frontier shipment of waste.

Whether a material or substance is determined as a 'waste' is determined under EU law. The Waste Framework Directive defines waste as "any substance or object in the categories set out in Annex 1 of the Directive which the holder discards or intends or is required to discard". Materials disposed of onshore must comply with the relevant health and safety, pollution prevention, waste requirements and relevant sections of the Environmental Protection Act 1990.

Management of radioactive materials is governed under Radioactive Substances Act 1993, Trans-frontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008. The handling and disposal of radioactive waste requires additional authorisation. Onward transportation of waste or recycled materials must also be in compliance with applicable legislation, such as the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, a highly prescriptive regulation governing the carriage of dangerous goods by road.

7.2. Waste from Onshore Dismantling

Infrastructure requiring removal as part of the PL5 pipeline decommissioning project were determined following completion of the CA process described in Section 2.2. A summary of the types and quantities of waste materials being removed from the subsea area is provided in Table 7.2.

Item	Description	Approximate weight (Te)
Metals	Ferrous (steel)	270
	Non-ferrous (e.g. copper, aluminium, zinc, indium)	2
Concrete	Aggregates (mattresses, grout bags, sand bags)	319
Plastic	Rubbers, polymers (Note 1)	30
Hazardous substances	Residual fluids (hydrocarbons, chemicals, control fluid)	N/A (Note 2)
	NORM	N/A (Note 2)
Total		621

Note 1 - May contain some hazardous materials but in extremely low quantities

Note 2 - There may be small volumes of residual fluids remaining in the pipeline post-pigging and flushing, however this cannot be quantified as yet as no sections of pipeline have been recovered from the pipeline during its operation. In terms of NORM contamination, again this cannot be quantified until material is recovered however, sampling from operational flushing activities indicates negative results for NORM which suggests either no or only trace contamination below any detectable levels.

Table 7.2 Summary of materials being removed from the PL5 pipeline subsea area

Steel and other recyclable metal are estimated to account for the greatest proportion of the materials inventory. Typically, between 95-98% of the materials from decommissioning projects can be recycled (OGUK, 2016b). OGUK (2016a) report that all of the 4,300 Te of scrap metal brought onshore from decommissioning projects in 2015 was reused or recycled. Given that much of the material returned to shore from the decommissioning of the PL5 pipeline will be recyclable, it is expected the same high proportion of recycling will be true for the PL5 pipeline decommissioning project. A summary of Fairfield's waste management aspirations for material brought to shore is given in Table 7.3.

Waste stream	Reuse	Recycle	Other recovery	Landfill
Ferrous metal	0 - 15%	95 - 98%	0%	0 - 5%
Non-ferrous metal	0%	95 - 98%	0%	0 - 5%
Concrete (aggregates) (Note 1)	0 - 50%	0%	50 - 100%	0 - 25%
Plastics	0%	50 - 75%	15 - 40%	0 - 10%
Residual hydrocarbons	0%	0%	85 - 100%	0 - 15%
NORM	0%	0%	0%	100% (Note 2)
Marine growth	0%	0%	75 - 100%	0 - 25%

Note 1 - Reuse/recovery opportunities will be dependent on availability of infrastructure projects

Note 2 - NORM may be sent for incineration prior to landfill in order to reduce volume

Table 7.3 Waste management aspirations

For materials where reuse or recycling is not an option, these will be sent to appropriate disposal facilities for recovery, or landfill where other options are not viable. In terms of the waste hierarchy, recovery is more beneficial than landfill since it means a waste product is used to replace other materials that would otherwise have been used to fulfil a particular function; in the case of concrete, for example, the mattresses may be crushed to form construction aggregate, meaning that construction aggregate need not be created from scratch.

Any hazardous wastes remaining in the recovered infrastructure will be disposed of under an appropriate permit. It is likely that there will be small volumes of residual hydrocarbons, chemicals (such as in the umbilical jumpers) and naturally occurring radioactive material; such equipment will be disposed of in accordance with relevant Safe Operating Procedures and the Fairfield waste management strategy with consideration of specific sampling, classification, containment, and consignment conditions.

Most of the marine growth will be soft marine growth (e.g. anemones and the soft coral), but hard marine growth is likely to include tube worms, barnacles and mussels. The receiving dismantling yard will strip the installation into its components before they undergo further processing and it is proposed that marine growth be either disposed of to landfill or composted. An alternative option is to send some of the marine growth to be disposed of at an anaerobic digestion facility for use as a fertiliser on land. However, these facilities can only take limited volumes of material.

With regards transboundary movement of waste, OGUK (2016a) report that 98% of all waste brought to shore from offshore oil and gas activities was processed in the UK, with just 1% transferred outside of the UK for processing (the disposal route for the remaining 1% of waste was not specified). Should Fairfield select a dismantling yard outside of the UK, all appropriate transboundary reporting and tracking of waste will occur.

7.3. Waste Management Strategy

Environmental management of the PL5 pipeline decommissioning project activities will include waste management as a key factor in limiting potential environmental impact. Management of waste will therefore be dealt with in accordance with Fairfield's Environmental Management Strategy (EMS), certified to the international standard ISO 14001:2015.

As Operator of the PL5 pipeline, Fairfield recognises its duty of care for all waste materials generated from the forthcoming decommissioning activities. As a result, Fairfield must consider the complete life cycle of decommissioning waste, including:

- Waste identification;
- Offshore treatment and storage;
- Offshore preparation/cleaning;
- Shipment of waste;
- Onshore deconstruction;
- Onshore transportation;
- Final disposal/recovery; and
- Ongoing monitoring.

To this end, Fairfield has developed a waste management strategy for the project, in order to describe the types of materials identified as decommissioning waste, and outline the processes and procedures necessary to support the Decommissioning Programme for the PL5 pipeline (consistent with other Fairfield decommissioning projects).

The waste management strategy details the measures in place to ensure that the principles of the waste management hierarchy are followed during the decommissioning (as described below). For example, transfer notes will accompany all non-hazardous waste to shore and consignment notes will be in place for any hazardous waste.

Furthermore, radioactive waste will be processed by a licensed facility capable of taking contaminated material under appropriate licences and disposing accordingly. The waste management strategy details the checks that Fairfield will undertake on the selected dismantling yard and any onward disposal facilities to ensure all permits and licenses are in place for the handling and disposal of the waste types identified. Fairfield will ensure that waste is transferred by an appropriately licensed carrier who should have a waste carrier registration, waste management licence or exemption, as appropriate for the type of waste. The contractor(s) that Fairfield will assign to the work will be required to maintain a waste audit trail through to recycling or disposal facility. The strategy will be kept under constant review and appropriately updated throughout the decommissioning activities.

The waste management strategy is underpinned by the waste hierarchy shown in Figure 7.1. The hierarchy is based on the principle of waste disposal only where re-using, recycling and waste prevention cannot be undertaken[4]. Fairfield will communicate the waste management strategy to all relevant members of the decommissioning team (including contractors where relevant).

[4] For decommissioning projects, the transfer of material to shore is difficult to limit in the context of the need to leave the seabed offshore in an appropriate condition. As such, waste prevention with regards the main sources of waste may not be possible. However, it is important that waste prevention is considered for other aspects, such as during day to day vessel use.

