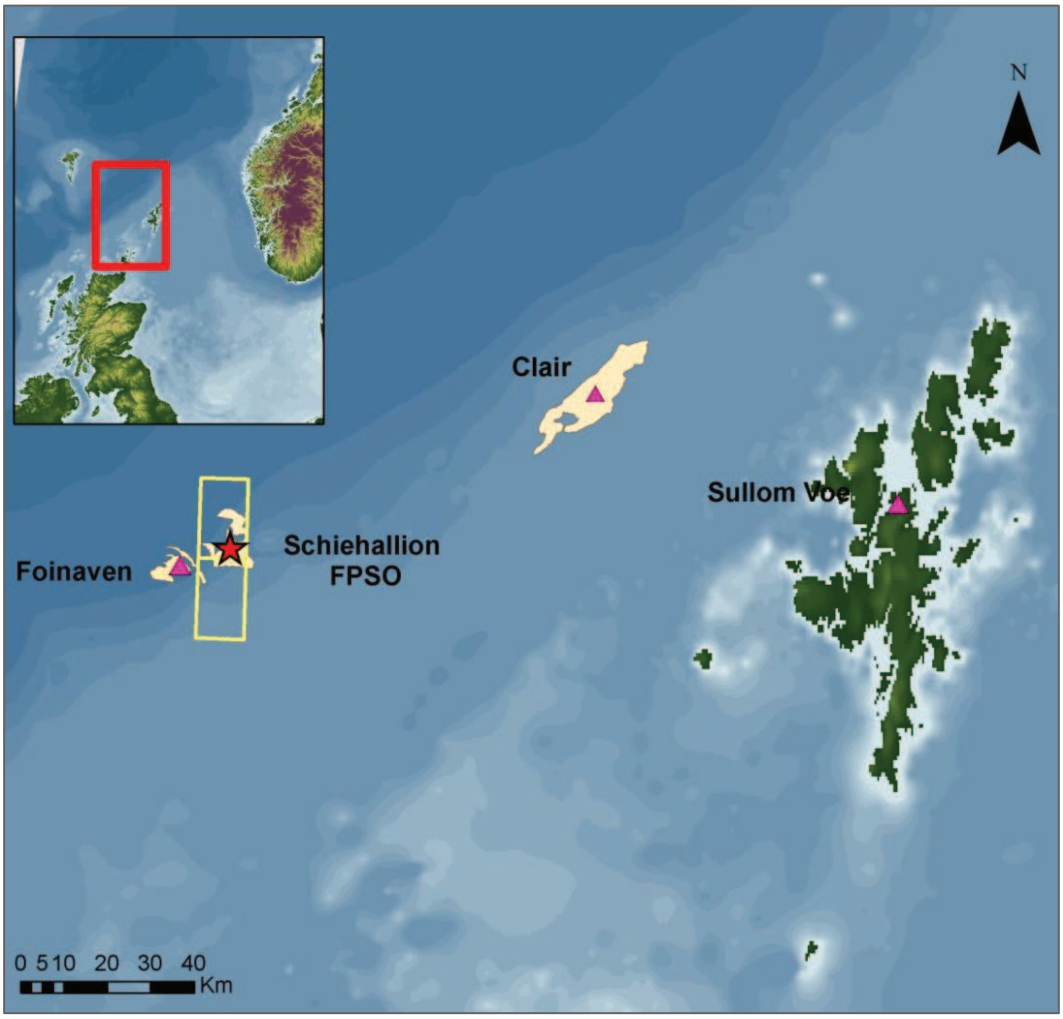

Schiehallion and Loyal Decommissioning Programme Phase I

Environmental and Socio-Economic Impact Assessment

December 2012

BP Reference number: DECOM-SCH-HS-IA-BP-0079

Information Sheet

Project name	Environmental and Social Impact Assessment for Schiehallion and Loyal Decommissioning Programme Phase I
Type of project	Decommissioning
Undertaken name	BP Exploration Operating Company Limited (BP)
Undertaken address	1-4 Wellheads Avenue, Dyce, Aberdeen, AB21 7PB
BP Document Reference Number	DECOM-SCH-HS-IA-BP-0079
Licences/owners	Britoil Ltd. is the nominated operator

Schiehallion field interests

BP Exploration Operating Company Limited	3.543 %
Britoil Ltd.	32.738 %
Shell UK Limited	36.281 %
Schiehallion Oil & Gas Limited	12.909 %
Statoil (UK) Limited	4.843 %
OMV (UK) Limited	4.843 %
Murphy Schiehallion Ltd	4.843 %

Loyal field interests

Britoil Ltd.	50 %
Enterprise Oil Middle East Ltd.	25 %
Shell UK North Atlantic Ltd.	25 %

Short description	In order to optimise hydrocarbon production at the Schiehallion and Loyal fields, it was deemed necessary to replace the existing Schiehallion FPSO. In order to do this production at the fields will be suspended. Where possible infrastructure associated with the fields will be reused. A number of items will be decommissioned and recovered whilst others will be left suspended and monitored on the seabed. This document provides an environmental and social impact assessment of the activities associated with the decommissioning activities.
Anticipated date for commencement of works	FPSO towaway expected June 2013.
Date and reference of any earlier environmental statements	Schiehallion Development: Wider Field Perspective Environmental Statement. DECC reference number: D/2176/2004 Quad204 Project Environmental Statement. DECC reference number: D/4098/2010
Significant environmental impacts identified	None
ESIA prepared by	Genesis

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Executive Summary

This document describes the Environmental and Social Impact Assessment (ESIA) process undertaken in support of the Schiehallion and Loyal Decommissioning Programme Phase I.

Decommissioning activities

The decommissioning and preparatory activities assessed in this ESIA are associated with: shutting in of the wells; flushing, preservation and deconstruction of the subsea and water column infrastructure; topside activities associated with the cleaning of the crude oil tanks and flushing and cleaning of the process trains; and towing of the Schiehallion FPSO (Floating Production Storage Offloading) to an interim storage location.

Physical and biological environment

The Schiehallion and Loyal fields lie in water depths of approximately 350 - 500 m, approximately 130 km west of the Shetland Islands. The development spreads across two licence blocks; Block 204/20 and 204/25.

The predominant residual surface flow in the area flows in a northeast direction along the contours of the continental shelf. Mean surface flow speeds in the region are between 0.1 m/s and 0.2 m/s while seabed currents in the area are around 0.3 m/s.

The development lies in an area where the seabed is dominated by iceberg ploughmarks (relict scars in the seabed historically caused by the dragging of iceberg keels) which are generally orientated in a northeast to southwest direction throughout the area. Seabed surveys indicate that the surface sediment comprises a thin veneer of sand (although thicker within the identified ploughmarks). Underlying sediments are very soft to firm (occasionally stiff) sandy clays and silty clays with gravel and occasional pebbles.

Surveys carried out in the area identified no environmentally sensitive habitats protected under Annex I of the EC Habitats Directive.

The area west of Shetland has a complex and productive ecosystem which supports important fish, seabird and marine mammal populations.

Benthic communities vary in species richness and abundance across the area, with this variation likely to be driven by the variation in sediment type, seabed features, depth and temperature associated with the area.

From fishing landings data it is evident a number of commercially important fish species occur in the area including saithe, hake, megrim, monkfish and cod. Pelagic shark species expected to occur in the area include the porbeagle and the basking shark. The IUCN status of both these shark species in the northeast Atlantic is given as vulnerable.

The most abundant cetacean in the deeper water beyond the continental shelf area to the west of Shetland is the Atlantic white-sided dolphin. The Faroe-Shetland Channel contains a number of species that are rare or endangered including the blue whale and right whale.

Low densities of grey seals have been observed in the area with higher densities possibly associated with periods of migration between their breeding sites in Faroe and Shetland. Hooded seals have been recorded in deep waters over the Faroe-Shetland Channel and may therefore occur in the area of the Schiehallion and Loyal fields. Both these seal species are protected under the EC Habitats and Species Directive.

Seabird vulnerability to surface pollution in the area of the Schiehallion and Loyal fields varies throughout the year and is considered low overall. Based on foraging distances, bird species expected to be found in the area of the Schiehallion and Loyal fields include Leach's petrel, great skua, lesser black-backed gull, kittiwake, guillemot, razorbill, manx shearwater, puffin, gannet and fulmar.

The nearest offshore protected areas are the Wyville Thomson Ridge and the Darwin mounds both of which are cSAC/SCIs and are located approximately 110 km and 160 km west of the FPSO. The Wyville Thompson ridge is a stony ridge, thought to have been formed by the ploughing movements of icebergs through the seabed at the end of the last ice age. The Darwin mounds are sandy mounds topped with thickets of cold water coral.

The Shetland Islands have a number of coastal SSSIs, SACs, RAMSAR and SPA sites.

Socio-economic environment

The Schiehallion and Loyal fields are in an area of relatively low fishing effort in terms of days at sea representing less than 0.2% of the total

reported UK fishing effort by UK vessels over 10 m. The area is predominantly targeted for demersal species such as saithe, cod and monkfish.

Shipping is the area is also considered low (DECC, 2012) and tend to be primarily associated with vessels going between the Schiehallion FPSO and Sullom Voe Terminal (SVT).

Other oil and gas activities in the area include the Foinaven and Clair fields while offshore operations have begun at the Laggan and Tormore fields.

There is no military activity, renewable or aggregate industries or tourism associated with the area.

Results of the ESIA

None of the planned activities associated with the Decommissioning Programme was found to have a significant impact on the physical, biological or socio-economic environment in the area. Accidental events resulting in a loss of well control, leaks from flowlines or loss of diesel inventory whilst the FPSO is under tow were found to have a significant impact prior to the identification of mitigation measures to control such events, but these risks are no different to those managed in routine operation of the fields.

Cumulative and transboundary impacts of planned events were also found to be insignificant. In the unlikely event of a loss of well control or loss of diesel from the FPSO there is the possibility of some transboundary impacts.

Acronyms

BSP	Blind Seal Plates
CDA	Controls Distribution Assemblies
CiSi	Corrosion Inhibitor / Scale Inhibitor
COT	Crude Oil Tank
COWing	Crude Oil Washing
DECC	Department of Energy and Climate Change
DMaC	Drag-to place system for Main Umbilicals
DUTA	Dynamic Umbilical Termination Assembly
EC	European Community
EIA	Environmental Impact Assessment
ENVIID	Environmental Issue Identification
EoFL	End of Field Life
EOR	Enhanced Oil Recovery
ESE	East Southeast
FPSO	Floating Production Storage and Offloading
EPS	European Protected Species
ESIA	Environmental and Social Impact Assessment
EU	European Union
FTA	Flowline Termination Assembly
FTP	Fly-to-Place
GI/GE	Gas Injection/ Gas Export
HP	High Pressure
IAPP	International Air Pollution Prevention
ICES	International Council for the Exploration of the Sea
ISL	Interim Storage Location
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
KISCA	Kingfisher Information Service – Cable Awareness
km	Kilometre
LSA scale	Low Specific Activity scale
LTC	Lower Tether Clamp
m	Metre
m^3	Cubic Metres
MCAA	Marine Coastal Access Act
MCZ	Marine Coastal Zone
ml	Millilitre
MEG	Mono-Ethylene Glycol
m/s	Metres per second
mmboe	Million barrels of oil equivalent
MMO	Marine Management Organisation
mmscf	Million standard cubic feet
MPA	Marine Protected Area
N_2	Nitrogen
NMHC	Non-methane hydrocarbons
N	North
ND	Nominal diameter
nm	Nautical mile
NNE	North Northeast
NNW	North Northwest
NORM	Naturally Occurring Radioactive Material
OCR	Offshore Chemicals Regulations
OPEP	Oil Pollution Emergency Plan
OPPC	Oil Pollution Prevention and Control
OVI	Offshore Vulnerability Index
PLEM	Pipeline End Manifold
PEXA	Practice and Exercise Areas
PON	Petroleum Operations Notices
PPC	Pollution Prevention and Control
PWA	Pipeline Works Authorisation
PWRI	Produced Water ReInjection
RAMSAR	Wetlands of international importance
RET	Riser End Termination
ROV	Remotely Operated Vehicle
ROVDBs	Remotely Operated Vehicle Deployable Blinds
RPS	Radiation Protection Services
RSA	Radioactive Substances Act
SAC (c/p/d)	Special Area of Conservation (candidate/possible/draft)

SCI	Site of Community Importance
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SW	Southwest
SSSI	Special Sites of Scientific Interest
SVT	Sullom Voe Terminal
UET	Umbilical End Termination
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UTC	Upper Tether Clamp
WI	Water Injection
WOSPS	West of Shetland Pipeline System

Glossary

Biocide	Chemical used to prevent microbial growth e.g. that could lead to corrosion
Blind Seal Plate	A sealing plate that fits onto the end of a pipeline to provide isolation
Crude oil washing	Removing surface oil deposits in tanks by jetting of hot crude oil
Dynamic umbilical	A flexible pipeline containing several cores for control fluids, from the FPSO to the seabed
DMac porch	A proprietary pull-in connection system for subsea pipelines (Diverless Maintained Connection)
Flowline	A rigid pipeline on the seabed that carries oil, gas and produced water or water for reinjection into the field
Fly-to-Place	Small flexible pipelines connecting electrical and hydraulic systems subsea
Foam pig	A foam pad pushed through a riser to displace any gas pockets present
Jumper	A short length of pipeline connecting a long straight flowline to a manifold
Manifold	A structure on the seabed that is a hub connecting multiple pipelines and allowing lines to be controlled and routed via valves
Oxygen scavenger	A chemical designed to remove excess oxygen from pipeline liquids, and inhibit corrosion
Riser	A flexible pipeline between the FPSO and the seabed that carries oil, gas and produced water or water for reinjection into the field
Static umbilical	A rigid pipeline containing several cores for control fluids, installed on the seabed and connected to a dynamic umbilical
Tote tank	Tank used for storage and transportation of liquids

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1 Introduction

1.1 Background to the Decommissioning Programme

The Schiehallion and Loyal fields lie within Quadrants 204 and 205 of the United Kingdom Continental Shelf (UKCS) approximately 130 km west of Shetland and 35 km east of the Faroe-UK median line, in water depths of 350 – 500 m on the slope of the Faroe-Shetland channel (Figure 1-1). These fields have been in production since 1998 through the Schiehallion FPSO with production to date totalling over 300 mmboe of oil and associated gas. The production history and experience obtained from the existing wells and recent reservoir studies have confirmed that a significant oil potential still remains to be exploited from these reservoirs. Additionally, a number of new oil and gas discoveries have been made that could potentially be developed in the future by subsea tiebacks to the Schiehallion and Loyal infrastructure.

To fully exploit the remaining Schiehallion and Loyal reserves would require the existing FPSO to remain on-station for a further period in excess of 35 years. In recent years operating challenges on the FPSO have resulted in a deterioration of the production operation efficiency and the existing FPSO is unable to fulfil the processing requirements of the anticipated economic field life. Therefore redevelopment of the surface facilities was deemed necessary for the optimal exploitation of hydrocarbon reserves in the area. Following consideration of a number of options it was determined that the Schiehallion FPSO should be replaced.

Section 6 of the 'Decommissioning of Offshore Oil and Gas Installations and Pipelines under

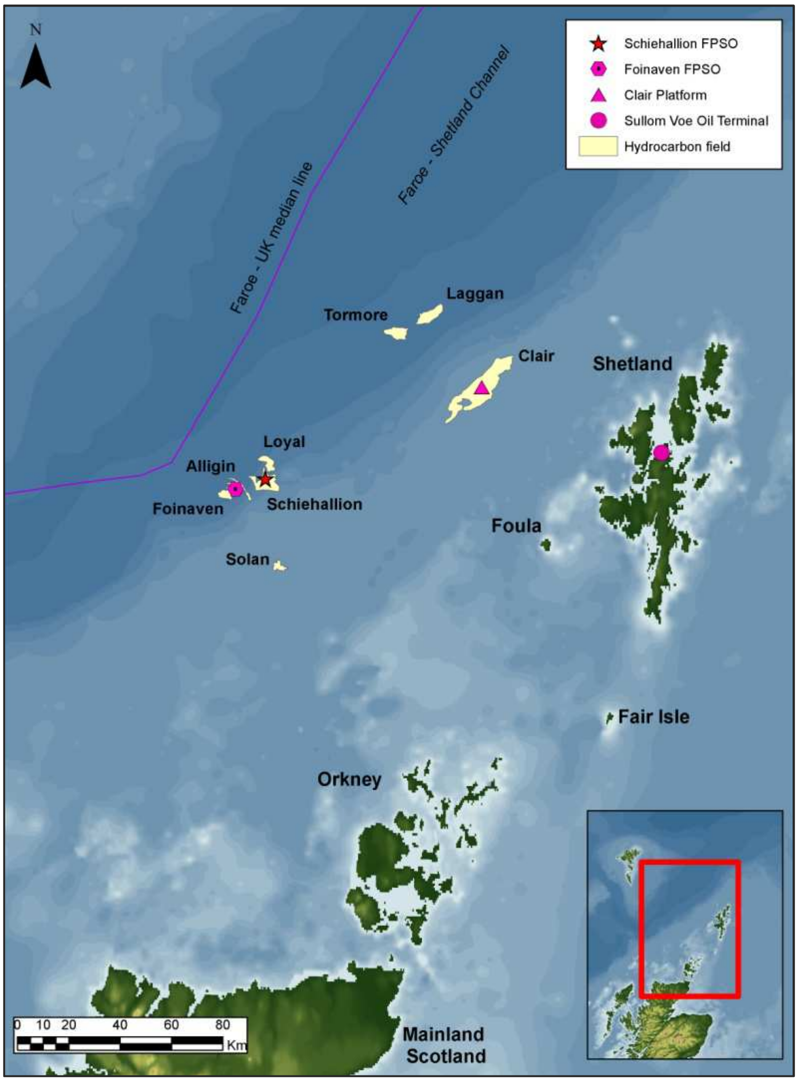

Figure 1-1 Location of the Schiehallion and Loyal development.

Petroleum Act 1998' guidance notes indicates the requirement for an Environmental Impact Assessment (EIA) to be carried out for the selected decommissioning options. This document presents the results from the Environmental and Social Impact Assessment (ESIA) carried out for the proposed Schiehallion and Loyal Decommissioning Programme.

The purpose of the ESIA is to identify potential environmental hazards, or 'aspects', and the socio impacts associated with the defined decommissioning activities. This was done by holding a study meeting to discuss the activities and their potential environmental aspects (e.g. emissions to air, discharges to sea, underwater noise) and the control measures that will be used to eliminate or mitigate the risks posed by these aspects.

1.2 Document Layout

Chapter 2 provides a description of the activities associated with the proposed decommissioning programme. In order to provide a reference point to allow the identification of potential environmental impacts of the proposed decommissioning programme, Chapters 3 and 4 provide descriptions of the environmental and socio-economic baselines in the area of the Schiehallion and Loyal fields.

Chapter 5 presents the environmental assessment methodology applied to the decommissioning activities. Each planned activity is assessed in terms of its duration and its consequence on the environment. Combined these give the risk associated with each activity on the physical, biological and socio-economic environments. Accidental events are assessed in terms of the likelihood of them occurring and the impact should such an event occur.

The results of the ESIA are presented as a table in Section 6. Where identified the table also lists mitigation measures that will be put in place to further minimise the impact of the activities. None of the planned activities were found to have a significant impact. However due to environmental aspects such as emissions to air and discharges to sea being under regulatory control and/or of public concern, the impacts are further described. In the absence of any mitigation measures some of the possible accident events identified were found to potentially lead to a significant risk. However mitigation measures were identified that would lower the potential of these events occurring thus reducing their risk.

Chapters 7 and 8 further describe the aspects resulting from the decommissioning activities that are under regulatory control and/or is of public concern and their environmental and socio-economic impacts. Potential accidental events associated with the Schiehallion and Loyal Decommissioning Programme are discussed in Section 9.

2 Project Description

This section describes the activities associated with the Schiehallion and Loyal Decommissioning Programme Phase I.

2.1 Schiehallion and Loyal Development

The existing Schiehallion and Loyal field development comprises five drill centres; Central, North, West, North West and Loyal with 53 active wells (52 trees) – 25 production wells and 28 water injection wells (Table 2-1). In addition there is one gas disposal well located at the Central drill centre. Appendix 2 (Field Isometrics) of the Schiehallion and Loyal Decommissioning Programme Phase I contains a schematic of the infrastructure present at the development. The North drill centre is a water injection centre only. In total ten production lines transport the hydrocarbons from the remaining four drill centres to the FPSO. Six water injection lines run from the FPSO to the drill centres: one each to Central, North, North West and Loyal and two to the West drill centre. A gas lift line runs to the Central, West, North West and Loyal drill centres whilst a gas import / export line connects to the Magnus EOR export line. The production, gas and water injection lines are connected to the FPSO via a number of risers; 10 production, 3 water injection, 1 gas lift and 1 gas import / export riser. The wells, flow lines and risers have a number of subsea structures associated with them including jumpers, manifolds, Flowline Termination Assemblies (FTAs) Controls Distribution Assemblies (CDAs) and Riser End Terminals (RETs).

A series of umbilicals, Fly-to-Place (FTPs) and Dynamic Umbilical Termination Assemblies (DUTAs) connect the wells to the FPSO.

2.2 Field Suspension and Decommissioning Activities

This section describes the activities associated with the suspension of production at the Schiehallion and Loyal fields in order to allow the Schiehallion FPSO to be taken off station. The activities described include preparatory works required in order for the decommissioning activities to progress along with those activities associated with the removal of infrastructure not to be returned to service at field start-up. Infrastructure to be left suspended an monitored on the seabed following start-up is also considered.

2.2.1 Field Preparation and Well Shut-In

Prior to shutting in the wells measures will be taken in order to minimise the adverse impacts at field start-up in 2016 resulting from the suspension of production. Such measures will include the continued injection of calcium nitrate to minimise the production of hydrogen sulphide. Activities associated with the mitigation of start-up issues are not part of the Schiehallion and Loyal decommissioning programme and are not discussed further.

In total 53 active wells (52 trees); 26 production wells (25 trees) and 28 water injection wells will be shut-in.

The wells are located at the five drill centres as shown in Table 2-1.

Table 2-1 Existing Production and Water Injection Wells associated with the development.

Drill centre	No. of production wells	No. of water injection wells
Central	14	9
West	6	9
North West	1 (ML)*	2
North	0	3
Loyal	4	4

*Muti-lateral; 2 wells originating from a single multi-lateral well.

Well isolation

Well isolation is scheduled to commence in January 2013. The isolations will be controlled from the FPSO and will involve closing the appropriate valves within the tree. Following the shut off of the gas lift at each well, the production rate will decline. The valves at each production well will then be closed. The integrity of the valves will be tested by maintaining pressure and checking that the valves restrict the passage of hydrocarbons. Blind seal plates (BSPs) will be installed at the ends of the production jumpers attached to the wells to isolate the hydrocarbons from the flowlines. This will be carried out by a remotely operated vehicle (ROV) operated from a vessel.

The shutting of the tree valves will result in small releases of subsea control fluid (HW540).

The production wells will be isolated before the water injection (WI) wells, as the latter will be required for reservoir conditioning and pipeline flushing.

The isolation sequence for the production wells will follow a drill centre by drill centre schedule: Loyal (4 wells), North West (1 well), Central (14 wells) and West (6 wells). Two wells at the West drill centre WP13 and WP14 will not be shut-in initially. These wells do not require gas lift and will continue producing in order that crude oil washing (COWing) of the crude oil tanks (COTs) may be carried out using sufficiently hot oil (Section 2.2.3).

The isolation sequence for the WI wells will also follow a drill centre by drill centre schedule and will be isolated in the following order; Loyal (4 wells), North West (2 wells) and Central (10 wells), West (7 wells) and North (3 wells).

Following the shut-in of the production wells, water injection will continue for up to three months in order to maintain reservoir pressure to mitigate start-up issues.

At present the gas disposal well is shut-in and will remain shut-in whilst the field is suspended.

2.2.1.1 Prevention of hydrate formation

Methanol will be used to prevent hydrate formation at the tree valves and production jumpers. Hydrates can form in pipelines in certain conditions where gas and some water is present and can form a physical blockage that is difficult to remove.

Following disconnection of the jumpers and flowlines, methanol will be pumped to the wellheads via one of the cores within the umbilical lines. Sufficient methanol will be pumped to the wellheads such that the production jumpers are also suspended filled with methanol.

The static umbilicals that contain the cores used to dose the methanol at the wellheads will be suspended with methanol in them. The dynamic umbilicals that contain the same cores will be flushed free of methanol, however, and the methanol will be displaced using the control fluid HW540. No methanol is expected to enter the flowlines during this process as only one jumper volume will be pumped, and filling of the jumpers with methanol will simply result in a displacement of inhibited water back to the FPSO for conveyance onshore.

2.2.2 Subsea Preservation and Deconstruction to 2016

Before the Schiehallion FPSO can be towed away, the subsea infrastructure will be maintained in a safe condition so that it may be either re-connected and re-commissioned when the new FPSO arrives, or removed as part of the Decommissioning Programme, or removed at the end of field life (EoFL) as part of field decommissioning.

Gas export from the Foinaven FPSO to the Magnus EOR pipeline will remain operational whilst the fields are suspended. Isolations will therefore be put in place between the current Schiehallion / Loyal subsea infrastructure and the live gas system. As this isolation is not part of the decommissioning programme it will not be discussed further.

Table 2-2 summarises the existing subsea infrastructure connecting the Schiehallion and Loyal drill centres to the FPSO. Additional structures at the development include Dynamic Umbilical Termination Assemblies (DUTAs); Fly-to-Place umbilical connectors (FTPs), manifolds, Controls Distribution Assemblies (CDAs), Umbilical End Terminations (UETs), Riser End Terminals (RETs), Flowline Termination Assemblies (FTAs) and a Pipeline End Manifold (PLEM) (Table 2-7 and Table 2-8).

Suspension of the production, WI and gas lift lines, risers and the static and dynamic umbilicals will include activities such as purging, flushing, placing of preservation chemicals, installation of isolations, leak testing and removal of redundant structures.

Table 2-2 Existing flowlines, umbilicals, risers, manifolds and jumpers.

Infrastructure	Quantity
Production flowlines	10
Water injection flowlines	6
Gas lift flowlines	4
Gas import/export flowlines	1*
Gas disposal flowline (currently unused)	1
Dynamic umbilicals	3 (1 currently unused)
Static umbilicals	10 (4 currently unused)
Risers	15
Manifolds	23
Jumpers (single and bundle jumpers- each bundle is counted as one)	100 (1 currently unused)
* does not include the gas export line from Foinaven to SVT via FTAs located at the Central drill centre.	

A comparative assessment was undertaken to review the fate of the subsea infrastructure. This is presented in Appendix 4 of the Phase I Decommissioning Programme. The comparative assessment considered four categories in which the infrastructures fate could fit:

- Infrastructure will be preserved and returned to service either:
  - at the same location when the new FPSO is on station e.g. the gas lift and water injection flow lines and the majority of the jumpers; or
  - relocated before being returned to service e.g. a number of the FTPs;
- Infrastructure will be suspended and monitored on the seabed e.g. the existing production flow lines;
- Infrastructure will be decommissioned *in situ* (note no items are to be decommissioned *in situ*)
- Infrastructure will be decommissioned and removed:
  - between 2013 - 2015 prior to installation of the new FPSO e.g. the risers and some of the jumpers;
  - removed after the new FPSO is on station i.e. post 2015. These structures are outwith the scope of the Decommissioning Programme.

A schematic showing the fate of the Schiehallion and Loyal infrastructure at field start-up is shown in Appendix 2 of the Decommissioning Programme Phase I.

2.2.2.1 Flowlines and jumpers

Production flowlines and jumpers

The production and test lines to the Central, Loyal and West drill centres will be bulk de-oiled and then flushed from and to the FPSO with injection quality water, achieving an estimated dispersed oil in water content of 100 mg/l. As only one line runs to the North West drill centre this line will be flushed using another vessel from the drill centre back to the FPSO.

Prior to this flushing, the corrosion and scale inhibitors (CiSi) in the umbilical cores will be displaced to the production system at the wellheads using HW540 injected at the FPSO. The CiSi will be flushed back to the FPSO during the bulk flushing of the flowlines. This is to avoid any contact between the inhibitors and the methanol during subsequent operations.

The wellhead jumpers will also be flushed to the FPSO via the production lines using injection quality water. At least two flushes of the production jumpers will be carried out. The jumpers are then filled with a mixture of preservation chemicals, from the FPSO in the case of Central, Loyal and West, whilst the production jumpers at North West are filled from a vessel located at the drill centre. The preservation liquids in the wellheads and jumpers are then displaced into the manifolds with methanol injected from the FPSO via one of the umbilical cores to provide hydrate inhibition.

The jumpers are subsequently isolated at the manifolds leaving them boxed in with methanol. Isolation involves the flowlines being disconnected at the manifolds and BSPs being installed in order to provide positive isolations whilst the fields are suspended. Leak testing (MEG/water mix) against the BSPs using a vessel will be carried out, with discharge of the vessel downline contents after the operation. Volumes to be discharged are captured in the PON15C (PON15C/470/0).

The production flowlines will then be disconnected at the riser end and isolated using

ROVDBs (ROV Deployable Blinds).

In total ten production lines flow back to the FPSO (Table 2-3). Each of these lines will be suspended and monitored on the seabed.

Table 2-4 summarises the number of production jumpers associated with each drill centre, and identifies those that occur as single jumpers and those occurring in loose bundles that are tied together. The bundles contain two 6" production lines and one 2" gas lift line. Table 2-5 shows the number of production jumpers to be recovered as part of the Phase I Decommissioning Programme. In addition one of the jumper bundles currently in service at Central will be recovered in 2018. The remaining production jumpers will be returned to service at field start-up. No production jumpers are to be left suspended on the seabed after re-commissioning.

Gas flowlines and jumpers

During Well Shut-In, gas lift will be suspended at the wells and the pressure further reduced by standard blowdown via the high pressure flare on the FPSO.

One gas lift flowline runs to each of the following production drill centres; Central, Loyal, North West and West (Table 2-3). All lines will be returned to service at field start-up. In addition a currently unused 8" gas disposal line runs to the gas disposal well at the West drill centre. This line will remain unused whilst the field is suspended.

No isolations are required between the drill centre gas lift jumpers and gas flowlines. Similarly no flushing of the lines is required as the gas lift system will be suspended with gas in it. At the FPSO end the flowlines will have ROVDBs installed on the gas FTAs.

Table 2-4 shows the number of jumpers associated with gas lift at each drill centre and identifies those that occur as single jumpers and in bundles. Table 2-5 summarises the number of gas jumpers to be recovered before the end of 2015. All single gas lift lines will be returned to service at field start-up. Two single gas lift jumpers; one at West and one at the FPSO associated with North West will be relocated before returned to service. Thirty one gas lift jumpers bundled with production jumpers will be removed.

Water injection flowlines and jumpers

One water injection line runs to each of the Central, Loyal, North and North West drill centres and two run to the West drill centre; the second being associated with the gas disposal well (Table 2-3). Prior to suspension of the water injection lines, production, gas lift and PWRI (Produced Water Re-Injection) will have ceased. The gas and production flowlines will have been positively isolated at the manifold end of the flowlines. Once WI has ceased the WI flowline contents will be displaced with filtered / inhibited injection quality seawater (dyed) into the wells. The displacement of this water is controlled via the tree valves (as initially all the wells will be shut-in), with the wells being opened individually to displace as required. The inhibited seawater will contain corrosion inhibitor, biocide, oxygen scavenger and a dye and will remain in the lines during suspension.

For the WI system general containment at the drill centres will not be broken. The flowlines at the FPSO end will have ROVDBs installed on the water injection FTAs.

All the water injection lines will be returned to service at field start-up. The water injection system has 39 jumpers associated with it (Table 2-4). Of these 35 will be returned to service while three will be recovered prior to the end of 2015 (Table 2-5). Of those returned to service, one associated with the North drill centre will be brought on shore in 2018.

Table 2-3 Flow lines associated with the Schiehallion and Loyal Fields.

Drill Centre	Production	Water Injection	Gas Lift
Central	4 (10,213 m)	1 (2,548 m)	1 (2,872 m)
West	3 (8,196 m)	2 (6,347 m)	1 (3,270 m)
Northwest	1 (2,280 m)	1 (3,141 m)	1 (3,041 m)
North	0 n/a	1 (2,271 m)	0 n/a
Loyal	2 (11,550 m)	1 (4, 883 m)	1 (5,979 m)
Note: This table does not include the line to the gas disposal well at West.			

Table 2-4 Jumpers associated with the Schiehallion and Loyal Fields.

Drill Centre	Production		Gas Lift		Water Injection
	Single	Within bundle*	Single	Within bundle	
Central	4 (337 m)	36 (1,544 m)	7 (814 m)	18 (77 m)	10 (408 m)
West	4[1] (572 m)	14 (534 m)	2 (176 m)	7 (267 m)	14[3] (869 m)
North West	3[2] (217 m)	2 (228 m)	2 (344 m)	1 (114 m)	4[4] (388 m)
North	0 n/a	0 n/a	0 n/a	0 n/a	6[5] (278 m)
Loyal	2 (99 m)	10 (446 m)	2 (201 m)	5 (223 m)	5 (250m)

*Note two production jumpers within each bundle. [1] Includes 1 associated with FPSO.
[2] Includes 2 associated with FPSO. [3] Includes 2 associated with FPSO.
[4]Includes 1 associated with FPSO. [5] Includes 1 associated with FPSO.

Table 2-5 Jumpers associated with Schiehallion and Loyal fields to be removed as part of the Decommissioning Programme.

Drill Centre	Production	Bundle	Water Injection
Central	4 (337 m)	5 (268 m)	0 n/a
West	4[1] (572 m)	1 (34 m)	1[3] (180 m)
North West	3[2] (220 m)	0 n/a	0 n/a
North	0 n/a	0 n/a	1[4] (78 m)
Loyal	1 (44 m)	0 n/a	1 (82 m)

[1] Includes 1 associated with FPSO. [2] Includes 2 associated with FPSO.
[3] Associated with FPSO. [4] Associated with FPSO.

Static umbilicals and FTPs

Following injection of methanol at the well heads via the umbilicals, methanol in the dynamic umbilicals will be displaced back to the FPSO via an alternative core within the umbilical by pumping in HW540 hydraulic fluid. This methanol is collected within tote tanks and shipped separate to shore for disposal. The methanol cores within the static umbilicals will be suspended containing methanol, whilst the cores used for CiSi injection will be suspended containing HW540.

At present there are four suspended static umbilicals (total length of approximately 6,236 m) and six in service static umbilicals at the site (Table 2-6). Each of the static umbilicals will be suspended and monitored. Following re-commissioning the umbilical to the gas disposal well will remain unused though in an operational state should it be required.

Table 2-6 Fate of static umbilicals currently in service.

Drill Centre	Length of umbilical (m)	Fate at Start-Up.
Central	4,750	Suspend and monitor
West	3,441	
North West	3,977	
North	2,382	
Loyal	4,812	
4 suspended static umbilicals	6,236 (total length)	
Gas disposal well	3,679	Operational*
*Note the gas disposal is not currently used; however, is kept on line should it be required.		

The number and fate of the FTPs associated with the controls system are summarised in Table 2-7. Relocation of FTPs generally refers to lifting one end of the line and moving it to connect to another structure such as a different UET.

Table 2-7 Fate of FTPs currently on location.

Drill centre	Number on site	Fate of FTPs			Approximate total length to be recovered (m)
		Returned to service	Relocate and returned to service	Recovered	
Central	37[1]	7	9	21	2,008
West	26[2]	12	7	7	728
North West	6	2	4	0	0
North	4	1	2	1	89
Loyal	13	5	1	7	785
FTPs in the immediate vicinity of FPSO	12[3]	0	3	8	914

[1]Includes one unused and one suspended FTA. [2]Includes one out of use.
[3]Includes one that shall remain suspended on the seabed.

2.2.2.2 Other subsea infrastructure

In addition to the flowlines, jumpers, static umbilicals and FTPs described, a number of other subsea structures are located at the Schiehallion and Loyal fields. These include DUTAs, manifolds, FTAs, UETs, CDAs and RETs. Table 2-8 provides a summary of the number of these structures associated with each drill centre whilst Table 2-9 summarises how many of these structures will be recovered as part of the Phase I Decommissioning Programme.

The 20 FTAs associated with the production flowlines will remain suspended on the seabed until EoFL. The eight gas lift FTAs and 11 of the 12 water injection FTAs will all be returned to service at field start-up. The final WI FTA located at North West will remain suspended on the seabed until EoFL. The two FTAs associated with gas disposal will remain suspended at field start-up. Finally two FTAs associated with the gas lift/gas import/ export line will be returned to service.

Of the UETs listed in Table 2-8 eight are currently out of use (two at Central, two at West and four at the FPSO) and will be recovered as part of the Decommissioning Programme. Of the 12 in service UETs, five will be returned to service at field start-up, three will be suspended and left on the seabed and four will be recovered. The three UETs associated with the gas disposal system will be returned to an operational state at field start-up.

The three DUTAs and three RETs and four of the eight CDAs will be recovered. The other four CDAs will be suspended and monitored on the seabed. At the time of writing one manifold was potentially to be recovered; however its reuse was under further consideration.

2.2.2.3 Fate after leaving field

Recovered subsea equipment will be returned to an existing logistics base in Shetland for initial laydown. It will be transferred within the site to an area designated for cleaning and dismantling where it will be prepared into components that are suitable for recycling. From this point it will enter established waste recycling chains, along with the many other wastes landed at Shetland by the oil industry. The site will have appropriate environmental and other operating licences in order to carry out this work and will be managed within BP's contractor assurance processes.

2.2.2.4 Monitoring for LSA / NORM

The presence of LSA / NORM (Low Specific Activity / Naturally Occurring Radioactive Material) deposits is a recognised phenomenon in the oil and gas industry. As a result Radiation Protection Services (RPS) trained personnel competent in the use of radioactivity detection monitors will be onboard the vessels used to recover the subsea infrastructure and will monitor all items as they come on board for the presence of LSA / NORM. In the unlikely event that one or more items is found to be contaminated, the items will be contained and sealed and shipped to shore for decontamination at BP’s approved contractor under BP’s and the contractor’s management systems.

Table 2-8 Subsea infrastructure (excluding flowlines, umbilicals, jumpers and FTPs) presently on location at the Schiehallion and Loyal Fields.

Drill Centre	DUTAs	Manifolds			FTAs				UETs[1]	CDAs	RETs
	Controls	Production	Water Injection	Gas import/export	Production	Water Injection	Gas Lift	Gas Disposal			
Central	0	6	2	3	4	1	1	0	4	6	0
West	0	2	2	0	3	2	1	1	5	1	0
North West	0	1	1	0	1	1	1	0	1	1	0
North	0	0	1	0	0	2	0	0	2	0	0
Loyal	0	2	1	0	4	1	1	0	2	0	0
FPSO	3	0	1	1	8	5	4	1	6	0	3

[1] includes both suspended and in service UETs.
Subsea structures associated with gas import/export have not been included i.e. those structures listed in the PWA as being located at the FPSO to GI/GE, Foinaven, SVT.

Table 2-9 Subsea infrastructure (excluding jumpers and FTPs) to be recovered as part of the Decommissioning Programme.

	DUTAs	Manifolds	FTAs	UETs	CDAs	RETs
Number to be recovered	3	1*	0	12	4	3

*Reuse still under further consideration.