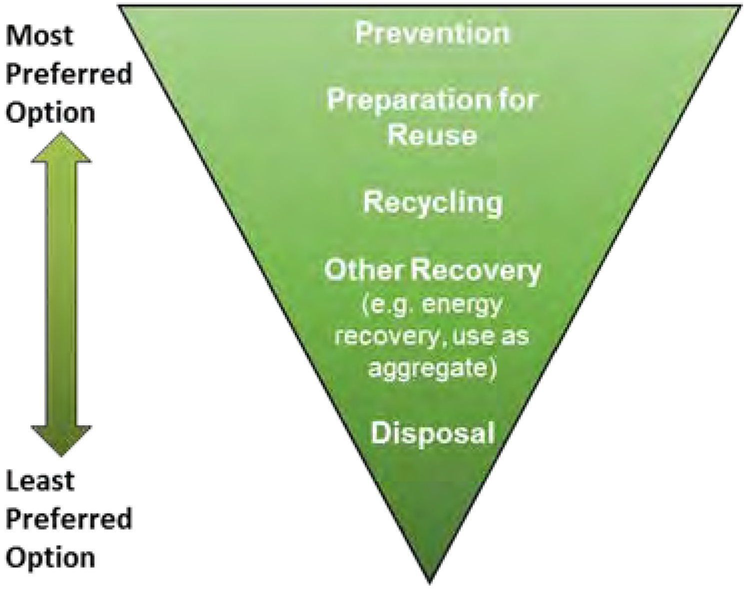


Figure 7.1 Waste hierarchy

7.4. Environmental Management

Beyond the main period of preparation for decommissioning *in situ* and removal of components of the PL5 pipeline subsea area, the project has limited activity associated with it, other than any post-decommissioning environmental surveys and deployment of additional rock protection. The focus of environmental performance management for the project is therefore to ensure that the activities that will take place during the limited period of decommissioning happen in a manner acceptable to Fairfield (and to stakeholders). The primary mechanism by which this will occur is through Fairfield's Environmental Management Policy, described in Section 7.5, and specifically through the EMS that it requires be operational.

7.5. Health, Safety and Environment Plan

Fairfield senior management is responsible for ensuring that Fairfield's Environmental Management System is applied to all activities. To support this, a project HSE plan will be developed which outlines how HSE issues will be managed and how Fairfield's HSE policies and EMS will be implemented effectively throughout the project. The HSE plan will apply to all work carried out on the project, be it onshore or offshore. Performance will be measured to satisfy both regulatory requirements including compliance with environmental consents, as well as to identify progress on fulfilment of project objectives and commitments.

7.6. Onshore Management

There is the potential for the onshore phase of decommissioning to interact with communities in the vicinity of the dismantling yard. The onshore location has yet to be confirmed, but locations within and outside of the UK may be considered. Whether in or outside of the UK, dismantling will be carried out at existing sites which will have in place site management plans and the correct licences for the proposed dismantling operations and as such will limit potential impacts to local communities. The site selected for decommissioning activities will have in place correct and up to date licences for operation and relevant site management plans. These will ensure operations on site minimise any potential impacts to the local community. For example, specific requirements are likely to include:

- Noise will be managed as part of the onshore dismantling contract and as part of the selection process for the dismantling yard, noise management will be taken into consideration. Noise emitting activities should not occur at particularly sensitive times such as early morning and late night;
- In order to mitigate odour from marine growth, Fairfield will require selection of a dismantling yard that has procedures in place to dispose of marine growth in a manner that will avoid odour nuisance occurrences. This could take the form of an odour management plan being in place within the dismantling yard, management measures could include rapid removal of marine growth and spraying of odour suppressants; and
- Fairfield may require that onshore dismantling yards conduct a review of records of engagement with communities and close-out any outstanding issues.

7.7. Commitments

With regards commitments to management interaction between the project and the environment, the key mitigation and management measures identified during the environmental impact assessment process that are above and beyond regulatory requirements are summarised in Table 7.4. Each commitment will be reviewed regularly to ensure that it is being met; in this way, environmental management is an ongoing process and will continue beyond implementation of mitigation measures identified during this environmental impact assessment. The HSE plan for the project will detail how these commitments are managed over the project.

Commitment
Seabed interaction
Fairfield will require that contractors ensure seabed interaction occurs in a controlled manner. For example, rock will be placed using a vessel with a flexible fall pipe, assisting with positional accuracy and controlling the spread of the material.
Other sea users
Once decommissioning activities are complete, updated information on the PL5 pipeline subsea area (i.e. which infrastructure remains *in situ* and which has been removed) will be made available to allow the Admiralty Charts and the Fishsafe system to be updated.
The number of vessels and length of time required on site will be reduced as far as practicable through careful planning of the decommissioning activities and information on the location of vessel operations will be communicated to other sea users through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings.
Any objects dropped during decommissioning activities, and other pre-existing oil and gas related debris, will be removed from the seabed as appropriate.
A geophysical survey will be undertaken and any oilfield related objects/debris identified will be removed by an ROV. Evidence of a clear seabed will be submitted to OPRED in place of a clear seabed certificate. Where required, an overtrawl assessment will be conducted to confirm that no snagging hazards exist.
Fairfield intends to set up arrangements to undertake post-decommissioning monitoring on behalf of the Licence Owners.
Noise
The duration of noise emitting activities will be limited; for example, vessels will only be deployed where necessary and the number of cuts will be limited as far as is practicable.

Commitment
Energy use and atmospheric emissions
Onshore facilities have appropriate management procedures in place to ensure that atmospheric emissions, including those from movement of materials, are below levels that could affect local air quality.
Where a dismantling yard is selected that is outside of the UK, Fairfield will ensure the adoption of any control measures for atmospheric emissions that exist in the selected country.
Accidental events
Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution.
Vessel personnel will be given full training in chemical release prevention and actions to be taken in the event of an accidental chemical release.
Operational procedures onboard vessels will include use of drip trays under valves, use of pumps to decant lubricating oils and use of lockable valves on storage tanks and drums.
AIS and other navigation controls will be used to reduce collision risk.
SIMOPs will be actively identified and managed.
Hoses and connections will be visually inspected prior to use.
Tool box talks will highlight the importance of minimising the likelihood of an accidental release occurring.
Waste
Fairfield will follow the principles of the waste hierarchy, which allows waste disposal only where re-using, recycling and waste prevention cannot be undertaken.

Table 7.4 Summary of key commitments

7.8. Scottish National Marine Plan

In addition to consider environmental performance in the execution of the project, Fairfield has considered project strategy in the context of the objectives and marine planning policies of the Scottish National Marine Plan. Fairfield considers that the PL5 pipeline decommissioning project is in broad alignment with such objectives and policies; the extent to which the project is aligned with oil and gas objectives and policies that are relevant to decommissioning is summarised in Table 7.5.

Objective/policy	Project Details
Maximise the recovery of reserves through a focus on industry-led innovation, enhancing the skills base and supply chain growth.	The Greater Dunlin Area has extracted hydrocarbons to the point that maximum economic recovery has been achieved. The decommissioning activities will provide high-skilled work in an emerging industry.
An industry which delivers high-level risk management across all its operations and that it is especially vigilant in more testing current and future environments.	Proportionate mitigation measures and response strategies have been developed for identified risks.

Objective/policy	Project Details
Where possible, to work with emerging sectors to transfer the experience, skills and knowledge built up in the oil and gas industry to allow other sectors to benefit and reduce their environmental impact.	The project will draw on experienced engineers, environmental specialists and other groups that are not necessarily limited to oil and gas experience, and seek opportunities to share experiences and lessons learnt with the wider decommissioning network.
Where reuse of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Reuse or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	Fairfield has given full consideration to all available decommissioning options, including reuse and removal, as part of the development of the project.
Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	The proposed activities have been developed in a way that there will be no significant impact on the physical, biological and socio-economic environment, now or in the longer-term.
Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.	Potential environmental impacts have been reviewed as part of this environmental impact assessment and relevant mitigation measures developed.