2.2.3 Topside Modifications

Prior to taking the Schiehallion FPSO off site a number of topside modifications are required. These include:

- the installation of a temporary generator which will supply the power requirements when the main power generators are not required;
- depressurisation, purging and N_2 blanketing of the topsides process systems;
- offloading, COWing cleaning and blanketing of the COTs;
- flushing and removal of the export hose and;
- sea fastenings and modifications required to allow the FPSO to be towed and to allow access to the yard and the yard's utilities.

In addition the topsides process system will be monitored for the presence of LSA scale/NORM.

Of the activities listed above the Schiehallion and Loyal Decommissioning Programme Phase I are primarily concerned with the cleaning and flushing of the tanks and topsides processing system.

2.2.3.1 Depressurisation, draining, flushing and inerting of the topsides

Once production has ceased the topsides will be depressurised, flushed, drained and filled with water (approximately 5,000 m^3) and nitrogen in order to make safe. Flushing will be carried out by the fluids used to flush the subsea infrastructure i.e. by water injection fluids that are tapped off and fed into the subsea system and transported back to the FPSO. Nitrogen quads will be used as the source of nitrogen.

2.2.3.2 Offloading, COWing and stabilising of the crude oil tanks

Following offload of the final tanks of uncontaminated crude the subsea infrastructure will be flushed back to the COTs. The tanks will then undergo COWing using oil of approximately 50 - 60^{o}C over a period of 4-5 weeks. Two wells at the West drill centre, (WP13 and WP14 chosen as they do not require gas lift), will remain flowing in order to provide the oil required. The COWing will be followed by two seawater flushes. These fluids will be offloaded to the tanker, as part of the final offload.

The crude oil tanks will be filled with seawater to a height of 2.9 m equivalent to a volume of approximately 15,000 m^3 of water, in order to ensure bulkhead integrity during the tow. The COTs will be inerted using gas emissions from two inert gas generators onboard.

2.2.3.3 Flushing and disconnection of the export hose

Following the final offload to the shuttle tanker the export hose will be flushed to the tanker before being disconnected. The line has a self sealing Pusnus coupling thus mitigating any discharges to sea. Following disconnection the export hose will be laid on the seabed prior to recovery.

2.2.3.4 Monitoring for LSA / NORM

During decommissioning activities there will be RPS trained personnel onboard the FPSO. Topsides will be monitored for the presence of LSA / NORM; however, containment will not be broken. In the unlikely event that LSA / NORM is detected the Schiehallion FPSO has in place the required Authorisation (Radioactive Substances Act, 1993) to allow it to dispose of the contamination offshore.

2.2.4 Disconnection of the FPSO

A total of 15 risers and 3 dynamic umbilicals will be disconnected and recovered as part of the Decommissioning Programme (Table 2-10).

Table 2-10 Risers and dynamical umbilicals to be recovered as part of the Schiehallion and Loyal Decommissioning Programme.

Line type	Number	Minimum length (m)	Maximum length (m)	Total length (m)
Production riser	10	705	777	7,408
Water injection riser	3	697	777	2,199
Gas lift riser	1	749	749	749
Gas import / export riser	1	721	721	721
Dynamic umbilical (includes 1 suspended umbilical)	3	725	1,925	3,389

2.2.4.1 Disconnection and pigging of the risers

As described the ten production / test flowlines will be isolated from the risers using ROVDBs. Once isolated the production risers can be disconnected at the seabed (at the DMac porch). This disconnection will result in a small permitted release of the preservation fluid contents.

It is possible that during production, gas will have seeped into the riser annuli and that once production has stopped this gas will seep back into the risers bore and collect at the hog bend (upward curving bend). In order to remove this gas a foam pig along with untreated seawater will be run through the production risers which will result in permitted discharges of oily water and preservation chemicals to sea. The discharged oily water and chemical mixture is the fluid that remains in the risers after the subsea infrastructure has been flushed back to the FPSO's crude oil tanks.

Similarly once the ROVDBs have been installed in the gas system and water injection lines the risers will be disconnected and pigged with a foam pig and untreated seawater which will be discharged to sea.

At the end of the risers a mesh basket will be put in place in order to recover the pigs from the seabed once they have exited the riser.

Following pigging, the risers will be disconnected from the FPSO and laid on the seabed for recovery.

2.2.4.2 Disconnection of umbilicals

There are currently three dynamic umbilicals connected to the Schiehallion FPSO: two in service and one suspended. All three umbilicals will be disconnected and recovered.

Following injection of methanol at the well heads, the static umbilical cores used to inject the methanol will be filled with methanol and suspended. However for the dynamic umbilicals it is planned to displace the methanol back to the FPSO where it will be collected in tote tanks for transport onshore for disposal. The hydraulic fluid HW540 will be used to displace the methanol. This is to mitigate accidents that could occur when disconnecting and removing the dynamic umbilicals should they have been disconnected and recovered whilst containing flammable methanol.

2.2.4.3 Laying of the risers and umbilicals on the seabed

Each of the risers and umbilicals will be laid on the seabed for recovery. Once disconnected from the FPSO, the FPSO end of the risers and the dynamic umbilicals will be laid on the seabed in line with the other end of each riser / dynamic umbilical. Whilst in this position it is expected that approximately 50% of the length of the risers and umbilicals will remain suspended in the water column thus minimising disturbance to the seabed.

The risers will be laid down in a different location to their current position, directed outward from the FPSO location. It is expected that some of the riser length will be within the existing safety zone relating to the FPSO location, and some will be outside this area. An MCAA licence will be applied for to cover the placing of the lines on the seabed. A safety zone will be maintained at the FPSO location after tow away.

2.2.4.4 Recovery of the risers and umbilicals from the seabed

The risers and dynamic umbilicals are fixed to the seabed at two points similar to that shown in Figure 2-1. Along the risers / dynamic umbilicals there are located two clamps – an upper tether clamp (UTC) and a lower tether clamp (LTC). The UTC is fixed to a swivel mechanism that allows for movement of the riser / dynamic umbilical resulting from drag, thus reducing the load on them. The UTC swivel mechanism is attached to the seabed by piles. The LTC is positioned on the dynamic risers / umbilicals just before they connect to the static risers / umbilicals and serve to reduce the load where the dynamic structures connect to the static lines. It is attached to the seabed via a suction anchor.

When recovering the risers / dynamic umbilicals the ends that were originally attached to the FPSO, will be winched onboard the vessel and the remainder will be gathered in by reeling the lines back in on a carousel. In order to carry this out a temporary clump weight will be attached to allow the UTC to be disconnected from the piled swivel mechanism. This temporary weight will hold the risers / dynamic umbilicals in place following disconnection. The LTC will be disconnected from the suction clamp allowing the risers / dynamic umbilicals to be reeled in. The temporary clump weight attached to the UTC will remain attached to the risers / dynamic umbilicals as they are being reeled in.

None of the piles or the suction clamps currently serving to anchor the risers / dynamic umbilicals are to be reused at re-commissioning. It is proposed to recover the swivel mechanism to drive the piles a metre below the surface of the seabed. The suction anchors will be recovered as part of the Decommissioning Programme.

2.2.4.5 Disconnection of the fibre optic cable

The fibre optic cable will be disconnected at the FPSO and stored in a basket on the seabed for reconnection to the new FPSO. Given the nature of the seabed in the area it is likely the basket will be laid on a mattress to prevent it sinking into the soft substrate.

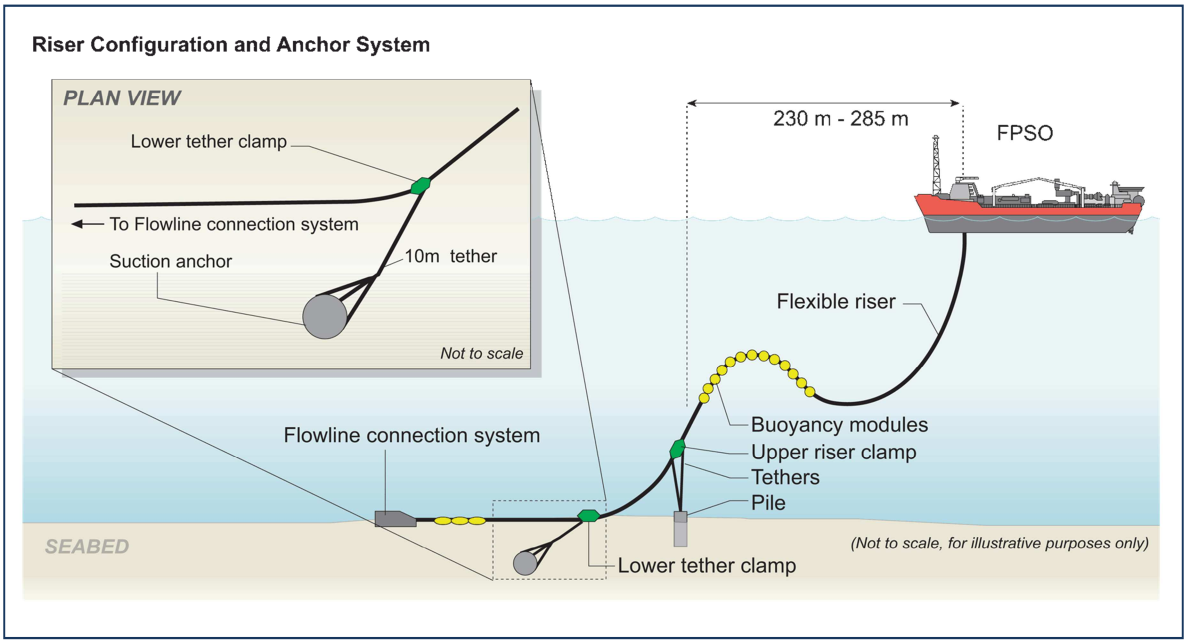

Figure 2-1 Schematic representation of the risers at the Schiehallion FPSO.

2.2.4.6 Disconnection and recovery of the mooring lines

There are 14 mooring lines arranged in four bundles securing the Schiehallion in position: two bundles contain three lines each and two bundles contain four lines each (Appendix 2 of the Decommissioning Programme). The lines are approximately 1.8 km in length and are anchored to the seabed using suction anchors.

The suction anchors are approximately 3 m in diameter and 10 m in height with 1.5 m protruding above the seabed. The mooring lines are secured to the anchors by a chain that is fastened to a point near the base of the anchor beneath the seabed, and the chain then emerges from the seabed around 8 m from the anchor and continues on the seabed towards the FPSO. To remove the mooring line, a link of this chain will be cut near the point where it emerges from the seabed using a specialised diamond wire cutting tool. The lines will be laid on the seabed before being recovered. The mooring lines are heavy enough to not require any weights to keep them on the seabed until recovery.

New suction mooring anchors will be installed for the new FPSO which will be close to the existing anchors. Options for decommissioning both sets of anchors will be considered at EoFL.

2.2.5 Towing of FPSO

Following disconnection the FPSO will be towed to an interim storage location (ISL) for cleaning and engineering down. The FPSO will be towed with half its main diesel capacity i.e. 1,700 m^3 and both service tanks which hold 50 m^3 of diesel each. In addition it will contain 20,000 m^3 of oily water (5,000 m^3 in the processing train and 15,000 m^s in the COTs). It will be towed by two tug boats with an additional tug remaining on stand-by in port during the period of the tow. Once the final decision has been made on the location of the ISL a towing route will be drawn up similar to that shown in Figure 2-2. Figure 2-2 shows a potential towing route should the ISL be located in the Netherlands. This particular route would cover a distance of approximately 1,150 km and will take up to 7 days.

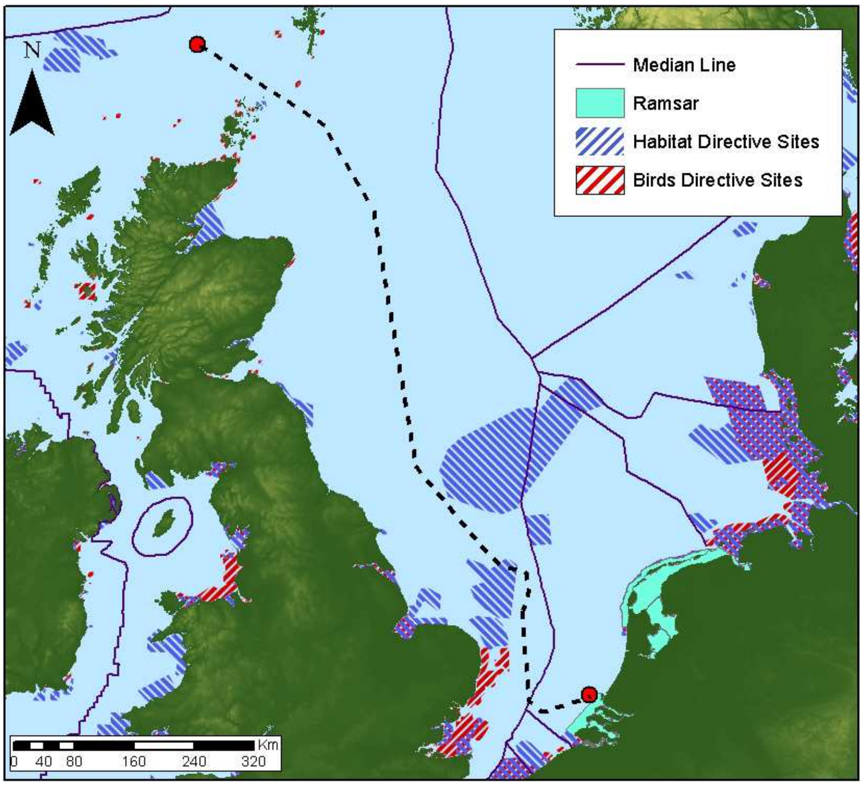

Figure 2-2 Example of a potential towing route should the ISL be in the Netherlands.

3 Environmental Description

This section provides a review of the key features of the environment at the Schiehallion and Loyal fields which are located primarily in Quadrant 204 with a small part of the field occurring within Quadrant 205. It was prepared from data presented by BP in the Quad204 Project Environmental Statement - DECC reference number D/4098/2010 (BP, 2010). which draws upon a wide range of environmental baseline and environmental monitoring surveys carried out in the area by BP and other industry groups.

3.1 Metocean conditions

3.1.1 Hydrology

The development is located on the UK continental slope approximately 130 km west of Shetland in water depths of approximately 350 to 500 m. The seabed in the vicinity of the project exhibits a gentle slope downwards to the northwest.

Water movements west of Shetland can be simplified into 'surface and upper' currents and 'lower and bottom' currents. The lower and bottom currents tend to be associated with depths below 500 m. Metoc (2002) report strong seabed currents of around 0.3 m/s in the area of the Schiehallion and Loyal fields.

The predominant residual surface flow in the area is the North Atlantic Slope current which flows in a northeast direction along the contours of the continental shelf (Figure 3-1). Mean surface current speeds in the region are between 0.1 m/s and 0.2 m/s.

The deep water over the continental slope is exposed to a large westerly fetch and strong winds, particularly from the west and southwest. These conditions generate an extreme wave regime in the area with significant wave heights exceeding 2.5 m for 50% of the year and 4.0 m for 10% of the year (BODC, 1998).

3.1.2 Meteorology

The seasonal distribution of wind speed and direction in the area of the Schiehallion and Loyal fields is summarised in Figure 3-2. Winds can occur from any direction with the predominant winds during the summer, autumn and winter months coming from the south and west. In spring there is a greater evenness of wind distribution, with winds originating from the ESE, NNW, N and NNE occurring with a higher frequency than those from the SW. The predominant wind speeds throughout the year are from 5.5 m/s (moderate) to 13.5 m/s (strong). Strong winds can occur throughout the year however their frequency is most prominent in the winter months.

3.1.3 Temperature and salinity

Mean sea surface temperatures range between 7.5°C in winter and 12.5°C in summer whilst bottom temperatures can be as low as - 0.5°C at 500 m water depth (BP, 2010).

Mean salinity in the area varies annually and with depth, but is typically between 34.5 and 35.25 (BP, 2010).

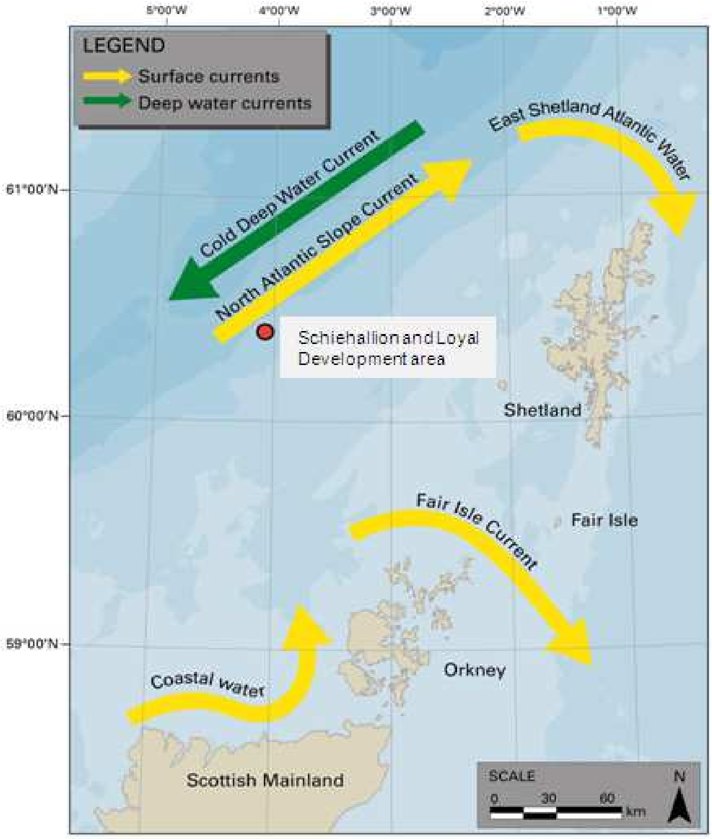

Figure 3-1 Prevailing currents west of Shetland.

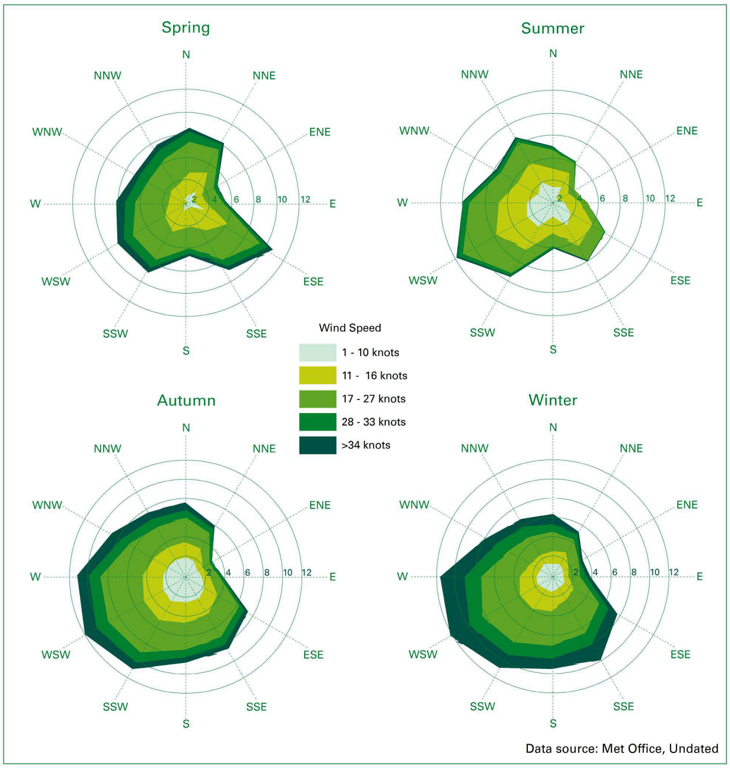

Figure 3-2 Wind speed and direction for the offshore area west of Shetland.

3.2 Environmental Legislation Protecting Habitats and Species

The EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC) are the main driving forces for safeguarding biodiversity in Europe. Through the establishment of a network of protected sites, these directives provide for the protection of animal and plant species of European importance and the habitats that support them.

The EU Habitats Directive 92/43/EEC and the EU Birds Directive 79/409/EEC have been enacted in the UK by the following legislation:

- The Conservation (Natural Habitats, &.c.) Regulations 1994 (as amended 2012): These regulations transpose the Habitats and Birds Directives into UK law. They apply to land and territorial waters out to 12 nautical miles (nm) from the coast and have been subsequently amended several times.
- The Conservation of Habitats and Species Regulations 2010 (as amended 2012): These regulations consolidate all the amendments made to the Conservation (Natural Habitats, &c.) Regulations 1994 in respect of England and Wales. In Scotland, the Habitats and Birds Directives are transposed through a combination of the Habitats Regulations 2010 (in relation to reserved matters) and the 1994 Regulations.
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended 2009 and 2010): These regulations are the principal means by which the Birds and Habitats Directives are transposed in the UK offshore marine area (i.e. outside the 12 nm territorial limit) and in English and Welsh territorial waters.
- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended 2007): These regulations apply the Habitats Directive and the Birds Directive in relation to oil and gas plans or projects wholly or partly on the United Kingdom Continental Shelf and superjacent waters outside territorial waters (‘the UKCS’) (i.e. outside the 12 nm territorial zone).

In Scotland, the Directives are transposed through a combination of the Habitats Regulations 2010 (in relation to reserved matters) and the 1994 Regulations (which have recently been amended by the Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2011).

The Habitats Directive lists those habitats and species (Annex I and II respectively) whose conservation requires the designation of special areas of interest. These habitats and species are to be protected by the creation of a series of ‘Special Areas of Conservation’ (SACs), and by various other safeguard measures (Sites of Community Importance (SCIs)) for particular species. The Birds Directive requires member states to nominate sites as Special Protection Areas (SPAs). Together with adopted SACs, the SPA network forms the ‘Natura 2000’ network of protected areas in the European Union.

The UK regulator (DECC) considers all types of SAC in the same way, as if they have already been designated. Therefore as with an SAC, any activity likely to have a significant effect on the site of a cSAC, pSAC or dSAC must be appropriately assessed.

Under these regulations, it is an offence to deliberately disturb any European Protected Species (EPS) while it is within its SAC or to capture, injure or kill an EPS at any time. New projects/developments must demonstrate that they will not significantly disturb an EPS in a way that will affect;

- the ability of the species to survive, breed, rear or nurture its young or affect its hibernating or migration patterns (termed the injury offence), or
- the local distribution or abundance of any protected species (termed the disturbance offence).

3.2.1 Habitats

Of the habitat types listed in the Habitats Directive (Annex I) requiring protection, four of them occur or potentially occur in the UK offshore area (JNCC, 2012);

- sandbanks which are slightly covered by seawater at all times;
- reefs:
  - bedrock reefs; made from continuous

outcroppings of bedrock which may be of various topographical shapes (e.g. pinnacles and offshore banks);

- stony reefs; aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces;
- biogenic reefs; formed by cold water corals (e.g. *Lophelia pertusa*) and the polychaete worm *Sabellaria spinulosa;*

- submarine structures made by leaking gases;
- submerged or partially submerged sea caves.

The nearest offshore protected areas are the Wyville Thomson Ridge and the Darwin mounds both of which are cSAC/SCIs and are located approximately 110 km and 160 km west of the development area respectively. The Wyville Thompson ridge is a stony ridge, thought to have been formed by the ploughing movements of icebergs through the seabed at the end of the last ice age. The Darwin mounds are sandy mounds topped with thickets of *L. pertusa.*

The Shetland Islands located approximately 130 km west of the Schiehallion and Loyal fields has a number of coastal SSSIs (Special Sites of Scientific Interest), SACs, RAMSAR (wetlands of international importance) and SPA sites.

Survey results from the area have identified no environmentally sensitive habitats protected under Annex I of the EC Habitats Directive. It should be noted that small colonies of *L. pertusa* have been observed on infrastructure at both the Foinaven and Schiehallion FPSO (BP, 2010).

3.2.2 Scottish Marine Protected Areas

The Marine (Scotland) Act and the UK Marine and Coastal Access Act (2009) include new powers for Marine Scotland, the Joint Nature Conservation Committee (JNCC), Historic Scotland and Scottish Natural Heritage (SNH) to designate Marine Protected Areas (MPAs) in the seas around Scotland as part of a range of measures to manage and protect Scotland's seas for current and future generations. A number of areas termed 'search areas' are being considered for MPA status (SNH, 2011).

The Marine (Scotland) Act outlines provisions to designate MPAs for the following purposes within Scottish territorial waters (inside 12 nm):

- Nature Conservation MPAs for the conservation of nationally important marine wildlife, habitats, geology and undersea landforms;
- Demonstration/Research MPAs to demonstrate or research sustainable methods of marine management or exploitation;
- Historic MPAs for features of historic/cultural importance such as shipwrecks and submerged landscapes.

The UK Marine and Coastal Access Act also includes equivalent provisions for Scottish Ministers to designate MPAs for the conservation of nationally important marine wildlife, habitats, geology and undersea landforms in offshore waters (outside 12 nm) adjacent to Scotland. Although legally Marine Conservation Zones (MCZs), for consistency they will collectively be referred to as Nature Conservation MPAs and will be established using the same Site Selection Guidelines.

These search areas were chosen based on:

- The contribution of existing protected area analysis;
- Contribution of other area-based measures; and
- Contribution of least damage/more natural locations.

The nearest MPA 'search area', is the Faroe-Shetland trench. The Schiehallion FPSO is located just within the eastern edge of this area. The Loyal and Northwest drill centres and the gas disposal well are located within this search area, while the West and Central drill centres are outside the area.

3.2.3 Species

The designation of fish species requiring special protection in UK waters is receiving increasing attention with particular consideration being paid to large slow growing species such as sharks and rays. In addition the status of a number of marine mammals has resulted in them being given special protection.

The Wildlife and Countryside Act 1981 consolidates and amends existing national legislation to implement the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) and the Birds Directive. The Act makes it an offence to intentionally kill, injure, possess or trade in any animal listed in Schedule 5 and to interfere with places used by such animals for shelter or protection. There are 12 Schedule 5 fish species occurring in UK marine and estuarine waters. Of these 12, those possibly occurring in the area of the Schiehallion and Loyal development are the Allis shad (*Alosa alosa*) the basking shark *(Cetorhinus maximus)* and the angel shark (*Squatina squatina*) (FishBase, 2012).

Fish species listed under the EC Habitats Directive with a distribution encompassing the area of the development include the basking shark, and the Allis shad. Mammal species designated under the EC Habitats Directive that could occur in the area include Atlantic white-sided dolphins (*Lagenorhynchus acutus*), long-finned pilot whales (*Globiecphala melas*), killer whales (*Orcinus orca*), fin whales (*Balaenoptera physalus*), sperm whales (*Physeter macrocephalus*), Risso's dolphins (*Grampus griseus*), common dolphins (*Delphinus delphis*), minke whales (*Balaenoptera acutorostrata*) and white-beaked dolphins (*Lagenorhynchus albirostris*).

IUCN listed vulnerable and endangered species likely to occur in the area include the common skate (*Dipturus batis*), basking shark, porbeagle (*Lamna nasus*), sandy ray (*Leucoraja circularis*), spiny dogfish (*Squalus acanthias*), blue shark (*Prionace glauca*), and the Portuguese dogfish (*Centroscymnus coelolepis*) (FishBase 2012).

3.3 The Seabed

A number of seabed surveys have been carried out at the Schiehallion and Loyal development. Seabed relief is illustrated in Figure 3-3 and the locations and references of surveys are shown in Figure 3-4.

3.3.1 Seabed sediments

The Schiehallion and Loyal fields lie in an area dominated by iceberg ploughmarks: inactive features that are very common along the outer shelf and upper slope area in water depths ranging from 200 – 450 m (Masson, 2001; Stoker *et al*., 1993 and Fugro Geoteam, 2000). They are considered relict scars in the seabed with raised margins that were originally caused by the dragging of iceberg keels. Typical ploughmarks are several tens to a few hundred metres in width and are nowadays infilled with sediment. In the area of the development the ploughmarks are generally orientated in a northeast to southwest direction and are particularly prominent in the southeast of the project area, becoming less frequent to the north and west. To the northwest, the seabed sand veneer shows evidence of sediment transportation with the formation of ripples of approximately 0.1 m height and 30 m wavelength.

3.4 Marine Flora and Fauna

The area west of Shetland has a complex and productive ecosystem which supports important fish, seabird and marine mammal populations. The flora and fauna that interact to make up the ecosystem in the area are discussed below.

3.4.1 Plankton

Plankton are drifting organisms that inhabit the pelagic zone of a body of water and include single celled organisms such as bacteria as well as plants (phytoplankton) and animals (zooplankton).

3.4.1.1 Phytoplankton

Phytoplankton are the primary producers of organic matter in the marine environment and form the basis of marine ecosystem food chains.

The composition and abundance of phytoplankton communities varies throughout the year and is influenced by several factors, in particular sunlight and vertical mixing in the water column due to wind and currents. All these factors are at their optimum in the spring months, leading to a pronounced period of phytoplankton growth, known as the spring bloom. The size and timing of the blooms may vary from year to year depending on local weather and oceanographic conditions.

Huthnance (1986) notes that phytoplankton distributions vary between areas due to effects of slope topography on the propagation of oceanic eddies and internal waves, differences in shelf edge tidal currents and slope currents, and seasonal and latitudinal variations in the degree of stratification across the shelf edge. However a broadly similar pattern of phytoplankton blooming is reported for the Northwest European shelf edge and adjacent Atlantic from the Rockall Trough through the Faroe-Shetland Channel to the northern North Sea.

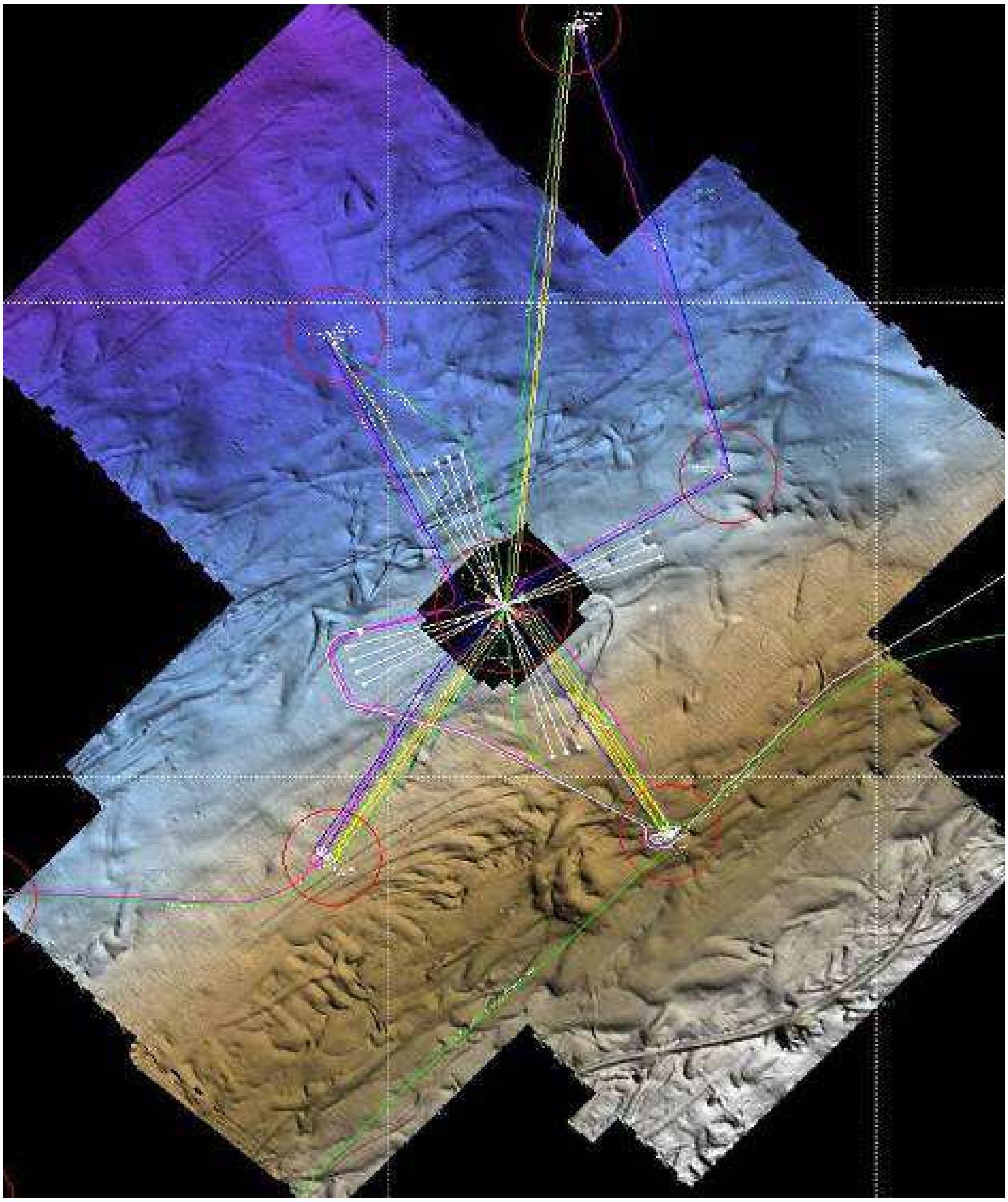

Figure 3-3 Seabed relief in the Schiehallion area

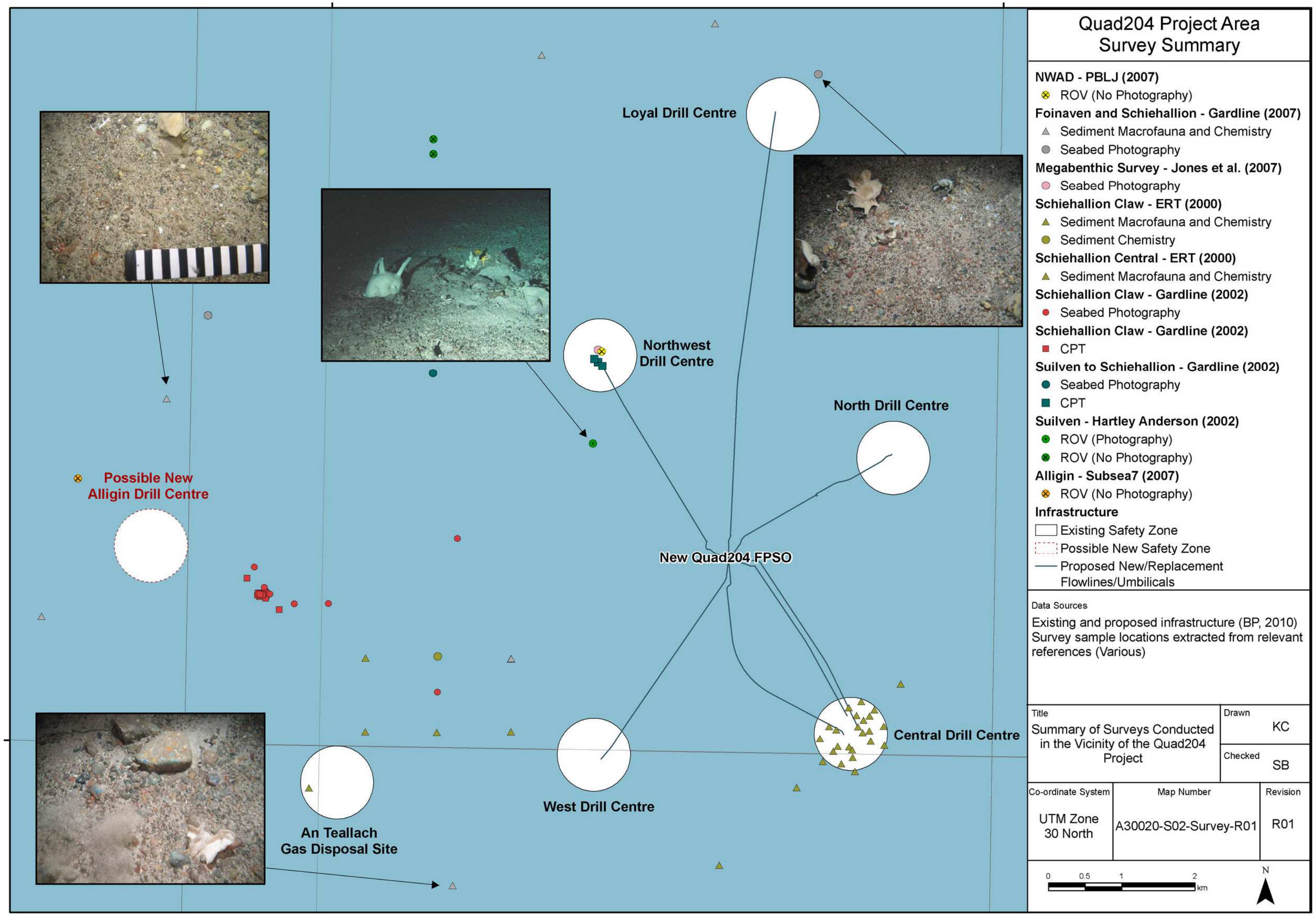

Figure 3-4 Location of surveys carried out at the Schiehallion and Loyal fields.

Robinson (1970) observed that, in deeper oceanic waters north of 60°N, (which includes the area of the project), phytoplankton abundance is lower and the productive season is shorter than that seen in the central or southern North Sea.

Information on phytoplankton specific to the development area is limited. However phytoplankton species as a whole in the area extending out from the west of Shetland is similar to that encountered in the North Sea. Table 3-1 lists some of the more abundant phytoplankton species recorded in the area.

Table 3-1 Some of the more abundant phytoplankton species found in the North Atlantic (DTI, 2003).

Phytoplankton
Ceratium fusus
Thalassiosira spp.
Chaetoceros (*Hyalochaete*) spp.
Ceratium furca
Chaetoceros (*Phaeoceros*) spp.
Rhizosolenia alata alata
Ceratium tripos
Thalassionema nitzscioides
Rhizosolenia styliformis
Nitzschia delicatissima

3.4.1.2 Zooplankton

Zooplankton are divided into two distinct groups – meroplankton, which refers to members of the plankton community that have a pelagic larval stage and a benthic adult stage (e.g. fish species), and holoplankton, which refers to organisms that are entirely planktonic.

Zooplankton are dependent upon phytoplankton as a food source and therefore show a similar temporal distribution pattern. Zooplankton are not restricted to the photic upper layers of the water column and as a rule undergo diurnal vertical movement, moving towards the surface to feed at night and sinking during daylight hours.

Large populations of the herbivorous zooplankton copepod *Calanus finmarchicus* over-winter in the nearby deep waters of the Faroe-Shetland channel and come to the surface during spring. Sampling undertaken approximately 3 km west of Schiehallion indicates peak biomass of *C. finmarchicus* in summer months (July – August). Another copepod species, *C. helgolandicus*, is also found in waters in the region. This species generally has a greater abundance further south; however, it is found in the area of the development.

T. longicaudata is the numerically dominant euphausiid in the near–surface waters of the North Atlantic. Euphausiids are an important group of zooplankton in the north Atlantic and in the Faroe-Shetland Channel being the main food source for several fish species on their feeding migration through the channel e.g. in blue whiting, krill have been shown to make up about 50% (by weight) of the diet (Bjelland and Monstad, 1997). In addition to being an important prey item for fish in the area, krill are an important food source for cetaceans such as fin-whales as well as for several seabirds species e.g. fulmars and storm-petrels (Debes *et al*., 2007).

3.4.2 Benthic Communities

Bacteria, plants and animals living on or within the seabed sediments are collectively referred to as benthos. Species living on top of the sea floor may be sessile (e.g. seaweeds) or freely moving (e.g. starfish) and are collectively referred to as epibenthic organisms. Animals living within the sediment are termed infaunal species (e.g. clams, tubeworms and burrowing crabs) while animals living on the surface are termed epifaunal (e.g. mussels, crabs, starfish and flounder). Semi-infaunal animals, including sea pens and some bivalves, lie partially buried in the seabed.