Table 7.5 Alignment between the project and the Scottish National Marine Plan

8. Conclusions

The environmental impact assessment presented in this EA has been undertaken in support of the Decommissioning Programme that will be submitted for the PL5 pipeline decommissioning project. The assessment has examined and quantified the proposed decommissioning strategy in the context of the environmental and societal sensitivities of the project area and describes the control measures that will be in place during project execution. It has also given due consideration to the decisions that remain to be made (e.g. dismantling yard location, vessel contractors). The key findings are summarised in the following sections.

8.1. Protected Sites

There will be no significant impact on any Annex I habitat (of the Habitats Directive). There are a number of offshore and coastal conservation areas around Scotland that have been designated as part of the MPA network. The potential for significant impacts on any such site has been considered within each impact assessment. Given the short-term duration of the decommissioning activities, the mitigation measures in place and the expected recovery from activities, the PL5 pipeline decommissioning project is considered unlikely to affect the conservation objectives or site integrity of any MPA.

The majority of species protected under Annex I of the Birds Directive that are present within the North Sea will generally be found much closer to shore and may only encounter the project with any regularity during the limited period of the vessel activity. Given such vessel use will result in only limited interaction with individuals of those protected species, the PL5 pipeline decommissioning project will not result in significant impacts to those populations.

The presence within the PL5 pipeline project area of species protected under Annex II of the Habitats Directive is limited to marine mammals. Marine mammal species that may be present in the area (or nearshore during vessel transit) occur in relatively low densities, or occur only occasionally, or as casual visitors. Fairfield has assessed whether the noise emitting operations associated with the project have the potential to result in injury or disturbance to any marine mammal species. This assessment concluded that there is a very low likelihood of injury (such as temporary or permanent hearing loss), or disturbance as a result of the activities associated with the project and that potentially significant environmental impacts would not result in population level impacts.

Considering all of the above, no significant impacts are expected upon protected species and habitats.

8.2. Cumulative and Transboundary Impacts

A review of each of the potentially significant environmental and societal impacts associated with the project, and the mitigation measures proposed against the range of other activities in the region indicates that no significant cumulative impacts are expected.

A review of each of the potentially significant environmental and societal impacts associated with the project and the mitigation measures proposed, indicates that no significant transboundary impacts are expected.

8.3. Environmental and Societal Impacts

The residual environmental impact for the project (i.e. following application of any mitigation) is summarised in Table 8.1.

Impact	Key potential impacts assessed	Mitigation identified?	Consequence	Significance
Discharges to sea	Short-term release of chemicals and hydrocarbons during removal activities, and longer-term release from lines decommissioned *in situ.* Short term release associated with cuttings deposits which are disturbed when pulling pipeline spools through deposits for removal.	Yes	Low	Not significant
Seabed	Effects of disturbance of seabed on habitats and species due to removal of pipeline ends, deposition of protective rock cover, and to disturbance of drill cutting.	Yes	Low	Not significant
Other sea users	Short and longer-term effects on fisheries use of the project area	Yes	Low	Not significant
Accidental events	Vessel-vessel collision	Yes	Low	Not significant

Table 8.1 Summary of residual environmental and societal impacts

8.4. Final Remarks

The planned operations have been rigorously assessed through CA and ENVID, resulting in a set of selected options which are thought to present the least risk of environmental or societal impact whilst satisfying safety risk, technical feasibility and economic requirements. Based on the findings of the EA and the identification and subsequent application of the mitigation measures identified for each potentially significant environmental impact (which will be managed through the Fairfield Environmental Management Strategy), it is concluded that the project will result in no significant environmental impact.

9. Appendix A ENVID Matrix

Differentiator / Criteria	Overarching Factor	Sub-Factor	Assumed Mitigation	Commentary of Potential Effects of Option	Potentially Significant in EA terms?	Stakeholder Expectation to Present Assessment in Environmental Appraisal?	Take Forward Further in EA?
Environment	Physical disturbance	Noise and vibrations (e.g. pipeline cutting, vessel noise,) causing injury and disturbance	- Adoption of JNCC measures. - No use of explosives.	- Noise from cutting - Vessel noise - Short duration activity (w/l days), maybe any time of year. - Primarily use shears but may use diamond wire.	No	No	Scoped Out
		Light emissions affecting migratory bird species	- Lights below the horizontal plane where appropriate for H&S.	- 24 hr ops - Multiple vessels	No	No	Scoped Out
		Long term habitat change from introduction on rock material in a soft sediment environment	- Minimise introduction of rock material where possible. - From licensed quarry. - Graded for use by fishing gear type used in area of PLS through discussions with SFF.	- Rock already present. Relatively small volume of rock. Deposited in discrete locations along pipeline of safety reasons. - Standard rock dump material (16-20t te rock)	No	Yes	Scoped In
		Short term disturbance of the seabed, including resuspension of sediments (to include rock dump as required, overtrawl, removal of materials and structures, limited excavation) including limited cuttings pile disturbance.	- Use of flexible fall pipe vessel for rock dump. - Minimise interaction with seabed. - Use of DP vessels. - Separation at pipeline ends via flanges where possible.	Some activities involve some or all of; rock dump, dredging, trawl sweeps, limited mass flow excavation, recovery baskets. Type and magnitude of disturbance, plus shape of area of disturbance, can all affect recovery (e.g. long narrow corridor of disturbance is likely to see more rapid recovery than wide square of the same area). DP vessel so no anchors.	Yes	Yes	Scoped In
	Atmospheric emissions	Power generation from facilities during recycling and remanufacture of materials leading to emissions of greenhouse gases that may affect global climate, or local air quality	- Low sulphur diesel. - Demonstration of BAT. - Maintenance according to manufacturer's recommendations.	N/a	No	Yes	Scoped Out
		Fuel use by vessels, leading to emissions of greenhouse gases that may affect global climate, or local air quality	- Vessel movement plan to reduce movement as much as possible. - Emissions according to Air Quality Standards and within limits set under MARPOL, maintenance according to manufacturer's recommendations. - the estimates are based on a total life cycle assessment.	- Limited vessels. - Few days at each site. - Minimised crew change. - Reduction of vessel usage where possible through combined decom programmes (campaign strategies). - Minimise infield transits.	No	Yes	Scoped Out
		Energy use and atmospheric emissions from material recycling or replacement		Advantageous vs returning to landfill	No	Yes	Scoped Out
	Discharges to sea	Chemical discharge, which may have toxic effects to species using the water column. Primarily related to the treated seawater left in the pipework post flushing . This will be assessed separately in the permit application for undertaking the cleaning/ flushings operations.	- Selection of chemicals with less potential for environmental impact. - Selection of chemicals with less potential for environmental impact - Environmental risk assessment through the MATs/SATs system (OCR)	Inhibited water within flushed pipelines. Baseline is to flush all lines prior to disconnection. Potentially expected discharge from one or two lines in order of few litres discharge. Assessment will focus on what is left in following flushing/cleaning and how that might be released in the short or long term	No	Yes	Scoped In
		Domestic waste (grey and black water) from vessels that may enrich the water column and alter community composition	Treatment and maceration to IMO standards	Standard practice	No	No	Scoped Out
		Pipeline and cleaning, which may release hydrocarbons to sea, resulting in toxic effects to marine species	Treated to ALARP Skipped or shipped or through processing system (captured in permit - ops (phase) - cleaning not part of scope	Pipelines already flushed No discharge from pipeline flushing as returned to platform No cleaning of infrastructure on deck	No	No	Scoped Out
		Gradual release of plastic particulates through degradation of buried mattresses and grout bags.	No specific mitigation proposed. Material will primarily be buried either in sediment or under rock.	Degradation will occur over a long period of time. Due to the depth and expected cover either by rock or sediment degradation path ways will be further reduced.	No	Yes	Scoped In
		Release of hydrocarbons and other contaminants over an extended period of time if structures are left in situ and subsequently degrade to release what is contained within	Pipelines will be flushed and cleaned to an approved level (ALARP). coating material under concrete coating (limited pathway for release)	Any residual material is expected to be minimal. As pipelines are left in situ, material will be released only when integrity of eth line degrades. This will be sporadic and localised releases. No instantaneous release.	No	Yes	Scoped In
		Release of hydrocarbons from disturbance of drill cuttings	Pipeline (spoolpieces) will be pulled through cuttings to minimise disturbance.	Potential for disturbing drill cuttings. Modelling predicts minimal effect with any material released being dispersed there aiding biodegradation. Small foot print of low concentration contamination. Rapid recovery of environment (agree wording in line with cuttings report)	No	Yes	Scoped In

	Accidental events	Hydrocarbon and chemical spills / loss of containment, leading to toxic or other effects on marine species,.	- Hydrocarbon free prior to works occurring. Maintenance procedures. - Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution . - Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures. - Preferred operational procedures to be in place onboard vessels including use of drip trays under valves, use of pumps to decant lubricating oils, use of lockable valves on storage tanks and drums. - SOPEP. - OPEP within 500m. - Vessel condition certificates. - Evidence of crew competency. - Use of Automatic Identification System (AIS) and other navigation controls.	Primary source of accidental hydrocarbon release is from vessel Accidental release of any chemical on board the vessels Release of hydraulic oils from ROVs, MFEs, etc. Potential collision risk at Dunlin/ Cormorant A covered by marine ops procedure within 500m zone minimal scope outside 500m (rock dump and 1 mat removal) Merlin as basis	No	Yes	Scoped in
		Dropped objects, impacting upon the seabed	- Installation and SIMOPS procedures will be in place to reduce the potential for dropped objects. - Lift planning will be undertaken to manage risks during lifting activities, including the consideration of prevailing environmental conditions and the use of specialist equipment where appropriate - All lifting equipment will be tested and certified - Procedures will be put in place to make sure that the location of any lost material is recorded and that significant objects are recovered where practicable - Debris clearance surveys will be carried out at appropriate points.	Potential effect not materially different to planned activities. Low number of lifts with proposed option. Debris clearance (anthropogenic) will be undertaken	No	No	Scoped Out
	Waste	Radioactive waste/NORM	- Project waste management plan. - Use of licensed waste contractors/sites. - Appropriate licences for handling material (ops and contractors) - Waste transfer notes.	Measurements will be taken on deck	No	No	Scoped Out
		Removed infrastructure and materials, including marine growth, taking up space for landfill	- Project waste management plan. - Use of licensed waste contractors/sites. - Waste transfer notes.	Covered in waste management strategy	No	No	Scoped Out
Societal	Commercial impact on Fisheries (Impacts from both the decom operations and the end-points of the present commercial fisheries in and around the pipeline)	Displacement/exclusion caused by vessel presence during decommissioning activities	- UKHO standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings. - Consultation will be undertaken with relevant authorities, stakeholders and organisations.	Short duration activities over a short period of time.	No	No	Scoped Out
		Long-term risk of snagging/damage to fishing gear	- Pipeline route inspection surveys. - Information on the location of all subsea infrastructure that remains in place will be communicated to other sea users (via the United Kingdom Hydrographic Office, UKHO) through the standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings. Consultation will be undertaken with relevant authorities and organisations with the aim to reduce potential interference impacts resulting from project activities as far as practicable.	Some infrastructure will remain in situ. Generally pipeline has maintained burial from installation - monitoring over time required to ensure no free spans formed.	No	Yes	Scoped in
	Socio-economic impact on communities and amenities (The impact from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling and land filling) on the health, well-being, standard of living, structure or coherence of communities or amenities. e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads.)	Waste transport and landfill, including noise, dust, marine growth (odour) and use of landfill (both hazardous and non-hazardous)	- Waste contractor dealing with the onshore disposal of solid/general waste should have ISO 14001 or equivalent. - Project Waste Management Plan to be developed. - Waste audits to be conducted. - Bridging documents issued to ensure awareness of responsibilities. - Transportation management plan to be incorporated to project specific plan.	Covered in waste management strategy	No	No	Scoped Out
		Interaction with other businesses	No mitigation required as any use of business will be positive.	Potential business areas include rock quarrying and the recycling or disposal of materials returned to shore. Some interactions with other operators due to crossings (e.g. Magnus)	No	No	Scoped Out
		Movement of naturally occurring radioactive material to shore, which poses risks to health	- Project waste management plan. - Use of licensed waste contractors/sites. - Waste transfer notes.	Covered in waste management strategy	No	No	Scoped Out
		Hazardous waste (NORM, hydrocarbons, chemicals. Marine growth), which poses a risk to health	- Project waste management plan. - Use of licensed waste contractors/sites. - Waste transfer notes.	Covered in waste management strategy	No	No	Scoped Out
		Consumption of materials, reducing that available for other industries	As part of cost reduction on the project, engineering work will be ongoing to limit the addition of any new material (such as rock dump or crwfl).	N/a	No	No	Scoped Out

10. Appendix B Impact Assessment Methodology

10.1. Impact definition

10.1.1. Impact Magnitude

Type of impact	Definition
Direct	Impacts that result from a direct interaction between the project and the receptor. Impacts that are actually caused by the introduction of project activities into the receiving environment. E.g. The direct loss of benthic habitat.
Indirect	Reasonably foreseeable impacts that are caused by the interactions of the project but which occur later in time than the original, or at a further distance from the proposed project location. Indirect impacts include impacts that may be referred to as 'secondary', 'related' or 'induced'. E.g. The direct loss of benthic habitat could have an indirect or secondary impact on by-catch of non-target species due to displacement of these species caused by loss of habitat.
Cumulative	Impacts that act together with other impacts (including those from any concurrent or planned future third-party activities) to affect the same receptors as the proposed project. Definition encompasses "in-combination" impacts.

Table B.1 Type of impact

Duration	Definition
Short term	Impacts that are predicted to last for a short duration (e.g. less than one year).
Temporary	Impacts that are predicted to last a limited period (e.g. a few years). For example, impacts that occur during the decommissioning activities and which do not extend beyond the main activity period for the works or which, due to the timescale for mitigation, reinstatement or natural recovery, continue for only a limited time beyond completion of the anticipated activity
Prolonged	Impacts that may, although not necessarily, commence during the main phase of the decommissioning activity and which continue through the monitoring and maintenance, but which will eventually cease.
Permanent	Impacts that are predicted to cause a permanent, irreversible change.

Table B.2 Duration of impact

Geographical extent	Description
Local	Impacts that are limited to the area surrounding the proposed project footprint and associated working areas. Alternatively, where appropriate, impacts that are restricted to a single habitat or biotope or community.
Regional	Impacts that are experienced beyond the local area to the wider region, as determined by habitat/ecosystem extent.
National	Impacts that affect nationally important receptors or protected areas, or which have consequences at a national level. This extent may refer to either Scotland or the UK depending on the context.
Transboundary	Impacts that could be experienced by neighbouring national administrative areas.
International	Impacts that affect areas protected by international conventions, European and internationally designated areas or internationally important populations of key receptors (e.g. birds, marine mammals).