A number of surveys have been undertaken to investigate the benthic ecology in the Schiehallion and Loyal area (Figure 3-4: AFEN, 2000; Bett, 2000; BP, 2000a; BP, 2000b; AFEN, 2001; Hartley Anderson, 2002; Fugro, 2003; Gardline, 2003; ERT, 2007; Gardline, 2007). From these surveys there is evidence that the regional distribution of benthic communities west of Shetland is strongly affected by sediment type, seabed features, depth and temperature with faunal distributions in the area varying down-slope and along-slope (AFEN, 2001). Along-slope variation can be linked to seabed features and, in the area of the development, this variation is dominated by the presence of iceberg ploughmarks. There are local variations in benthic fauna in the different zones of iceberg ploughmarks. The relatively open sediment areas that mark the iceberg scour tracks frequently have extensive gravel cover and are dominated by irregular burrowing echinoids, whereas the iceberg track margins which appear to be marked by lanes of glacial erratics are dominated by cidarid urchins and a variable encrusting epifauna (Bett, 2001).

The continental shelf and slope area is characterised by two main macrofaunal assemblages, which are approximately separated by the boundary between the north flowing warm North Atlantic waters and the deeper cold water flowing from the Norwegian Sea. The boundary area between these two main macrofaunal assemblages occurs in the 300 – 600 m depth range, (within which the Schiehallion and Loyal fields lie), and benthic diversity appears to peak at these depths, which correspond with the greatest temperature variations (Hughes *et al.*, 2003).

Surveys around Schiehallion have reported that the sediments support a species-rich and relatively abundant macrofauna (BP 2000a; 2000b) consisting mainly of annelids (47%), crustaceans (26%), molluscs (16%) and echinoderms (4%). This is broadly typical of macrobenthic communities in offshore soft sediments for the northeast Atlantic area (Pearson *et al*., 1996). In addition these surveys identified a small epilithic component present in the area, mainly comprising sponges, bryozoans, spirobid polychaete worms and hydrozoans inhabiting the small stones on the seabed. Other epifauna reported from the region include the sea cucumber and a number of crab species (e.g. Lithodes spp.).

In contrast Gardline (2007) reported the benthic faunal community within the Foinaven / Schiehallion survey area to be sparse with an average of 52 individuals and 25 taxa identified per 0.1 m^2, and typical of a deep water location. The ten most abundant species within the survey area included the polychaetes *Galathowenia oculata* agg; the crustaceans *Ampelisca spinipes*, undetermined Ampelisca spp., *Haploops setosa* and *Haploops tubicola*; the burrowing brittlestar *Amphiura* sp and the bivalves *Astarte cf. sulcata*, *Limopsis aurita* and *Thyasira succisa*.

Surveys at the Schiehallion North West drill centre, found macrofauna to be of a moderate to relatively high density (Fugro, 2003); however, when compared to surveys at the Central drill centre, the numbers at North West could be considered low (ERT, 2007). The majority of taxa found were typical for the area, although several species characteristic of faunal communities elsewhere at Schiehallion were not present at the North West drill centre.

The limited areas of hard substrata (e.g. boulders) found in the development area supports sessile epifaunal populations the most abundant of which are sponges (e.g. Geodia spp, Stryphnus spp), sea urchins (*Cidaris cidaris*, Echinus spp), sea cucumbers (Stichopus tremulus) starfish (*Hippasteria phrygiana*) and crabs (e.g. *Chaceon affinis*) and squat lobsters (Munida sp.) (Hartley Anderson, 2002).

The surveys described above support the view that the benthic communities vary in species richness and abundance across the development area. ERT (2007) concluded this variation is not a result of anthropogenic activity in the area. Rather, as previously mentioned it is likely to be driven by the variation in sediment type, seabed features, depth and temperature associated with the area (AFEN, 2001).

Surveys undertaken in the area suggest that there are no species or habitats of conservation importance identified (under the UK's Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001) in the region (Gardline, 2007). Small colonies of *L. pertusa* have been observed on infrastructure at both the Foinaven and Schiehallion FPSO (BP, 2010).

3.4.3 Fish Populations

Fish occupying areas in close proximity to offshore oil and gas activities could be exposed to aqueous discharges and may accumulate hydrocarbons and other contaminating chemicals in their body tissues.

Fish communities consist of species that have complex interactions with one another and the natural environment. They consume a wide range of benthic invertebrates and / or act as predators at higher trophic levels, while themselves being a source of prey for larger animals.

At present more than 330 fish species are thought to inhabit the shelf seas of the UKCS (Pinnegar *et al*., 2010). Pelagic species (e.g. herring (*Clupea clupea*), mackerel (*Scomber scombrus)*, blue whiting (*Micromesistius* *poutassou*) and sprat (*Sprattus sprattus*)) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g. cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), sole (*Solea solea*) and whiting (*Merlangius merlangus*)) live on or near the seabed and similar to pelagic species, many are known to passively move (e.g. drifting eggs and larvae) and/or actively migrate (e.g. juveniles and adults) between areas during their lifecycle.

From fishing landings data (Scottish Government, 2012) it is evident a number of commercially important fish species occur in the area of the Schiehallion and Loyal fields some of which are listed in Table 3-2. Pelagic shark species expected to occur in the area include the porbeagle (*L. Nasus*) and the basking shark (*C. Maximus*). As a result of target fisheries the IUCN status of both these shark species in the northeast Atlantic is given as vulnerable.

The most vulnerable stages of the life cycle of fish to general disturbances such as disruption to sediments and oil pollution are the egg and larval stages, hence recognition of spawning and nursery times and areas within a development area is important. Data on the use of this area by fish species as a spawning or nursery ground is limited as large monitoring surveys such as the UK ground fish surveys and the European coordinated ichthyoplankton surveys (egg surveys) do not tend to cover this area.

Species such as monkfish and Norway pout use the area as a spawning ground whilst the presence of mackerel and blue whiting juveniles indicate these species uses the area as a nursery ground (Coull *et. al*, 1998: Ellis *et al*., 2012). The Schiehallion and Loyal development also lies across an important mackerel migration and wintering area. Following spawning, adult mackerel migrate through the West of Shetland area to summer feeding grounds in the Norwegian Sea and northern North Sea (Belikov *et al.*, 1998 and Reid *et al.*, 1997).

Table 3-2 Some of the commercially important species occupying the area in the vicinity of the Schiehallion and Loyal fields.

Demersal Fish Species		
Saithe (*P. virens*)	Hake (*M. merluccius*)	Ling (*M. molva*)
Megrim (*L. whiffiagonis*)	Monkfish (Lophius spp)	Haddock (*M. aeglefinus*)
Cod (*G. morhua*)	Redfish (Sebastes spp)	Sea bream (Spondyliosoma spp)
Halibut (*H .hippoglossus*)	Whiting (*M. merlangus*)	Pollack (*P. pollachius*)
Blue Ling (*M. dypterygia*)	Torsk (*B. brosme*)	Lemon sole (*M. kitt*)
Skates and rays	Greater forkbeard (*P. blennoides*)	Greenland halibut (*R.hippoglossoides*)
John Dory (*Z. faber*)	Conger eel (*C. conger*)	Turbot (*S. maximus*)
Plaice (*P. platessa*)	Red gurnard (*A. cuculus*)	Roundnose grenadier (*C. rupestris*)
Roughead grenadier (*M. berglax*)	Black scabbard (*A. carbo*)	Red mullet (*M. surmuletus*)
Rabbitfish (*C. monstrosa*)	Spurdog (*S. acanthias*)	
Pelagic Fish Species		
Mackerel (*S. scombrus*)	Herring (*C. harengus*)	Horse mackerel (*T. trachurus*)
Greater silver smelt (*A. silus*)		
Note: the species listed are taken from landings data reported by UK vessels from ICES rectangle 49E5 (Scottish Government, 2012). It is not an exhaustive list of all the species landed or occurring in the area.		

Spawning and nursery ground are known to shift over time and as a result the recognised spawning and nursery grounds of some commercial fish species in the northeast Atlantic are shown in Figure 3-5 and Figure 3-6 (Coull *et al*., 1998). It should be noted that though spawning and nursery areas do alter over time it is unlikely that the spawning and nursery grounds of some of the species shown would extend into the area of the Schiehallion and Loyal fields due to the depths associated with the region.

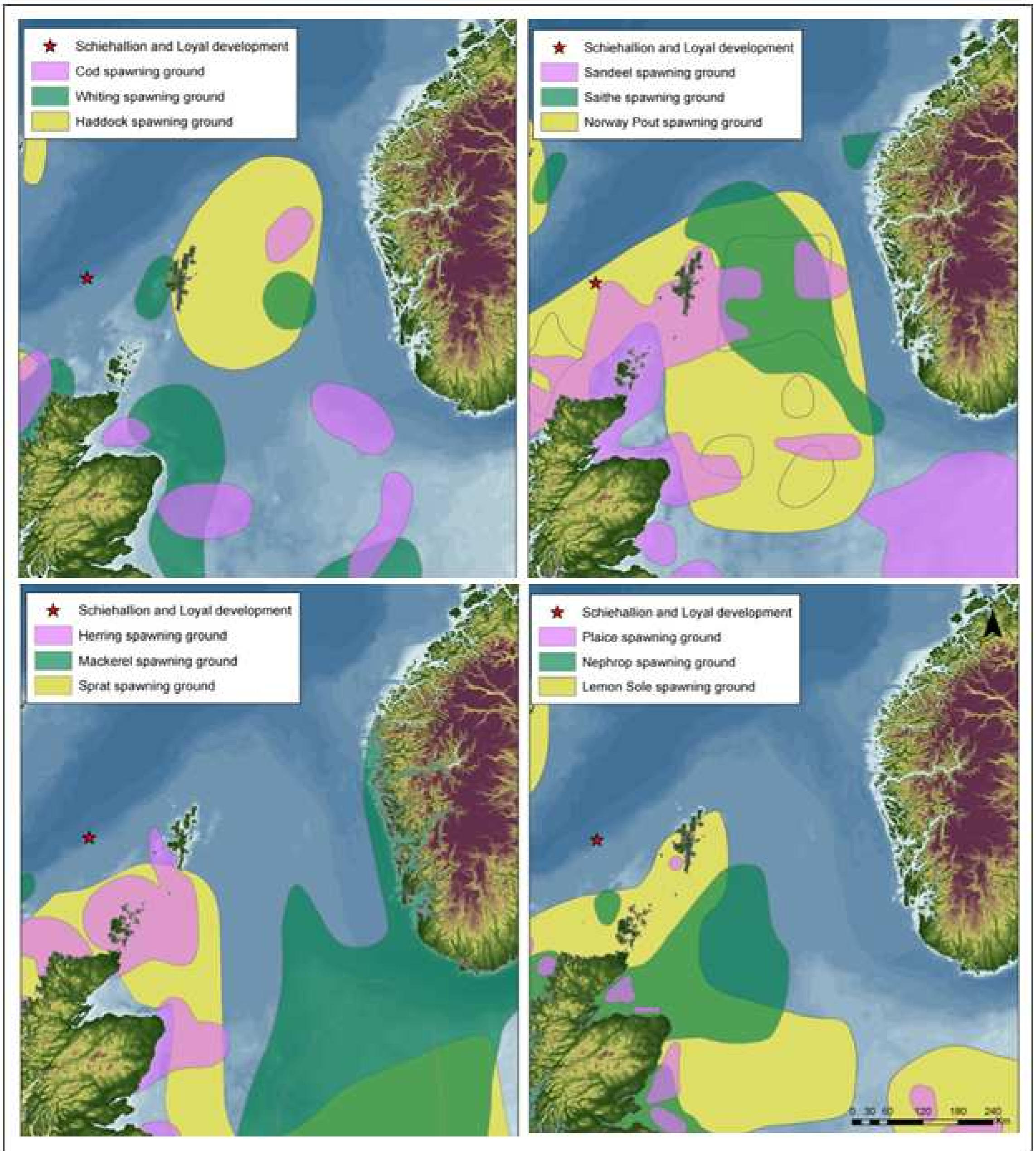

Figure 3-5 Recognised spawning grounds of some commercial fish species in the northeast Atlantic.

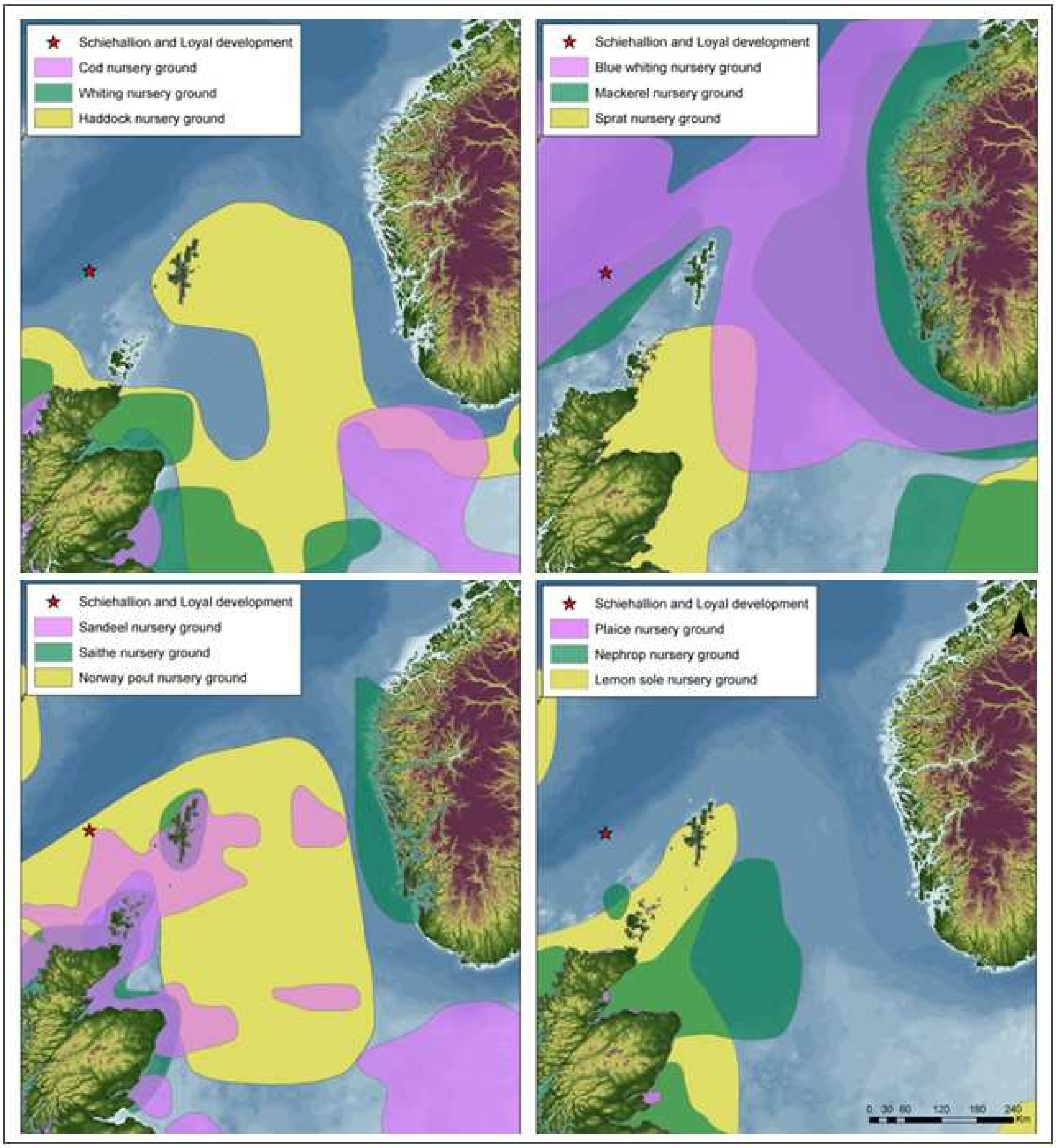

Figure 3-6 Recognised nursery grounds of some commercial fish species in the northeast Atlantic.

3.4.4 Marine Mammals

Pinnipeds (seals) and cetaceans (whales, dolphins and porpoises) are vulnerable to the direct effects of oil and gas activities such as noise, contaminants and oil spills. They are also affected indirectly by any processes that may affect prey availability.

3.4.4.1 Pinnipeds

Three seal species regularly occur to the west of Shetland of which two; the grey seal (*H. grypus*) and the hooded seal (*C. cristata*) occur in the vicinity of the Schiehallion and Loyal fields. Both these seal species are protected under the EC Habitats and Species Directive.

The grey seal breeds mainly in the Western Isles, Orkney and the Shetland Islands. Grey seals tend to be present all year round in water depths of less than 200 m. Only low densities have been observed in the area of the development with higher densities possibly associated with periods of migration between their breeding sites in Faroe and Shetland (BP, 2004; McConnell *et al.*, 1992, 1999).

Hooded seals breed and moult on the packed ice of Arctic waters, but are also known to range extensively outwith their breeding and moulting periods of March and July (Folkow *et al.*, 1996). Hooded seals have been recorded in deep waters over the Faroe-Shetland Channel and may therefore occur in the area of the Schiehallion and Loyal fields. The species has not been recorded in water depths less than 200 m (Pollock *et al.*, 2000).

3.4.4.2 Cetaceans

Twenty seven species of cetacean have been recorded in UK waters, 16 of which are known to be present in the area to the west of Shetland. The most abundant cetacean in the deeper water beyond the shelf area to the west of Shetland is the Atlantic white-sided dolphin. The Faroe-Shetland Channel contains a number of species that are rare or endangered including the blue whale and right whale. Macleod *et al.*, (2003) noted that of three regions surveyed: west of the Outer Hebrides, west of the Shetland Islands and the central Faroe-Shetland Channel, the Faroe-Shetland Channel had the greatest relative abundance of large whales and dolphins.

Table 3-3 gives an indication of the species that may be present in the area and the times of the year that they are most likely to occur.

Table 3-3 Seasonal occurrence of cetaceans in the waters west of Shetland (Pollock *et al*., 2000; Hammond *et al*., 2003; Reid *et al*., 2003; Stone, 2003a; 2003b; Macleod *et al*., 2003).

	Species	Comment
Seasonal migrants	Fin whale	Rare/uncommon. Most sightings to the northwest of the development in the Faroe-Shetland channel. Believed to be both a seasonal migrant and summer resident.
	Blue whale	Very rare. Presence recorded around Shetland and Faroe Islands. Thought to migrate to northern latitudes during the summer, some over winter in the north.
	Sei whale	Very rare/ rare. Mainly sighted in deep waters on the western side of the Faroe-Shetland channel. Seasonal numbers fluctuate.
	Humpback whale	Very rare. Generally recorded in water depths > 1,000 m. Migrate southwest through the region in November to March. Some sightings on the continental shelf.
Deep water species	White-sided dolphin	Common. Found all year round in the deep waters of the Faroe-Shetland Channel and the Faroe Bank Channel. These dolphins are regularly sighted in large pods.
	Long-finned pilot whale	Common along shelf break and the Faroe-Shetland Channel. Also occur in shallower waters with sightings to the west and north of the Schiehallion and Loyal fields.
	Killer whale	Found over the continental shelf and in deep waters all year. In May and June observations are predominantly along the continental slope.
	Sperm whale	Rare – mainly in deep waters of the Faroe-Shetland Channel and Rockall Trough. Peak sightings occur in summer, acoustic data also indicate presence in winter.
	Bottlenose whale	Very rare. Most sightings over the Wyville Thompson Ridge. Very few sightings at Orkney, Shetland or the Faroes. Sightings are reported throughout the year.
Mainly continental shelf species	White-beaked dolphin	Common. Mainly concentrated in shelf waters. Rare in waters over 200 m deep although it has been sighted in the vicinity of the Schiehallion field in late summer.
	Harbour porpoise	Commonly found in waters west of Shetland, although rarely recorded in waters deeper than 500 m.
	Minke whale	Uncommon in the vicinity of the development, with sightings generally occurring in waters less than 200 m. Sightings have been made throughout the year and it is believed a small proportion of those associated with the west of Shetland area may overwinter there.
	Bottlenose dolphin	Uncommon in the Atlantic margin area. Mostly recorded along the Atlantic margin shelf ridge and over the Wyville Thompson Ridge.
	Risso's dolphin	Rare / uncommon in the Atlantic margin region with most sightings occurring on the continental shelf in depths of 50 – 100 m.