Table B.3 Geographical extent of impact

Frequency	Description
Continuous	Impacts that occur continuously or frequently.
Intermittent	Impacts that are occasional or occur only under a specific set of circumstances that occurs several times during the course of the project. This definition also covers such impacts that occur on a planned or unplanned basis and those that may be described as 'periodic' impacts.

Table B.4 Frequency of impact

10.1.2. Impact Magnitude Criteria

Magnitude	Criteria
Major	Extent of change: Impact occurs over a large scale or spatial geographical extent and /or is long term or permanent in nature. Frequency/intensity of impact: high frequency (occurring repeatedly or continuously for a long period of time) and/or at high intensity.
Moderate	Extent of change: Impact occurs over a local to medium scale/spatial extent and/or has a prolonged duration. Frequency intensity of impact: medium to high frequency (occurring repeatedly or continuously for a moderate length of time) and/or at moderate intensity or occurring occasionally/intermittently for short periods of time but at a moderate to high intensity.

Magnitude	Criteria
Minor	Extent of change: Impact occurs on-site or is localised in scale/spatial extent and is of a temporary or short-term duration. Frequency/intensity of impact: low frequency (occurring occasionally/intermittently for short periods of time) and/or at low intensity.
Negligible	Extent of change: Impact is highly localised and very short term in nature (e.g. days/ few weeks only).
Positive	An enhancement of some ecosystem or population parameter.
Notes: Magnitude of an impact is based on a variety of parameters. Definitions provided above are for guidance only and may not be appropriate for all impacts. For example, an impact may occur in a very localised area (minor to moderate) but at very high frequency/intensity for a long period of time (major). In such cases informed judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.	

Table B.5 Impact magnitude criteria

10.1.3. Receptor sensitivity

Receptor sensitivity	Definition
Very high	Receptor with no capacity to accommodate a particular effect and no ability to recover or adapt.
High	Receptor with very low capacity to accommodate a particular effect with low ability to recover or adapt.
Medium	Receptor with low capacity to accommodate a particular effect with low ability to recover or adapt.
Low	Receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.
Negligible	Receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt.

Table B.6 Sensitivity of receptor

10.1.4. Receptor Vulnerability

Receptor vulnerability	Definition
Very high	The impact will have a permanent effect on the behaviour or condition on a receptor such that the character, composition or attributes of the baseline, receptor population or functioning of a system will be permanently changed.
High	The impact will have a prolonged or extensive temporary effect on the behaviour or condition on a receptor resulting in long term or prolonged alteration in the character, composition or attributes of the baseline, receptor population or functioning of a system.

Receptor vulnerability	Definition
Medium	The impact will have a short-term effect on the behaviour or condition on a receptor such that the character, composition, or attributes of the baseline, receptor population or functioning of a system will either be partially changed post-development or experience extensive temporary change.
Low	Impact is not likely to affect long term function of system or status of population. There will be no noticeable long term effects above the level of natural variation experience in the area.
Negligible	Changes to baseline conditions, receptor population of functioning of a system will be imperceptible.

Table B.7 Vulnerability of receptor

10.1.5. Receptor Value

Value of receptor	Definition
Very high	Receptor of international importance (e.g. United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site (WHS)). Receptor of very high importance or rarity, such as those designated under international legislation (e.g. EU Habitats Directive) or those that are internationally recognised as globally threatened (e.g. IUCN Red List). Receptor has little flexibility or capability to utilise alternative area. Best known or only example and/or significant potential to contribute to knowledge and understanding and/or outreach.
High	Receptor of national importance (e.g. NCMPA, SAC, SPA). Receptor of high importance or rarity, such as those which are designated under national legislation, and/or ecological receptors such as United Kingdom Biodiversity Action Plan (UKBAP) priority species with nationally important populations in the study area, and species that are near-threatened or vulnerable on the IUCN Red List. Receptor provides the majority of income from the project area. Above average example and/or high potential to contribute to knowledge and understanding and/or outreach.
Medium	Receptor of regional importance. Receptor of moderate value or regional importance, and/or ecological receptors listed as of least concern on the IUCN Red List but which form qualifying interests on internationally designated sites, or which are present in internationally important numbers. Any receptor which is active in the project area and utilises it for up to half of its annual income/activities. Average example and/or moderate potential to contribute to knowledge and understanding and/or outreach.

Value of receptor	Definition
Low	Receptor of local importance. Receptor of low local importance and/or ecological receptors such as species which contribute to a national site, are present in regionally. Any receptor which is active in the project area and reliant upon it for some income/activities. Below average example and/or low potential to contribute to knowledge and understanding and/or outreach.
Negligible	Receptor of very low importance, no specific value or concern. Receptor of very low importance, such as those which are generally abundant around the UK with no specific value or conservation concern. Receptor of very low importance and activity generally abundant in other areas/ not typically present in the project area. Poor example and/or little or no potential to contribute to knowledge and understanding and/or outreach.

Table B.8 Value of receptor

10.1.6. Assessment of Consequence and Impact Significance

Assessment consequence	Description (consideration of receptor sensitivity and value and impact magnitude)	Impact significance
Major	Impacts are likely to be highly noticeable and have long term effects, or permanently alter the character of the baseline and are likely to disrupt the function and status/value of the receptor population. They may have broader systemic consequences (e.g. to the wider ecosystem or industry). These impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Moderate	Impacts are likely to be noticeable and result in prolonged changes to the character of the baseline and may cause hardship to, or degradation of, the receptor population, although the overall function and value of the baseline/ receptor population is not disrupted. Such impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Low	Impacts are expected to comprise noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause long term degradation, hardship, or impair the function and value of the receptor. However, such impacts may be of interest to stakeholders and/or represent a contentious issue during the decision-making process, and should therefore be avoided or mitigated as far as reasonably practicable	Not significant
Negligible	Impacts are expected to be either indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant
Positive	Impacts are expected to have a positive benefit or enhancement. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant

Table B.9 Assessment of consequence

References

Aires, C., Gonzlez-Irusta, J.M. and Watret, R. (2014). Scottish Marine and Freshwater Science Report, Vol 5 No 10, Updating Fisheries Sensitivity Maps in British Waters' found at: http://www.scotland.gov.uk/Publications/2014/12/3334 with further details online at http://www.scotland.gov.uk/Topics/marine/science/MSInteractive/Themes/fish-fisheries/fsm [Accessed 17/02/2017].

Anatec (2017). Dunlin Decommissioning Fishing Risk Assessment. A3910-XG-RA-1.

Anatec (2018). Dunlin Alpha to Cormorant Alpha Subsea Infrastructure Decommissioning Fishing Risk Assessment. July 2018. A4057-XG-RA-1.

Ashley, M. (2016). [Maldanid polychaetes] and [Eudorellopsis deformis] in offshore circalittoral sand or muddy sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-10-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1105

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B. and Moffat, C.F. (Editors) (2011). Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh. pp. 191. Online at http://www.scotland.gov.uk/Publications/2011/03/16182005/0 [Accessed 16/02/2017].

Beare, D.J., Batten, S., Edwards, M. and Reid, D.G. (2002). Prevalence of boreal Atlantic, temperate Atlantic and neritic zooplankton in the North Sea between 1958 and 1998 in relation to temperature, salinity, stratification intensity and Atlantic inflow. *Journal of Sea Research*, **48**, 29 – 49.

BEIS (2017). A review of the NAEI Shipping Emissions Methodology. Report for the Department of Business, Energy and Industrial Strategy, Ricardo Energy and Environment. PO number 1109088. Issue number 5. Date: 12/12/2007

BEIS (2018). Guidance Notes – Decommissioning of Offshore Oil and Gas Installations and Pipelines.

Brussaard, C., Peperzak, L., Beggah, S., Wick, L.Y., Wuerz, B., Weber, J., Arey, J.S., van der Burg, B., Jonas, A., Huisman, J. and van der Meer, J.R. (2016). Immediate ecotoxicological effects of short-lived oil spills on marine biota. Nature Communications: 2016 Apr 4; 7:11206. Online at http://www.nature.com/articles/ncomms11206 [Accessed 15/02/2017].

Coull, K.A., Johnstone, R. and Rogers, S.I. (1998). Fisheries Sensitivity Maps in British Waters. UKOOA Ltd., London.

De Bastos, E.S.R. (2016). [Owenia fusiformis] and [Amphiura filiformis] in offshore circalittoral sand or muddy sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-10-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/381

DECC (2009). UK Offshore Energy Strategic Environmental Assessment. Future Leasing for Offshore Windfarms and Licensing for Offshore Oil and Gas and Gas Storage. Environmental Report, 2009. Available at: https://www.gov.uk/government/publications/uk-offshore-energy-strategic-environmental-assessment-oesea-environmental-report [Accessed on 30/10/2018].

DECC (2016). UK Offshore Energy Strategic Environmental Assessment. OESEA3 Environmental Report. Future Leasing/Licensing for Offshore Renewable Energy, Offshore Oil & Gas, Hydrocarbon Gas and Carbon Dioxide Storage and Associated Infrastructure.

Decom North Sea (2017). Environmental Appraisal Guidelines. Online at http://decomnorthsea.com/about-dns/Projects-update/environmental-appraisal-guidelines [Accessed 02/10/2018].

Defra (2010). MB0102 2B Distribution of *Arctica islandica* in the United Kingdom and Isle of Man. Published by Marine Environmental Data & Information Network. Available at https://data.gov.uk/dataset/2010-defra-mb0102-2b-distribution-of-arctica-islandica-in-the-united-kingdom-and-isle-of-man.

Edwards, M., Beaugrand, G., Halaouet, P., Licandro, P., McQuatters-Gollop, A. and Wootton, M. (2010). Ecological Status Report: results from the CPR survey 2009/ 2010. SAHFOS Technical Report 8 1-8, Plymouth UK.

Eleftheriou, A. and Basford, D.J. (1989). The macrobenthic infauna of the offshore northern North Sea. *Journal of the Marine Biological Association of the UK*, **69**, 123-143.

Ellis, J.R., Milligan, S., Readdy, L., South, A., Taylor, N. and Brown, M. (2012). Mapping the spawning and nursery grounds of selected fish for spatial planning. Report to the Department of Environment, Food and Rural Affairs from Cefas. Defra Contract No. MB5301.

Fairfield (2016). 160028_FEL_PL005_Listing, 2016 ROVSV and Pre Decommissioning Inspection, PL005 24" Export (Cormorant Alpha), Fugro.

Fairfield (2017a). Dunlin Alpha to Cormorant Alpha Export Pipeline (PL5 pipeline) Decommissioning Inventory. Document No. FBL-DUN-SSP-PL5 pipeline-RPT-00001, Rev. A3

Fairfield (2017b). Decommissioning Scoping – Dunlin Alpha to Cormorant Alpha Pipeline (PL5 pipeline). Document No. FBL-DUN-SSP-PL5 pipeline-RPT-00002, Rev. A2

Fairfield (2017c). Decommissioning Screening – Dunlin Alpha to Cormorant Alpha Pipeline (PL5 pipeline). Document No. FBL-DUN-SSL-PL5 pipeline-RPT-00005, Rev. R2

Foden, J., Rogers, S.I. and Jones, A.P. (2009). Recovery rates of UK seabed habitats after cessation of aggregate extraction. Marine Ecology Progress Series, 390, 15-26.

FRS (2004). Zooplankton and climate change – the Calanus story. Online at http://www.marlab.ac.uk/FRS.Web/Uploads/Documents/Zooplankton.pdf [Accessed 22/02/16].

Fugro (2001). Wind and wave frequency distributions for sites around the British Isles, Offshore technology report 2001/030. Online at http://www.hse.gov.uk/research/otopdf/2001/oto01030.pdf [Accessed 30/06/2016].

Fugro (2013). North Cormorant Environmental Monitoring Survey UKCS Block 211/26a July 2012. Fugro reference J-1-22-2236-4(2).

Fugro (2014a). Cormorant Alpha Environmental Monitoring Survey UKCS BLOCK 211/26A May 2013. Fugro reference J/1/20/2324-4(2).

Fugro (2014b). Cormorant Underwater Manifold Centre Environmental Monitoring Survey UKCS Block 211/26A May 2013. Fugro reference J/1/20/2324-6(2).

Fugro (2016a). Dunlin Field Pre-decommissioning Habitat Survey and Environmental Baseline Survey (EBS)

Fugro (2016b). Fairfield Pre-decommissioning Habitat Survey: Merlin Field and Merlin/Dunlin Tieback November 2015 to April 2016.

Fugro (2016c). Fairfield Pre-decommissioning Habitat Survey: Osprey Field and Osprey/Dunlin Tieback 21 November 2015 to 12 April 2016. Fugro reference 160120_03rev3.

Fugro (2016d). Fairfield Pre-decommissioning Habitat Survey: Dunlin A to Brent C Power Import Cable Route 21 November 2015 to 12 April 2016. Fugro reference 160120_04rev3.

Fugro (2016e). Fairfield Pre-decommissioning Habitat Survey: Dunlin Fuel Gas Import Pipeline 21 November 2015 to 12 April 2016. Fugro reference 160120_05rev2.

Fugro (2017a). Merlin Pre-decommissioning Environmental Survey UKCS Blocks 211/23 21 November 2015 to 12 April 2016. Fugro reference 60120_08rev3.

Fugro (2017b). Merlin Pre-decommissioning Cuttings Assessment Survey UKCS Block 211/23 November 2015 to April 2016.

Fugro (2017c). Osprey Pre-decommissioning Environmental Survey UKCS Block 211/23 21 November 2015 to 12 April 2016. Fugro reference 60120_09rev3.

Fugro (2017d). Dunlin Alpha Power Import Cable Route Pre-decommissioning Environmental Survey UKCS Blocks 211/23 to 211/29 21 November 2015 to 12 April 2016. Fugro reference 160120_11rev3.

Fugro (2017e). Dunlin Alpha Fuel Gas Import Pipeline Pre-decommissioning Environmental Survey UKCS Blocks 211/18 to 211/23 21 November 2015 to 12 April 2016. Fugro reference 160120_12rev3.

Fugro (2017f). Dunlin Alpha Pre-decommissioning Environmental Survey UKCS Block 211/23. 21 November 2015 to 12 April 2016. Fugro reference 160120_10rev3.

Fugro ERT (2013). Murchison Pre-decommissioning Environmental Baseline Survey April/May 2011. Fugro ERT reference J36037-3(9), Client reference MURDECOM-ERT-EN-REP-00056.

Furness, R.W. (2015). Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164.

Gardline (2009a). Dunlin Debris Clearance, 'mud mound' and Environmental Baseline Survey. December 2008. Gardline Report Ref 7859.

Gardline (2009b). Osprey Debris Clearance, Habitat Assessment and Environmental Baseline Survey. November/December 2008. Gardline Report Ref 7858.1.

Gardline (2009c). UKCS 211/26 Pelican Site and Environmental Survey July 2009; Survey Report. Gardline reference 8110, Client reference 1562-0609-TAQA.

Gardline (2010a). Skye to Dunlin Pipeline Route Survey UKCS Block 211/23a October 2009; Survey Report. Gardline reference 8204, Client reference 1601.