3.4.5 Seabirds

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

Birds are vulnerable to oily surface pollution, as it can cause direct toxicity through ingestion and hypothermia as a result of the birds' inability to waterproof their feathers. Birds are most vulnerable in the moulting season when they become flightless and spend a large amount of time on the water surface, significantly increasing their vulnerability to oil spills. Fulmar (*Fulmarus glacialis*), guillemot (*Uria aalge*) and puffin (*Fratercula arctica*) are particularly vulnerable to surface pollutants as they spend the majority of their time on the surface of the water. Herring gull (*Larus argentatus*), kittiwake (*Rissa tridactyla*) and great black-backed gull (*Larus marinus*) are less vulnerable as they spend a larger proportion of their time flying and therefore less time on the sea surface (Stone *et al*., 1995). After the breeding season ends in June, large numbers of moulting auks, guillemot (*Uria aalge*), razorbill (*Alca torda*) and puffin (*Fratercula arctica*) disperse widely away from their coastal colonies and into offshore waters. At this time these high numbers of birds are particularly vulnerable to oil pollution.

The JNCC has produced an Offshore Vulnerability Index (OVI) for seabirds encountered within each offshore licence block within the southern, central and northern North Sea and the Irish Sea. For each block, an index of vulnerability for all species is given which considers the following four factors:

- the amount of time spent on the water;
- total biogeographical population;
- reliance on the marine environment;
- potential rate of population recovery.

Each of these factors is weighted according to its biological importance and the OVI is then derived (Williams *et al*., 1994). As seen in Table 3-4 the OVI of seabirds within each offshore licence block changes throughout the year. This is due to seasonal fluctuations in the species and number of birds present in the area. Figure 3-7 shows the location of the blocks listed in Table 3-4 in relation to the Schiehallion and Loyal fields and also shows the overall annual vulnerability of birds in the area to surface pollution.

Table 3-4 OVI for seabirds in the area of the Schiehallion and Loyal fields.

Block No.	Month												Overall
	J	F	M	A	M	J	J	A	S	O	N	D	
204/14	3	ND	3	4	2	3	3	3	2	3	3	4	4
204/15	3	4	2	4	2	3	3	3	2	3	3	4	4
205/11	3	4	2	4	3	3	3	4	2	4	ND	4	4
204/19	3	4	3	4	2	2	3	3	2	3	3	4	4
204/20	3	4	2	3	2	2	3	3	2	3	3	4	4
205/16	3	4	2	3	3	3	3	4	2	4	3	4	4
204/24	3	4	3	3	3	2	2	4	3	3	3	4	4
204/25	3	4	3	2	3	2	2	4	3	3	3	4	4
205/21	3	4	3	2	3	3	2	4	3	3	3	4	4
204/29	3	4	3	3	3	2	2	4	3	3	3	4	4
204/30	3	4	3	2	3	2	2	4	3	3	3	4	4
205/26	3	4	3	2	3	3	2	4	4	3	3	4	4

ND no data	1= Very high	2 = High	3 = Medium	4 = Low

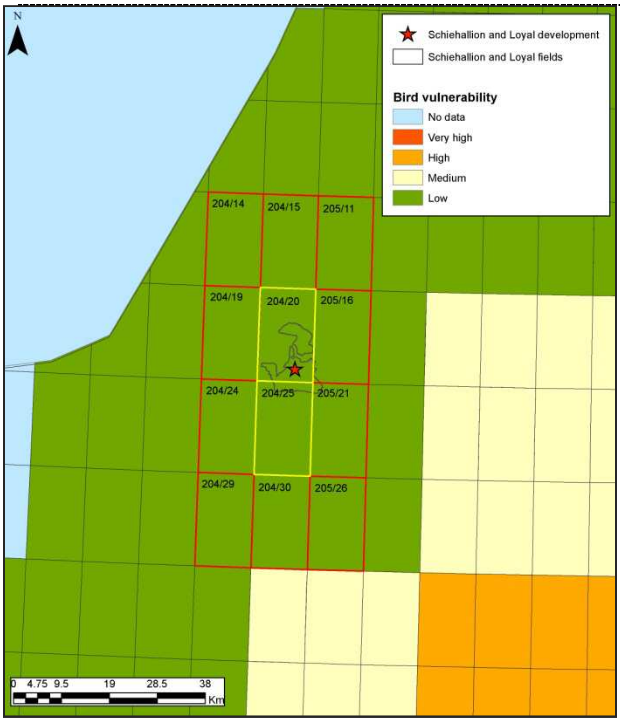

Figure 3-7 Overall annual seabird vulnerability to surface pollution in the area of the Schiehallion and Loyal fields.

Table 3-4 suggests seabird vulnerability to surface pollution in the area of the Schiehallion and Loyal fields varies throughout the year. The periods of lowest vulnerability coincide with seabirds generally leaving offshore waters following the winter period and returning to their coastal colonies for the breeding season. Overall annual vulnerability in the area of the development and surrounding blocks is considered low. Figure 3-9 shows the foraging ranges of a number of bird species found on the Shetland and Orkney Islands. Based on this information, bird species expected to be found in the area of the Schiehallion and Loyal fields include Leach's petrel, great skua, lesser black-backed gull, kittiwake, guillemot, razorbill, manx shearwater, puffin, gannet and fulmar.

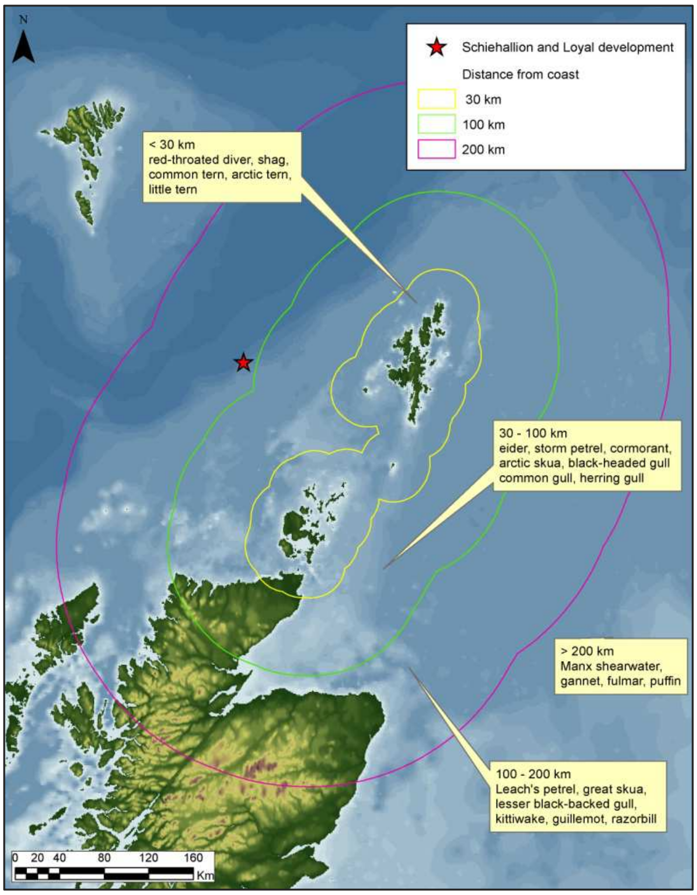

Figure 3-8 Maximum foraging distances of some bird species occupying colonies on the Shetland and Orkney Islands.

4 Socio-Economic Description

The need for a socio-economic assessment comes directly from the decommissioning obligations under the Petroleum Act 1(998) which require that as part of the EIA the potential impact of decommissioning activities on mariculture and other sea users is assessed in addition to the environmental impacts.

This section describes the baseline socio-economic environment at the development in order to allow the assessment of any potential societal impacts of the decommissioning programme.

4.1 Fishing Activity

One of the main areas of potential adverse effects associated with the offshore oil and gas industry is in relation to fishing activities. Offshore structures have the potential to interfere with fishing activities as their physical presence may obstruct access to fishing grounds.

Satellite tracking for all EU licensed vessels over 15 m and the requirement for UK fishermen to report catch information such as total landings (including species type and tonnage of each), location of hauls and catch method (type of gear / duration of fishing) means it is possible to get an idea of the value of the area at the Schiehallion and Loyal fields to the UK fishing industry. In addition BP commissioned two commercial fisheries studies (Brown and May, 2003 and SFF/Brown and May, 2010) to review the fishing levels in the area.

The northeast Atlantic is divided into ICES sub-divisions for the purposes of fisheries management. ICES statistical rectangles are the smallest area units used for collating fisheries data in the Western Margins. For management purposes, ICES collates fisheries information for individual rectangles measuring 30 nm by 30 nm. Each ICES rectangle covers approximately one half of one Quadrant, i.e. 15 licence blocks. The importance of an area to the fishing industry is assessed by measuring the fishing effort which may be defined as the number of days (time) x fleet capacity (tonnage and engine power). Landings reported by UK fishermen are reported by ICES rectangle. It should be noted, however, that fishing activity may not be uniformly distributed over the whole area of the ICES rectangle. The Schiehallion and Loyal development lies primarily within ICES rectangle 49E5.

4.1.1 Fishing effort

The fishing effort data presented in this section covers UK over 10 m vessels only and includes time spent travelling to the fish grounds as well as time spent fishing. Effort data could only be obtained for those ICES rectangles where five or more UK vessels over 10 m undertook fishing activity in a given year. Rectangles in which less than five such vessels undertook fishing activity cannot be sourced due to the data protection act as the data is considered disclosive.

Based on 2010 and 2011 data reported to the Marine Management Organisation (Scottish Government, 2012) the main fishing gears used in ICES rectangle 49E5 are bottom otter trawls, midwater twin trawls, longlines and fixed gill nets. Some twin boat trawling also takes place.

Analysis of effort data from 2009 – 2011 (Scottish Government, 2012) from ICES rectangle 49E5 suggests an average fishing effort of 385 days per annum i.e. approximately 0.2% of total reported effort by UK boats over 10 m. To put this into context fishing effort per ICES rectangle in 2011 is presented in Table 4-1.

Table 4-1 Fishing effort per ICES rectangle for 2011.

Fishing effort (number of days)	Number of ICES rectangles
< 100	93
100 - 500	126
501 - 1000	40
1,001 - 2,500	40
2,501 - 6,800	14

Note: this table does not include those ICEs rectangles in which less than five UK over 10 m vessels were active.

On a more localised scale Figure 4-1 shows this fishing effort compared to reported effort from the surrounding ICES rectangles.

It can be concluded fishing effort by UK vessels in the area of the Schiehallion and Loyal fields is relatively low.

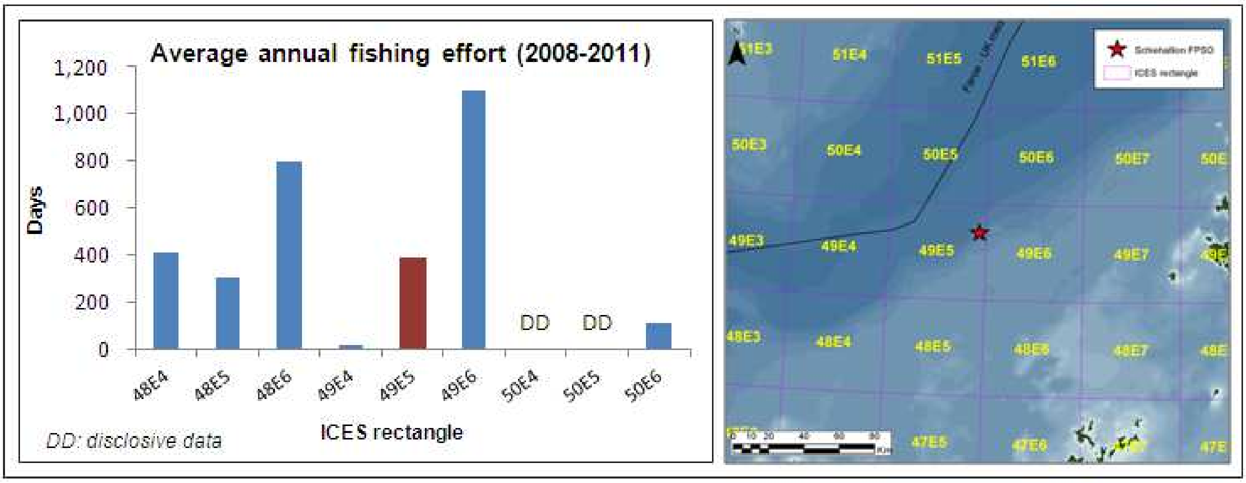

Figure 4-1 Fishing effort by UK vessels over 10 m in the region of the Schiehallion and Loyal fields.

The fishing effort presented is restricted to UK vessels; however, data on effort by international vessels fishing in 49E5 and landing in UK ports is available in SFF/Brown and May (2010) (Table 4-2).

Table 4-2 Nationality effort distribution in ICES rectangle 49E5 by vessels into UK ports (2004-2008).

Country	Percentage effort
United Kingdom	89.92
Spain	5.32
France	4.09
Germany	0.26
Faroe Islands	0.05
Poland	0.02

4.1.2 Fish landings

Rectangle 49E5 is predominantly targeted for demersal species such as cod, monkfish, saithe and hake. Many of the targeted species will not necessarily be evenly distributed throughout the rectangle for example it is unlikely that cod will be found in those areas of water depths over 400 m. Pelagic species caught between 2009 and 2011 have primarily comprised mackerel. Figure 4-2 shows the quantity and value of demersal and pelagic landings into UK ports by UK and non UK vessels taken from 49E5. Shellfish landings are small and averaged 8 tonnes per annum between 2008 and 2011. Landings from the rectangle vary annually and in 2011 represented 0.5% of the total UK landings in that year.

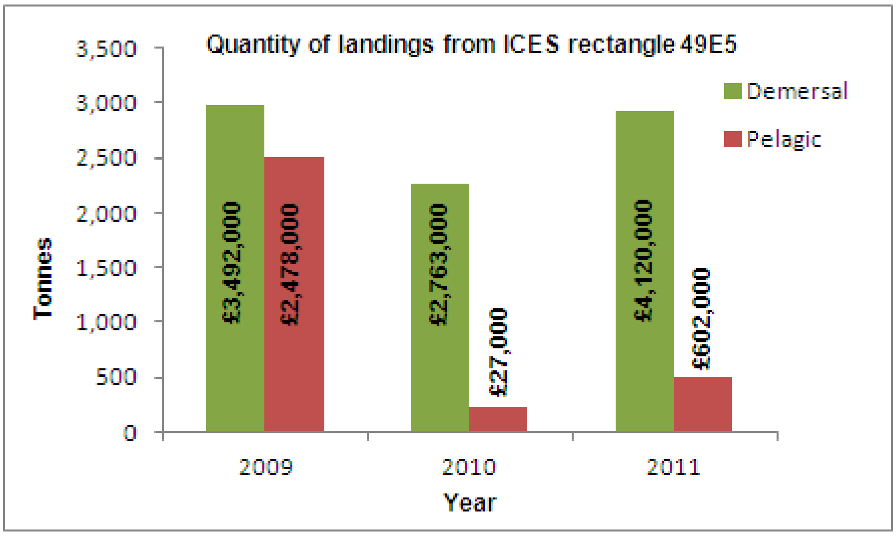

Figure 4-2 Quantity and value of landings into UK ports from ICES rectangle 49E5.

The information presented in Figure 4-2 should be treated with caution as it is believed that 49E5 has historically been known to incur substantial levels of misreporting with landings from nearby rectangles being attributed to it (communication between Scottish Fisheries Protection Agency and Brown and May; SFF/Brown and May 2010).

Based on effort data and the landings data available it can be concluded that the Schiehallion and Loyal development lie is an area of low to medium importance to the UK fishing industry.

4.2 Shipping

Overall shipping activity is considered low in the area of the Schiehallion and Loyal fields (DECC, 2012). Those shipping routes that do pass near the Schiehallion and Loyal development area were found to typically comprise vessels en route to and from SVT and vessels in transit across the Atlantic (Table 4-3; Anatec, 2010).

Table 4-3 Shipping routes identified within 10 nm of the Schiehallion FPSO (Anatec, 2010).

Route name	Closest point of approach to Schiehallion FPSO (nm)	Bearing (°)	No. ships per annum	% of total
Aberdeen-Foinaven*	3.4	227	166	17
Schiehallion Field-SVT*	3.8	86	130	13
Moray Firth-Schiehallion (tanker)	3.8	87	20	2
Aberdeen-Schiehallion*	3.8	87	102	10
Moray Firth-Schiehallion (supply)*	3.8	93	182	18
Sullom Voe-America North*	6.4	162	85	9
Canada-SVT	8.1	343	20	2
Humber-Faroes	8.5	47	5	1
Faroes-Rotterdam*	9.0	236	50	5
Kattegat-Iceland*	9.8	201	225	23
Total			985	

*Where two or more routes have identical closest point of approach and bearing they have been grouped together. In this case, the description lists the sub-route with the most ships per year.

4.3 Existing oil and gas activity

There is a long history of oil and gas activity north and west of Scotland, with the first well being drilled in 1972 and the first commercial discovery (the Clair field) made in July 1977. To date, the Foinaven, Schiehallion/Loyal and Clair fields are the only producing fields in the region, with first oil in 1997, 1998 and 2005 respectively. In 2002, the West of Shetland Pipeline System (WOSPS) was installed to transport surplus gas from the Foinaven and Schiehallion fields to the Magnus field in the northern North Sea, via SVT, as part of the Magnus Enhanced Oil Recovery Project.

Recently, offshore operations have begun at Laggan and Tormore (Figure 1-1). In addition, there are a number of other recent finds and on-going appraisals to the west of Shetland, including Chevron Rosebank which was drilled in 2007, the large gas find in the Glenlivet field, successfully drilled in 2009 and a recent gas discovery located in Block 204/13a and 14b known as Tornado.

4.4 Military exercises

There are no military exercise areas near the Schiehallion and Loyal development (DECC, 2012). Hydrophones to track submarines are present on the seabed in the Atlantic Margin area, although information on their location is confidential. The nearest practice and exercise area (PEXA) is located over 110 km to the south.

4.5 Submarine cables

The closest known submarine telecommunication or power cable to the Schiehallion FPSO is the SHEFA-2 Segment 5 cable which connects the Schiehallion FPSO to Clair (Figure 4-3).

4.6 Other Potential Users

There is no tourism, renewable energy or aggregate industries associated with the area.

Table 4-4 Identified structures on the seabed within 10 km of the Schiehallion FPSO.

Seabed feature	Approximate depth (m)	Date sunk	Distance/direction from Quad204 Project	Details
Foul Ground - Anchor	500 m	17/5/95	3.2 km NW	Lost during mooring recovery operation
Foul Ground - Drill Casing	490 m	14/10/94	9 km W	String of drill casing dropped onto seabed by the rig 'Sovereign Explorer'.
Wreck	405 m	25/07/17	2.9 km NW	Norwegian schooner captured and sunk by a German U-boat while on passage from Stavanger to Halifax.