Gardline (2010b). Skye to Dunlin Pipeline Route Survey UKCS Block 211/23a October 2009; Environmental Baseline Survey. Gardline reference 8204.1, Client reference 1600.

Gardline (2010c). Skye to Dunlin Pipeline Route Survey Phase 2 UKCS Block 211/23a April/May 2010; Survey Report. Gardline reference 8372, Client reference 1670.

Gardline (2010d). UKCS Block 211/23a Skye Phase 2 Site, Habitat Assessment and Environmental Survey April/May 2010; Survey Report. Gardline reference 8375, Client reference 1669.

Gardline (2010e). UKCS 211/23a Skye 'Looksee 3' Site, Habitat Assessment and Environmental Survey Phase 2 April/May 2010; Environmental Baseline Report. Gardline reference 8375.1, Client reference 1669.

Gardline (2010f). UKCS Quad 211 Infield Environmental Survey November to December 2008 and September to October 2009; Environmental Baseline Report. Gardline reference 7860, Client reference 1559.

Gardline (2010g). Dunlin Fuel Gas Import Route Survey and Environmental Baseline Survey UKCS Blocks 211/18a and 211/23a. August to September 2010. Environmental Baseline Report. Gardline Report Ref 8529.1.

Gardline (2010h). Dunlin to NLGP Pipeline Route Survey UKCS Block 211/24. August to November 2009. Environmental Baseline Report. Gardline Report Ref 8122.1.

Gardline (2010f). UKCS Quad 211 Infield Environmental Survey. November to December 2008 and September to October 2009. Environmental Baseline Report. Gardline Report Ref 7860.

Gardline (2014). NW Hutton Pre-decommissioning Seabed Survey. Environmental Baseline Report, August 3013. Gardline reference 9552, Client reference P511.

GESAMP (2015). "Sources, fate and effects of microplastics in the marine environment: a global assessment" (Kershaw, P. J., ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 90, 96 p.

Gubbay, S. (2003). Marine aggregate extraction and biodiversity. Information, issues and gaps in understanding. Report to the Joint Marine Programme of the Wildlife Trusts and WWF-UK.

Gubbay, S. and Earll, R. (2000). Review of literature on the effects of oil spills on cetaceans. Scottish Natural Heritage Review No. 3. Online at http://www.snh.org.uk/pdfs/publications/review/003.pdf [Accessed 15/02/2017].

Hammond, P.S., Gordon, J.C.D., Grellier, K., Hall, A.J., Northridge, S.P., Thompson, D. and Harwood, J. (2001). Background information on marine mammals relevant to SEA2. Report to the Department of Trade and Industry. Online at http://www.offshore-sea.org.uk/consultations/SEA_2/TR_SEA2_Mammals.pdf [Accessed 17/02/2017].

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Borjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M.B., Scheidat, M., Teilmann, J., Vigada, J. and Oien, N. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Online at https://synergy.st-andrews.ac.uk/scans3/files/2017/04/SCANS-III-design-based-estimates-2017-04-28-final.pdf [Accessed 01/04/18].

Hiddink, J., Jennings, S. and Kaiser, M.J. (2006). Indicators of the Ecological Impact of Bottom-Trawl Disturbance on Seabed Communities. Ecosystems, 9(7), 1190 – 1199.

Hiscock, K., Langmead, O., Warwick, R. and Smith, A. (2005). Identification of Seabed Indicator Species to Support Implementation of the EU Habitats and Water Framework Directives. Second Edition. Report to the Joint Nature Conservation Committee and the Environment Agency from the Marine Biological Association. Plymouth: Marine Biological Association. JNCC Contract F90-01-705.

HSE (Health and Safety Executive) (1997). The abandonment of offshore pipelines: Methods and procedures for abandonment. Offshore technology report. HSE Books, Norwich. ISBN -7176-1421-2. Health and Safety Executive.

Hylland, K. and Erikson, D.O. (2013). Naturally occurring radioactive material in North Sea produced water: environmental consequences. Norsk Olje og Gass.

ICES (2015). Report of the Benchmark Workshop on North Sea Stocks (WKNSEA), 2–6 February 2015, Copenhagen, Denmark. ICES CM 2015/ACOM:32. 253 pp.

IEEM (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland, marine and Coastal. August 2010. Final Version 5.

IEMA (2015). environmental impact assessment Guide to Shaping Quality Development.

IEMA (2016). environmental impact assessment Guide to Delivering Quality Development.

IOGP (International Association of Oil and Gas Producers) (2016). Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations. Report 543, March 2016. IOGP, London, UK. 144 pp.

JNCC (2005a). Hermaness, Saxa Vord and Valla Field SPA Site Description. Online at http://jncc.defra.gov.uk/page-1891-theme=default [Accessed 18/01/2017].

JNCC (2005b). Fetlar SPA Site Description. Online at http://jncc.defra.gov.uk/page-1893-theme=default [Accessed 18/01/2017].

JNCC (2011). Memorandum submitted to the House of Commons Energy and Climate Change Select Committee Second Report on UK Deepwater Drilling-Implications of the Gulf of Mexico Oil Spill. Online at https://www.publications.parliament.uk/pa/cm201011/cmselect/cmenergy/450/450vw03.htm [Accessed 15/02/2017].

JNCC (2013a). Pobie Bank Reef SAC Selection. Online at http://jncc.defra.gov.uk/protectedsites/SACselection/SAC.asp?EUCode=UK0030385 [Accessed 17/02/2016].

JNCC (2013b). Third Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2007 to December 2012. Conservation status assessment for Species: S1351 - Harbour porpoise (*Phocoena phocoena*). Online at: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf [Accessed 14/02/2017].

JNCC (2016). Faroe-Shetland Sponge Belt MPA. Online at http://jncc.defra.gov.uk/page-6479 [Accessed 18/01/2017]

JNCC (2017a). North East Faroe-Shetland Channel MPA. Online at http://jncc.defra.gov.uk/page-6483 [Accessed 18/01/2017].

JNCC (2017b). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. Available at http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_apr2017.pdf [Accessed 23/11/2018].

Johns, D.G. and Reid, P.C. (2001). An Overview of Plankton Ecology in the North Sea. Technical Report TR_005 produced for Strategic Environmental Assessment-SEA2.

Kafas, A., Jones, G., Watret, R., Davies, I. and Scott, B. (2012). Representation of the use of marine space by commercial fisheries in marine spatial planning. ICES CM I:23.

Kennish, M. J. (1997). Pollution Impacts on Marine Biotic Communities. CRC Press LLC, USA, ISBN 0-8493-8428-1.

Kerr McGee (2001). Hutton Field Decommissioning Programme. Second draft 12.10.01.

Kunitzer, A., Basford, D., Craeymeersch Dewarumez, J.A. Dorjes, J., Duineveld, G.C.A., Eleftheriou, A., Heip, C., Herman, P., Kingston, P., Niermann, U., Rachor, E., Rumohr, H. and de Wilde, P. A. J. (1992). The benthic infauna of the North Sea: species distribution and assemblages. *ICES Journal of Marine Science* **49**, 127-143.

MMO (2014). Mapping UK shipping density and routes from AIS. A report produced for the Marine Management Organisation, pp 35. MMO Project No: 1066. ISBN 978-1-909452-26-8.

MMO (2017). Economic value of landings (£), fishing effort (time) and quantity (tonnes) by gear type at the ICES statistical sub-rectangle level for the period 2012 – 2016. Data requested directly from MMO by Xodus.