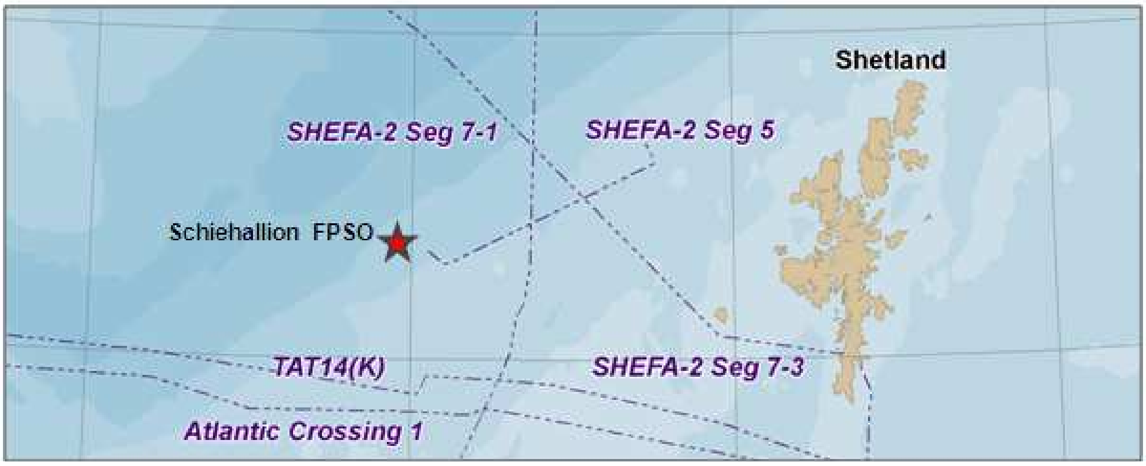

Figure 4-3 Cables in the area of the Schiehallion and Loyal fields. (Source: KISCA, 2010).

5 The Environment and Socio-Economic Impact Assessment Process

This chapter describes ESIA process applied to each of the field suspension activities in order to determine their significance.

5.1 Overview

The Environment and Socio-economic Impact Assessment (ESIA) process is a process which identifies the environmental effects of a proposed development and aims to prevent, reduce and offset any adverse impacts identified. The requirements for an EIA are defined by the Council Directive 85/337/EEC as amended by Directives 97/11/EC and 2003/35/EC.

For the EIA process, activities likely to have an impact on the environment, other users (socio-economic) of that environment, and potential cumulative and transboundary impacts are first identified. Once identified, these activities are assessed to define the level of potential risk they present to the environment so that, where necessary, such risks can be removed or reduced through design or the adoption of operational measures (mitigation).

5.2 The ESIA Methodology

Central to the ESIA process is the requirement to identify activities that could cause harm to the environment or other users of that environment. Once identified these activities are assessed to define the level i.e. the significance of potential impact that they present so that measures can be taken to remove or reduce negative impacts through design or operational measures (mitigation).

The significance of any potential impact is determined through the use of a risk assessment approach which employs the standard risk assessment philosophy of: *Likelihood of occurrence (frequency/probability) x magnitude of impact (consequence) = Risk*

The significance of potential risk is assessed against three drivers:

i. Regulatory compliance (R) - considering current and anticipated future legislative requirements and also corporate policies
ii. Environmental impact (E) - considering environmental sensitivities and scientifically established measures of risk, but also perceived risk or concern (precautionary principle)
iii. Stakeholder concern (S) - considering other sea users (potential conflict/concern resolution), interest groups and general public (perceptions and concerns)

Defining what constitutes unacceptable harm to the natural environment ultimately depends on what value society places on ecosystem integrity and biodiversity. In addressing the environmental impact driver (E, above), broad scientific criteria have been applied; whereas in rating the factors represented under stakeholder concern (S, above), wider concerns have been considered.

For every issue or aspect identified for the project, the potential risk was evaluated by combining the likelihood of occurrence (frequency / probability) (rated 1 to 5 as defined in Table 5-1) with the magnitude of the consequences for each of the three drivers indicated above - the highest consequence rating score in any of the driver categories was used (rated positive to severe as defined in Table 5-2). Both components are at best semi-quantitative, representing best judgements on the basis of available knowledge and experience, but provide a consistent and documented approach across the whole project. The overall significance of any potential risk was then determined from the risk matrix (Table 5-3) Definitions of overall significance are provided in Table 5-4.

Once overall impact significance has been assessed appropriate mitigation measures should be applied to each area of impact with the aim of reducing the level of significance. Once mitigation measures have been applied issues are reassessed to see if overall impact significance has been reduced.

The outcomes for each of the potential issues identified are presented in the EIA matrix (Chapter 6).

Table 5-1 Likelihood of occurrence (frequency / probability).

Likelihood	Routine (Planned[1]) Operation (Frequency)	Accidental Event (Unplanned[2]) (Probability)
5	Continuous emission or permanent change over more than 5 years	Likely: 10^{-1} - >1 per year Event likely to occur more than once on the facility
4	Continuous emission or permanent change over less than 5 years OR Regular over more than 3 years	Possible: 10^{-2} - 10^{-1} per year Could occur within the lifetime of the facility
3	Regular over less than 3 years OR Intermittent over more than 3 years	Unlikely: 10^{-3} - 10^{-2} per year Event could occur within lifetime of 10 similar facilities Has occurred at similar facilities
2	One off event over lifetime of development over several weeks duration OR Once per year for <24 hours	Remote: 10^{-5} - 10^{-3} per year Similar event has occurred somewhere in industry or similar industry but not likely to occur with current practices and procedures
1	One off event over lifetime of development for < 5 days	Extremely remote: < 10^{-5} per year Has never occurred within industry or similar industry but theoretically possible
0	Will not occur	Will not occur

Planned environmental aspects are those that are guaranteed to occur over the course of operations and include single, intermittent and continuous events
Unplanned environmental aspects are those arising from abnormal activities or from hazardous or emergency situations

Table 5-2 Magnitude of consequences.

	Regulatory Compliance (R)	Environmental Impact (E)	Stakeholder Concern (S)
Severe	Activity prohibited Likely major breach of regulatory requirements resulting in potential prosectution or significant project approval delays	Widespread long-term degradation to the quality or availability of habitats and/or wildlife with recovery not expected for >5 years or that cannot be readily rectified Major impact on the conservation objectives of internationally/nationally protected sites, habitats or populations Major transboundary effects expected Major contribution to cumulative effects	International public concern and extensive international media interest likely Well established and widely held areas of concern in society, including perception of threat to the global environment Decrease in the availability or quality of a resource to the extent of affecting over 5+ years the well being of the persons utilising that resource e.g. loss off fishing access or recreational use Potential major effect on human health
Major	Possible major breach of specific regulatory consent limits resulting in non-compliance	Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort. Recovery likely within 2-5 years following cessation of activities Moderate-minor impact on the conservation objectives of internationally/nationally protected sites, habitats or populations Moderate transboundary effects expected Moderate contribution to cumulative effects	National public concern and extensive national media interest likely Well established and widely held areas of concern in national society Decrease in the availability or quality of a resource to the extent of affecting over 2-5 years the well being of the persons utilising that resource Potential moderate impact on human health
Moderate	Possible minor breach of specific regulatory consent limits resulting in non-compliance	Widespread change in habitats or species beyond natural variability with recovery likely within 1-2 years following cessation of activities, or localised long-term degradation with recovery in 2-5 years Impact on status of locally important sites or species Possible transboundary effects Possible contribution to cumulative effects	Regional/local concerns at the community or broad interest group level Decrease in the availability of a resource to the extent of affecting over 1-2 years the well being of the persons utilising that resource Possible but unlikely effect on human health, but may cause or be perceived to cause a nuisance
Minor	Regulatory terms set defined consent limits	Change in habitats or species which can be seen and measured but is at same scale as natural variability Unlikely to contribute to transboundary or cumulative effects	Issues that might affect individual people or businesses or single interests at the local level Some local public awareness and concern A short-term decrease in the the availabiilty or quality of a resource likely to be noticed by persons utilising it, but does not affect their well being
Negligible	No likelihood of breach of regulatory or corporate/ company goals	Effects unlikely to be discernable or measurable No contribution to transboundary or cumulative effects	No noticeable stakeholder concern and only limited public interest A possible short-term decrease in the availability or quality of a resource, which is unlikely to be noticed by persons utilising it, or those who live in the immediate area, and does not affect their well being
Positive	N/A	An enhancement of some ecosystem or population parameter	No public interest or positive public support An enhancement in the availability or quality of a resource to the extent of potentially benefiting the well-being of the persons utilising that resource or benefiting from it in some way

Table 5-3 Risk Matrix.

	Consequence	Regulatory Compliance (R)	Environmental Impact (E)	Stakeholder Concern (S)	Likelihood 5 Continuous/ Likely	4 Regular/ Possible	3 Intermittent/ Unlikely	2 One off Event/ Remote	1 One off Event/ Extremely Remote	0 Will Not Occur
5	Severe	Activity prohibited Likely major breach in compliance resulting in prosecution	Severe magnitude/ sensitivity ranking	International concerns	25	20	15	10	5	0
4	Major	Possible major non-compliance	Major magnitude/ sensitivity ranking	National concerns	20	16	12	8	4	0
3	Moderate	Possible minor non-compliance	Moderate magnitude/ sensitivity ranking	Regional concerns	15	12	9	6	3	0
2	Minor	Regulatory terms or corporate policy set defined conditions	Minor magnitude/ sensitivity ranking	Local concerns	10	8	6	4	2	0
1	Negligible	No specific statutory control	Negligible magnitude/ sensitivity ranking	Individual concerns	5	4	3	2	1	0
0	Positive	N/A	Positive benefit or enhancement	No public interest or improves aspect of community importance	0	0	0	0	0	0

Table 5-4 Overall significance definitions.

Severe	Intolerable risk/highly significant - requires immediate action
Major	Intolerable risk/highly significant - requires immediate action
Moderate	Signficant - requires additional control measures and/or management
Minor	Not significant - however will require some management to ensure remains within acceptable levels
Negligible	Not significant
Positive Impact	Positive - to be encouraged

6 The Environment and Socio-Economic Impact Assessment

This section presents the results from the identification and assessment of environmental impacts from the proposed Decommissioning Programme. The environmental and socio-economic risks associated with the decommissioning activities was determined following the screening process outlined in Section 5. Table 6-1 presents all the potential impacts identified and assessed.

Table 6-1 The EIA matrix.

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
Field Preparation and Well Shut-In												
Shutting of tree valves	Discharges to sea resulting from the release of small volumes of subsea control fluid (HW540).	P	1	1	1	1	3	3	Permitted under Offshore Chemicals Regulations.	1	3	3
Methanol injection to manage hydrate risk	Emissions to air from generators used to inject methanol.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
	Discharges to sea: some discharge of methanol to sea will occur when blind seal plates (BSPs) are installed to isolate subsea infrastructure.	P	2	1	1	2	1	2	Risks are assessed and permitted under Offshore Chemicals Regulations (OCR). Installation procedures / work packs will be in place.	2	1	2
Accidental events	Discharges to sea resulting from loss of containment from wells resulting from dropped object and possible fishing gear interaction.	UP	5	4	5	5	1	5	Existing guard vessel activity will be in place during field suspension. In addition designated 500 m exclusion zones and an offshore development area are in place. These serve to keep other sea users out of the area. Increased vessel activity associated with field suspension could contribute to greater risk of dropped objects, however it will also deter other sea users entering the area. Lower master valves in place should an emergency shut-in of one of the wells be required. OPEPs detailing spill emergency procedures are in place.	5	1	5

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
	Discharges to sea: corrosion may lead to leaks from the well.	UP	3	2	3	3	3	9	The effects of corrosion caused by H_2S and CO_2 for the trees are being studied. ROVs working in the area will aid detection of any leaks. If a leak is identified there is the option of using the lower master valve to shut-in the well.	2	2	4
Subsea Preservation												
Depressurisation of gas export line. Closure of valves at M1C/M1J which isolates the gas export line.	Emissions to air from flaring.	P	1	1	1	1	1	1	No mitigation measures identified (Calculated as 1.5 mmscf of gas)	1	1	1
Installation of isolations on gas export line.	Emissions to air - minor release of gas during the process as sea water is left in and gas is left out.	P	1	1	1	1	1	1	Installation procedures / work packs will be in place.	1	1	1
Vessel operations during suspension and recovery activities.	Exhaust emissions to air from vessels.	P	1	1	1	1	3	3	Optimise vessel use	1	3	3
Chemical purge into production header at trees; bulk deoiling of the production and test lines; and flushing of the production and test system via the risers into the cargo tank.	Emissions to air - from generators used to power the flushing. Involves flushing with chemicals first, followed by two seawater flushes followed by a biocide/corrosion inhibitor mix.	P	1	2	1	2	2	4	No mitigation measures identified.	2	2	4

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
Flushing of lines associated with NW drill centre from vessel.	Discharged to sea - small volumes of treated water will be released at the drill centre during connection of lines from vessel to subsea infrastructure.	P	1	1	1	1	1	1	No mitigation measures identified. Risks are assessed and permitted under the OCR.	1	1	1
Disposal of chemical purging fluids from COTs.	Water treatment and flaring issues if methanol is routed through SVT. Liquid waste issues if the methanol cannot be flared.	P	2	2	1	2	1	2	Permitted under Offshore Chemicals Regulations. Minimum amount of MeOH will be returned to the FPSO by purging the dynamic umbilicals only and returning the remainder in the static umbilicals. Up to 3 tonnes of methanol will be returned, which will be recovered into tote tanks and returned to shore for safe disposal.	1	1	1
Isolate production and test flowlines using BSPs at the manifold end of the lines.	Discharges to sea : this activity will result in small volumes of oil and chemicals being discharged.	P	2	1	1	2	3	6	Permitted under Offshore Chemicals Regulations and OPPC regulations. Isolation strategy to avoid unwanted flow in pipes i.e. following correct procedures.	1	3	3
Isolate FW12 well (water injection well) - using BSPs at manifold.	Discharges to sea: this activity will result in small volumes of chemicals being discharged.	P	1	1	1	1	3	3	Risks are assessed and permitted under OCR. Isolation strategy to avoid unwanted flow in pipes i.e. following correct procedures.	1	3	3
Flushing WI systems with inhibited seawater.	Emissions to air from generators used to pump inhibited seawater.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
Shut-in of water injection wells	Normal discharge of well control fluids (permitted under PON15D).	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
Storage of jumpers and FTPs in baskets subsea for recovery.	Disturbance to seabed i.e. seabed footprint.	P	1	1	1	1	3	3	Use of baskets minimises seabed disturbance. Procedures in place for moving lines. Small area impacted in relation to facilities footprint. Short term activity.	1	3	3
Recovery of subsea infrastructure to shore for disposal up to end of 2015.	Solid waste including steel and mixed plastics.	P	1	1	1	1	3	3	Waste Management Plan and Waste Hierarchy will be adhered to.	1	3	3
	Underwater noise - disturbance to marine mammals.	P	1	1	2	2	2	4	Optimise vessel use.	2	2	4
Accidental events	Discharges to sea of MEG/water mixture and methanol should BSP at jumper fail or there is a failure downline from the vessel during pressure testing.	UP	3	1	1	3	4	12	Procedures / work packs will be in place. MEG and methanol are PLONAR and therefore impact is minimised.	3	3	9
	Discharge to sea: damage to pipelines from corrosion, dropped objects etc. whilst still in service.	UP	4	2	3	4	3	12	During subsea preservation activities, facilities from FPSO are still available to shut pipelines. Lessons learnt from other sites. OPEPs detailing spill emergency procedures are in place. Routine visual inspections of the pipelines will be carried out. In addition there will be an increased number of ROVs in the area during Field Suspension.	4	2	8
	Discharges to sea: damage to pipelines still connected to wells (wells shut-in) resulting from interaction with fishing trawlers, vessel anchors or dropped objects or corrosion of pipeline.	UP	3	2	2	3	3	9	No additional risk other than existing regional risks. Existing guard vessel activity will be in place during field suspension. Designated 500 m exclusion zones and an offshore development area are in place.	3	3	9

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
									These serve to keep other sea users out of the area. Increased vessel activity associated with field suspension will deter other sea users entering the area. The water is sufficiently deep that most fishing activities do not interact with the seabed or subsea infrastructure. In addition there are established safe zones for deployment/ recovery of equipment and tooling to minimise dropped object risk. Consultation with SFF. Equipment maintenance. OPEPs detailing spill emergency procedures are in place.			
	Discharges to sea resulting from damage to pipelines containing suspension fluids.	UP	2	1	1	2	3	6	Equipment maintenance and monitoring	2	3	6
Topside Modifications												
Depressurisation of topsides	Emissions to air: flaring of gas from process system.	P	2	2	1	2	1	2	Schiehallion flare policy applied to minimise quantities.	2	1	2
Routine operations and COWing and flushing of the COTs	Emissions to air from routine operations of the FPSO, power required to heat the oil for COWing to 50-60°C, power generation to carry out the COWing.	P	1	1	1	1	4	4	Power supplied by the new temporary generator which is more efficient than existing generators and therefore reduces emissions. PPC permit.	1	4	4

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
	Liquid and solid waste: Oily water and oily sludge will be offloaded to the shuttle tanker along with normal product and processed at SVT.	P	1	1	1	1	2	2	Waste Management Plan and Waste Hierarchy will be adhered to. SVT will be made aware of cargo contents.	2	2	4
Process train draining and flushing	Discharges to sea: Liquids produced during process train draining and flushing will be treated at SVT and subsequently discharged to sea.	P	2	1	1	2	1	2	Permitted under SVT PPC consent. Minimum amounts of chemicals will be used.	1	1	1
N_2 blanketing of topsides process train.	Emissions to air: venting of hydrocarbons. Use of nitrogen quads.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
Offload of final COT contents	Venting from shuttle tanker and combustion emissions.	P	1	1	1	1	1	1	Normal venting operations. International Air Pollution Prevention (IAPP) Certificates in place for the vessel.	1	1	1
Stabilise cargo tanks by filling tanks to a height of 2.9 m with filtered treated seawater.	Emissions to air: power generation to operate seawater pump.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
Inerting of COTs by exhaust gas blanketing.	Emissions to air: purging of tank atmosphere.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
LSA scale/NORM removal	Discharges to sea of natural low specific activity radioactive material found to have built up within the processing system.	UP	2	1	1	2	2	4	LSA scale / NORM unlikely to be present. If found, will be disposed of to sea according to RSA Authorisation.	2	2	4

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
Drain chemical stores (including back loading to IBCs and redistribution where possible).	Liquid waste: backloading of chemicals to shore.	P	2	1	1	2	2	4	Chemicals will be reused if possible.	2	2	4
Export hose flushing	Liquid waste: oily water flushed into tanks on shuttle tanker.	P	1	1	1	1	1	1	Oily water will be treated onshore.	1	1	1
Export hose removal	Solid waste: steel reinforced flexible hose material.	P	1	1	1	1	1	1	Waste Management Plan and Waste Hierarchy will be adhered to.	1	1	1
Accidental events	Discharges to sea: loss of flushing fluids or hydrocarbons.	UP	3	2	2	3	4	12	Procedures / work packs will be in place. OPEPs detailing spill emergency procedures are in place.	3	3	9
	Disturbance to seabed: potential dropped objects, e.g. chemical containers, equipment etc.	UP	2	1	1	2	3	6	Lifting procedures / work packs will be in place. There are established safe zones for deployment / recovery of equipment and tooling to minimise dropped object risk.	2	2	4
	Interactions with other sea users: collision with vessels.	UP	1	3	3	3	3	9	No additional risk other than existing regional risks. Presence of a guard vessel during suspension. In addition there will be significant vessel activity with drilling rigs, installation contractor vessels and a seismic vessel that will result in fishing vessels staying away from site.	3	2	6

Activity	Aspect	Planned or Unplanned	Consequence: Regulatory	Consequence: Environmental	Consequence: Stakeholder	Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
FPSO Disconnection												
Vessel operations during disconnection and recovery	Exhaust emissions to air	P	1	1	1	1	3	3	Optimise vessel use.	1	3	3
Disconnection of production risers at seabed	Discharges to sea: oily water and preservation chemicals.	P	2	1	1	2	1	2	Managed under OPPC and OCR.	2	1	2
Disconnection of gas risers at seabed	Discharges to sea: treated seawater.	P	2	1	1	2	1	2	Managed under OPPC and OCR.	2	1	2
Disconnection of water injection risers at seabed	Discharges to sea: treated seawater.	P	2	1	1	2	1	2	Managed under OPPC and OCR.	2	1	2
Pigging of production risers	Discharges to sea: oily water and preservation chemicals.	P	1	1	1	1	1	1	Managed under OPPC and OCR.	1	1	1
Pigging of gas and water risers	Gas emissions to sea.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
Installing mesh basket to catch pig	Seabed disturbance.	P	1	1	1	1	1	1	Basket to be recovered.	1	1	1
Disconnection of all risers at FPSO and subsequent lay down on the seabed.	Seabed disturbance: risers on seabed.	P	1	2	1	2	3	6	Part of risers will be left floating in water column which will minimise seabed impact. Risers will be placed on seabed carefully using ROV. Managed under MCAA Licence.	2	3	6
	Discharges to sea: residual riser contents.	P	1	1	1	1	1	1	Managed under OPPC and OCR.	1	1	1

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
	Interactions with other sea users as part of the risers will be left floating in the water column.	P	1	1	1	1	3	3	Existing guard vessel activity will continue during field suspension. Increased vessel activity associated with field suspension will deter other sea users entering the area. Established safe zones.	1	3	3
Removal of all risers from the seabed.	Solid waste: steel reinforced flexible hose material.	P	1	1	2	2	2	4	Waste Management Plan and Waste Hierarchy will be adhered to.	1	2	2
Removal of the risers lower tether clamps (LTCs) (suction pile)	Solid waste: steel	P	0	0	0	0	1	0	Waste Management Plan and Waste Hierarchy will be adhered to. Considered a positive impact as makes steel available.	0	1	0
Removal of the swivel caps on the risers upper tether clamps (UTCs) and driving of associated pile.	Solid waste: steel	P	0	0	0	0	1	0	Waste Management Plan and Waste Hierarchy will be adhered to. Considered a positive impact as makes steel available.	0	1	0
	Noise: driving of piles to 1 m below surface level.	P	1	2	2	2	3	6	Adherence to JNCC guidelines: marine mammal observer on board, soft start etc.	2	3	6
Disconnection at FPSO & lay down of dynamic umbilicals.	Seabed disturbance and interaction with other sea users as for disconnection of risers.											
Removal of dynamic umbilicals	Solid waste: steel reinforced flexible umbilical material and multiple cores.	P	1	1	2	2	2	4	Waste Management Plan and Waste Hierarchy will be adhered to.	1	2	2
Removal of LTCs & UTCs and driving of UTC piles	Solid waste and noise as described for removal of riser tethers and driving of associated piles.											