MPE (1999). The Final Disposal of Disused Pipelines and Cables. Summary of the Findings of a Norwegian Assessment Programme. Oslo, December, 1999. Ministry of Petroleum and Energy.

NBN Atlas (2018). National Biodiversity Network. Available at: https://nbnatlas.org/ [Accessed 23/11/2018].

Neff, J.M., McKelvie, S. and Ayers Jr, R.C. (2000). Environmental impacts of synthetic based drilling fluids. Report prepared for MMS by Robert Ayers & Associates, Inc. August 2000. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

NMPi (2018). National Marine Plan Interactive. Available at: http://www.gov.scot/Topics/marine/seamanagement/nmpihome [Accessed September 2018].

National Oceanic and Atmospheric Administration (NOAA) (2015). Office of Response and Restoration. Available at: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html [Accessed on 26/11/2018].

OGUK (2016a). Environment report 2016. Online at http://oilandgasuk.co.uk/wp-content/uploads/2016/11/Environment-Report-2016-Oil-Gas-UK.pdf [Accessed 14/03/17].

OGUK (2016b). Decommissioning insight 2016. Online at http://oilandgasuk.co.uk/decommissioninginsight.cfm [Accessed 14/03/17].

OSPAR (2005). Agreement on background concentrations for contaminants in seawater, biota and sediment. OSPAR agreement 2005-6.

OSPAR (2006). Harmonised Reporting Format to Compile Environmental Monitoring Data and Information Related to Offshore Oil and Gas Activities. OSPAR 2006-07, OIC 06/7/1-E.

OSPAR (2008). Case Reports for the OSPAR List of threatened and/or declining species and habitats. OSPAR Commission. Online at http://qsr2010.ospar.org/media/assessments/p00358_case_reports_species_and_habitats_2008.pdf [Accessed 28/01/2017].

OSPAR (2009a). OSPAR Background for Ocean Quahog *Arctica Islandica*. Publication Number: 407/2009.

OSPAR (2009b). Assessment of the possible effects of releases of oil and chemicals from any disturbance of cuttings piles. OSPAR Commission, London. Publication number 337/2009 (2009 update). Online at www.ospar.org/documents?d=7082 [Accessed 18/01/2017].

OSPAR (2009c). Implementation report on Recommendation 2006/5 on a management regime for offshore cutting piles. OSPAR Commission, London. Publication number 451/2009. Online at http://www.ospar.org/documents?d=7170 [Accessed 31/01/2017].

PhysE (2012). Metocean criteria for the Dunlin Field Volume 1: Design Criteria. Report Ref: R-521-12-F3.

Reid, J., Evans, P.G.H. and Northridge, S. (2003). An atlas of cetacean distribution on the northwest European Continental Shelf. Joint Nature Conservation Committee, Peterbourgh.

Rogers, C.S. (1990). Responses to coral reefs and reef organisms to sedimentation. Marine Ecological Progress Series, 62, 185 – 202

Russell, D.J.F., Jones, E.L. and Morris, C.D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25, 25pp. DOI: 10.7489/2027-1.

Rygg, B., and Norling, K. (2013). Norwegian Sensitivity Index (NSI) for Marine Invertebrates, and an Update of Indicator Species Index (ISI). NIVA Report 6475-2013, 29 January 2013.

SAHFOS (2015). Sir Alister Hardy Foundation for Ocean Science. CPR Data: Standard Areas. Online at http://www.sahfos.ac.uk/cpr-data/standard-areas.aspx [Accessed 17/02/2017].

SCOS (2014). Scientific Advice on Matters Related to the Management of Seal Populations: 2014. Online at http://www.smru.st-andrews.ac.uk/documents/2589.pdf [Accessed 01/04/2016].

Scottish Government (2015). Scotland's National Marine Plan. The Scottish Government, Edinburgh 2015. ISBN: 978-1-78544-214-8.

Scottish Government (2018). Scottish Sea Fisheries Statistics, 2012 - 2017. Available online at http://www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData [Accessed 18/06/2018].

Scottish Government (2017). UK Fishing Intensity Associated with Oil and Gas Pipelines (2007-2015) dataset. DOI: 10.7489/1972-2. Available at: https://data.marine.gov.scot/dataset/uk-fishing-intensity-associated-oil-and-gas-pipelines-2007-2015-0 [Accessed 28/11/2018].

SMRU (2011). Utilisation of space by grey and harbour seals in the Pentland Firth and Orkney waters. Scottish Natural Heritage commissioned report No. 441.

SNH (2013). A handbook on environmental impact assessment Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland. Online at http://www.snh.gov.uk/docs/A1198363.pdf [Accessed 17/02/2017].

SNH (2017). Fetlar to Haroldswick MPA. Online at http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/mpas/mpa-fth/ [Accessed 17/02/2017].

Sonntag, R.P., Benke, H., Hiby, A.R., Lick, R. and Adelung, D. (1999). Identification of the first harbour porpoise (Phocoena phocoena) calving ground in the North Sea. Journal of Sea Research, 41, 225 – 232.

Tillin, H.M. & Ashley, M. (2016). [*Hesionura elongata*] and [*Protodorvillea kefersteini*] in offshore coarse sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-10-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1113.

Tillin, H.M. and Budd, G. (2016). *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Online at http://www.marlin.ac.uk/habitat/detail/62 [Accessed 26/01/2017].

Tillin, H.M. (2016). [*Glycera lapidum*], [*Thyasira*] spp. and [*Amythasides macroglossus*] in offshore gravelly sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-10-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1136 .

Tyler-Walters, H., Lear, D. and Allen J.H. (2004). Identifying offshore biotope complexes and their sensitivities. Report to Centre for Environmental, Fisheries, and Aquaculture Sciences from the Marine Life Information Network (MarLIN).

Plymouth: Marine Biological Association of the UK. [Sub contract reference A1148]. Online at http://www.marlin.ac.uk/assets/pdf/Cefas_Rpt_revised.pdf [Accessed 28/01/2017].

Tyler-Walters, H. and Sabatini, M. (2008). Arctica islandica Icelandic cyprine. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Online at http://www.marlin.ac.uk/species/detail/1519 [Accessed 27/01/2017].

Webb et al. (2016). Webb, A., Elgie, M., Irwin, C., Pollock, C. And Barton, C. Sensitivity Of Offshore Seabird Concentrations to Oil Pollution Around the United Kingdom: Report to Oil & Gas UK. Prepared for Oil & Gas UK by HiDef Arial Surveying Limited. Document Number: HP00061 701. 01 April 2016.

UKOOA (2001). An analysis of U.K Offshore Oil & gas Environmental Surveys 1975-95, pp. 141.

UKSeamap (2016). A broad-scale seabed habitat map for the UK. Available at http://jncc.defra.gov.uk/UKSeaMap/.

Xodus (2018a). Dunlin Alpha to Cormorant Alpha Pipeline CA. Comparative Assessment Recommendation PL5 Export Pipeline. Document No. A-301649-S17-REPT-003.

Xodus (2018b). Dunlin Alpha to Cormorant Alpha Pipeline Fisheries Baseline Report. Document No. A-301649-S17-REPT-007, Rev. A01

Xodus (2018c). Dunlin Alpha to Cormorant Alpha Pipeline CA. Specific Scope Technical Note. Document No. A301649-S17-TECH-001, Rev. A01.

Xodus (2018d). DREAM: PL5 pipeline Spool Removal Cuttings Disturbance Modelling. Document No. A-301524-S12-TECH-001, Rev. A02.

Xodus Group (2017). Multi operator survey review for PL5. Review of survey data for pipeline PL5 between Dunlin Alpha and Cormorant Alpha. Document Number A-301524-S10-TECH-001.