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
Disconnection of fibre optic cable and storage in basket on seabed.	Seabed disturbance: basket on seabed.	P	1	1	1	1	1	1	Basket will be recovered following reconnection of fibre optic cable.	1	1	1
Mechanical cutting of the mooring lines	Underwater noise associated with cutting of anchor wires: disturbance to fish and marine mammals.	P	1	1	1	1	1	1	No mitigation measures identified.	1	1	1
Laying of mooring lines on seabed	Disturbance to seabed: disturbance from mooring lines	P	1	2	1	2	3	6	Mooring lines will be placed on seabed carefully using ROV. Managed under MCAA Licence. Short term activity.	2	3	6
	Interactions with other sea users.	P	1	1	1	1	3	3	Increased vessel activity associated with field suspension will deter other sea users entering the area. Established safe zones.	1	3	3
Removal of mooring lines and suction anchors	Disturbance to seabed.	P	1	2	1	2	2	4	Managed under MCAA Licence. Short term activity.	2	2	4
	Resources: steel wire available for reuse.	P	0	0	0	0	1	0	Waste Management Plan and Waste Hierarchy will be adhered to. Considered a positive impact as makes steel available.	0	1	0
Accidental Events	Discharge to sea: when disconnecting risers at elbow (after flushing) due to inaccessability.	UP	2	1	1	2	4	8	Procedure / work pack in place which will include an operational risk assessment.	1	2	2
	Disturbance to seabed: dropping mooring lines or risers.	UP	2	2	2	2	3	6	Removal plan / work pack in place. Requirement to remove at end of field life.	2	2	4

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
Towing of FPSO												
General operations when under tow	Emissions to air from towing vessels (two working tugs and one on standby) and power generation equipment on FPSO.	P	1	2	1	2	2	4	International Air Pollution Prevention Certificates in place for the FPSO and tow vessels. Marine diesel will be used not heavy fuel oil.	2	2	4
	Discharges to sea - bilge water and black and grey water discharges from the tugs (normal operations). Oily discharges from the FPSO are not expected; however, there will be black and grey water discharges.	P	2	1	1	2	2	4	MARPOL (Merchant Shipping) requirements. Exemptions will be obtained for any aspects not meeting MARPOL as a result of the specific FPSO design features, ensuring compliance with class prior to tow commencing. No discharge is allowed within 4 nautical miles of land - MARPOL Annex IV.	2	2	4
	Interaction with other sea users.	P	2	1	2	2	2	4	Route plan. Shipping lanes used. Notifications to other sea users.	2	2	4
	Underwater noise - disturbance to marine mammals.	P	3	2	2	2	2	6	FPSO thrusters won't be used during the tow. Established shipping lanes will be used so minor noise contribution to pre-existing background levels.	2	2	4
	Waste - galley waste returned to shore and landfilled.	P	1	1	1	1	2	2	Waste management hierarchy followed.	1	1	1
Dragging of hawse pipes.	Seabed disturbance in shallower harbour waters.	P	1	1	1	1	1	1	Should the draught of the FPSO with hawse pipes be an issue in chosen yard the hawse pipes will be tied up.	1	1	1

Activity	Aspect	Planned or Unplanned	Consequence			Final (Highest Consequence Rating)	Frequency / Probability	Significance	Mitigation and Comment	Residual Consequence	Residual Frequency / Probability	Residual Impact / Significance
			Regulatory	Environmental	Stakeholder							
Accidental events	Ship collision or grounding - release of fuel from diesel tanks and oily water from slops tanks, seabed disturbance.	UP	5	3	4	5	2	10	IMO resolution to minimise inventory to that required for the tow. FPSO will be gross hydrocarbon free.	5	2	10
	NGO activity - boarding vessel and causing disruption.	UP	1	1	3	3	4	12	NGO management plan and security plan.	2	2	4

7 Further Assessment of Potential Environmental Impacts

From the impact assessment it was found that none of the planned activities associated with the preparatory and decommissioning activities are likely to have a significant impact. However, due to some aspects e.g. emissions to air, discharges to sea and underwater noise being under regulatory control and/or of public interest, this section further describes the impacts. The aspects considered include:

- Emissions to air
- Disturbance to the seabed
- Discharges to sea
- Underwater noise
- Production of waste

7.1 Emissions to Air

Gaseous emissions contribute to global atmospheric concentrations of greenhouse gases, regional acid loads and in some circumstances low-level ozone and photochemical smog formation. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halogenated fluorocarbons (the latter are now strictly controlled under the Montreal Protocol).

Emissions from the decommissioning activities and associated preparatory works will result from:

- flaring of the gas during depressurisation of the gas export line and topsides;
- the installation of the isolations (blind seal plates) on the gas export line, which may result in a minor release of gas as seawater is left in and gas is left out (assessed as negligible and therefore not considered further);
- venting during offloading and as a result of N_2 blanketing of the process train and inerting of the cargo tanks using exhaust emissions; and
- fuel use associated with power generation; to run the WI pumps; to carry out the methanol and CaNO3 injections; to power the purging and flushing activities; to power the offloading of hydrocarbons to the shuttle tanker and to operate the FPSO facilities
- the use of vessels to carry out activities such as flushing of the North West drill centre, recovery of subsea infrastructure, disconnection and recovery of water column structures, i.e. risers and dynamic umbilicals

7.1.1 Gas Flaring

Depressurisation of the gas export line is predicted to result in flaring of up to 1.5 mmscf (31 tonnes) of gas.

To make safe, the topsides must be depressurised which will result in the gas being flared. This activity is routinely carried out on the FPSO, for example, when the fire alarms are activated. The gas risers will also be depressurised to flare; this is not common practice but the system can accommodate this. Flare systems are designed to collect, combust and safely dispose of hydrocarbons that are routed to the atmosphere. Flaring is preferable over cold venting as gas streams that undergo combustion have a reduced Global Warming Potential (GWP).

Depressurisation of the topsides is expected to result in flaring of approximately 150 tonnes (8 mmscf) of gas. Any increased flaring will be controlled within the flare consent for Schiehallion FPSO. Flaring quantities and resulting emissions associated with the Schiehallion decommissioning and preparatory activities are summarised in Table 7-1. These have been calculated based on the expected flaring quantities and emissions factors provided by EEMS (2008). These emissions are expected to represent approximately 1.0% of typical annual gas flaring emission on the UKCS and would not, therefore, be expected contribute significantly to greenhouse gas emissions (Table 7-1; DECC, 2011).

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Table 7-1 Flaring emissions associated with decommissioning and preparatory activities.

Flaring category	Quantity (tonnes)	Emissions (tonnes) (3 s.f.)						
		CO_2	CO	NO_x	N_2O	SO_2	CH_4	VOC
Baseload flare	12,100	33,900	81.1	14.5	0.98	0.155	121	121
Blowdown of topsides	164	459	1.10	0.197	0.013	0.00210	1.64	1.64
Blowdown of subsea gas system	31	86.1	0.206	0.0369	0.0025	0.000394	0.308	0.308
Emergency shut down	410	1150	2.75	0.492	0.033	0.00525	4.10	4.10
Total from flaring during FS Project	**12,705**	**35,600**	**85.1**	**15.2**	**1.0**	**0.163**	127	127
Total flaring emissions on UKCS in 2009		3,518,928	9,173	2,712	100	201	13,691	10,317
FS flaring emissions as % of total UKCS in 2009		**1.0%**	**0.93%**	**0.56%**	**1.0%**	**0.081%**	**0.93%**	**1.23%**

7.1.2 Gas Venting

During normal operations the transfer of hydrocarbons from the crude oil tanks to the shuttle tanker results in the release of non-combusted hydrocarbon vapours (CH_4 and NMHC). Final hydrocarbons and minimal liquids from the cargo tanks on board will be offloaded, and will therefore contribute to this effect. The Schiehallion and shuttle tanker have International Air Pollution Prevention (IAPP) Certificates in place regulating these emissions

In order to ensure no oxygen ingress into the process train and hence avoid potentially explosive reactions between the oxygen and any residual hydrocarbons the process train will be filled (blanketed) with N_2 gas. This is also required for preservation of equipment, i.e. to prevent ingress of air.

The crude oil tanks will also require to be inerted as is normal operational practice. The FPSO has two inert gas generators (maximum 3.5 MWth each) available for use in order to produce the exhaust emissions required; however, N_2 quads will be available if needed. These generators are diesel operated. If required, N_2 levels can be topped up whilst under tow.

Venting emissions associated with all aspects of the programme are summarised in Table 7-2. These have been calculated based on the expected venting quantities and emissions factors provided by EEMS (2008).

It is estimated that up to 3,302 tonnes of gas would be vented during purging of the topsides. This is based on the volume of the topsides equipment, assuming a worst case scenario of the topsides being 100% hydrocarbon gas, and is likely to be an overestimate.

Venting as a result of offloading to the shuttle tanker and inerting of the crude oil tanks and has been estimated based on Schiehallion normal operational venting figures from the crude oil tanks and offloading. This gives an estimate of approximately 295 tonnes / month for at most four months from the start of field suspension until final offload from the FPSO.

Table 7-2 Venting emissions associated with decommissioning and preparatory activities.

Venting category	Quantity (mmscf)	Quantity (tonnes)	Emissions (tonnes) (3 s.f.)	
			CH_4	VOC
Operational venting (incl. operation of two wells, final offload to shuttle tanker and purging of COTS)	58	1,180	1,060	118
Purging of topsides	161	3,302	2,970	330
Total venting	**219**	**4,482**	**4,030**	**448**

7.1.3 Power Generation on the FPSO

The existing FPSO power generation capacity, delivered by two Gas Turbine generation sets (approx. 10MW – 36MW depending on engine condition and fuel supply) and an Emergency Generator of 1.4 MW, is considerably greater than will be required to meet the power requirements once the final offload to the Rannoch shuttle tanker has taken place. Therefore, the decision was taken to install a 1.4 MW diesel generator to meet the power requirements while under tow. The new generator will use approximately 6 te/day of diesel compared to 120 te/day used by the main generators, which will result in a major decrease in power generation emissions.

When estimating the emissions associated with power generation on the FPSO it was assumed the main generators would power all activities for the first three months (approximately 90 days) and following final offload at the end of this period these generators would be switched off and power supplied by the new temporary generator for the last six months (approximately 180 days) until the FPSO is secured at its ISL.

While the decommissioning and preparatory activities are being carried out the generators will run on diesel. Table 7-3 shows the estimated fuel use for power generation over the nine months from initial turning off of the gas lift to tying up of the FPSO at its ISL.

Table 7-3 Power generation emissions associated with decommissioning and preparatory activities

Operation	Fuel use (tonnes)	Emissions (tonnes) (to 3 s.f.) [1]						
		CO_2	CO	NO_x	N_2O	SO_2	CH_4	VOC
Main generators (running on diesel)	10,800[1]	34,600	9.94	146	2.38	21.6	0.354	3.19
Temporary diesel generator engine	1,080[2]	3,460	17	64.2	0.238	2.16	0.194	2.16
Total emissions from power generation	**11,880**	**38,000**	**26.9**	**210**	**2.61**	**23.8**	**0.549**	**5.35**
Total emissions on the UKCS in 2009 [2]		11,800,000	15,200	46,300	889	1,710	1,710	720
Schiehallion power generation emissions as % of total UKCS in 2009		**0.32%**	**0.18%**	**0.45%**	**0.29%**	**2.78%**	**1.39%**	**0.74%**

[1] 120 tonnes per day for 90 days [2] 6 tonnes per day for 180 days
Note: emissions associated with the potential use of the main generators to offload the topsides and bulk stabilising fluids when in the yard are not included as activities in the yard are not covered by the Decommissioning Programme.

7.1.4 Emissions from other vessels associated with the decommissioning

The estimated fuel use and emissions associated with vessels during all phases of the decommissioning and preparatory activities are summarised in Table 7-4. These have been calculated using expected vessel days provided by BP and contractors, fuel use per day for different vessels and operating statuses from the Institute of Petroleum (2000) and emissions factors provided by EEMS (2008). For completion the table includes the emissions associated with the tugs used whilst the FPSO is on tow as well as the barges required to offload the oily water transported in the COTs (approximately 15,000 m^3) and in the topsides processing system (approximately 5,000 m^3) The CO_2 emissions from the field suspension vessel use represent approximately 0.26% of typical annual emissions on the UKCS (Table 7-4; DECC, 2011).

7.1.5 Management and mitigation

Measures taken by BP in order to minimise the potential emissions to air associated with the Schiehallion and Loyal Decommissioning Programme Phase I include:

- Auditing of contractors to ensure compliance with UK legislation.
- Addition of a new temporary generator requiring 6 te/ day of fuel as opposed to the 120 te/day required by the main generators. This temporary generator will power the FPSO once final offloading to the shuttle tanker has been completed.
- Minimising the volume of water required to stabilise the COTs.

In addition the development of a tow plan and auditing of the tow contractors and ISL, will work towards minimising the environmental impacts of the activities following the removal of the Schiehallion from its station.

Many of the emissions discussed are not strictly associated with the decommissioning activities; however they have been included for completion. Overall the emissions from flaring, power generation and other vessels over the period of the decommissioning and preparatory activities can be considered to be relatively low.

Emissions from venting are relatively higher, however, given that this is primarily associated with purging of the topsides over a short period and therefore a one off activity, the impacts are not considered to be significant.

Table 7-4 Vessel emissions associated with decommissioning and preparatory activities and towing of the FPSO.

Field suspension phase	Vessel	Fuel use (tonnes)	Emissions (tonnes) (to 3 s.f.)						
			CO_2	CO	NO_x	N_2O	SO_2	CH_4	VOC
Field prep & well shut in	No additional vessels	0	0	0	0	0	0	0	0
Subsea preservation[1]	MSV (Subsea Viking)	3,258	10,400	26.1	192	0.717	6.52	0.88	7.82
	MSV (Skandi Seven)	3,258	10,400	26.1	192	0.717	6.52	0.88	7.82
Topsides modification	Shuttle tanker	14	44.8	0.112	0.826	0.00308	0.028	0.00378	0.0336
FPSO disconnection[1]	Utility vessel	170	544	1.36	10	0.0374	0.34	0.0459	0.408
	MSV (Fugro Saltire)	1,330	4,260	10.6	78.5	0.293	2.66	0.359	3.19
	MSV (Fugro Symphony)	2,066	6,610	16.5	122	0.455	4.13	0.558	4.96
	DSV (Wellservicer)	878	2,810	7.02	51.8	0.193	1.76	0.237	2.11
	Tug x 2	1,160	3,710	9.28	68.4	0.255	2.32	0.313	2.78
Towing of FPSO[2]	Tug x 2 (towing)	490	1,570	3.92	28.9	0.108	0.98	0.132	1.18
	Tug (on standby)	28	89.6	0.224	1.65	0.00616	0.056	0.00756	0.0672
Yard activities	Barge x 8	70	224	0.56	4.13	0.0154	0.14	0.0189	0.168
Total vessel emissions during field suspension			**40,700**	**102**	**751**	**2.8**	**25.4**	**3.43**	**30.5**
Total emissions on the UKCS in 2009			15,786,751	24,756	4,9121	995	2120	53,243	58,007
Field suspension vessel emissions as % of total UKCS in 2009			**0.26%**	**0.41%**	**1.53%**	**0.28%**	**1.2%**	**0.0064%**	**0.053%**

[1]Fuel use associated with vessel use during subsea preservation activities and FPSO disconnection, includes anticipated fuel use during recovery.
[2]Note, the fuel use calculated for the towing of the FPSO assumes a towing distance of approximately 1,150 km as illustrated in section 2.2.5. These emissions will be recalculated once a final decision has been made on the ISL.

7.2 Disturbance to the Seabed

Seabed disturbance from the proposed decommissioning activities is primarily associated with the recovery or relocation (for reuse) of the subsea infrastructure.

This section quantifies and describes the seabed disturbance associated with the infrastructure to be removed i.e. those structures to be decommissioned. Tables 2-5, 2-7, 2-9 and 2-10 quantify the number of and, where applicable, the length, of structures to be recovered. The area of seabed disturbance was determined assuming a worst case of 2 m width disturbance at each of the jumpers, FTPs, risers and dynamic umbilicals to be recovered. Note that the area of seabed disturbance by the risers and dynamic umbilical was calculated assuming only 50% of these lines will be in contact with the seabed. To calculate the area disturbed by the removal of the remaining infrastructure an additional impacted area of 1 m was assumed to each side of the structures.

An estimate of seabed disturbance (0.079 km^2) associated with the decommissioning activities is given in Table 7-5. It should be noted that these estimates do not include disturbance cause by baskets to retrieve FTPs, jumpers etc. At the time of writing it was as yet unknown how many baskets would be required. It is unlikely that activities associated with the decommissioning activities will impact on an area greater that 0.08 km2 after disturbance caused by baskets is accounted for. Baskets for recovery will have a length and width of 5.15 m x 3.5 m. Any impacts will be localised and short term.

Table 7-5 Anticipated area of seabed disturbance associated with the Decommissioning Programme.

<table>
<tr><th colspan="2"></th><th>Total length (km) / footprint (m^2)</th><th>Approximate area impacted (km^2)</th></tr>
<tr><td colspan="2">Total length of jumpers to be recovered</td><td>1.815 km</td><td>0.0036</td></tr>
<tr><td colspan="2">Total length of FTPs to be recovered</td><td>4.524 km</td><td>0.0090</td></tr>
<tr><td colspan="2">Total length of risers expected to be on seabed [1]</td><td>5.538 km</td><td>0.0111</td></tr>
<tr><td colspan="2">Total length of dynamic umbilicals expected to be on seabed [1]</td><td>1.694 km</td><td>0.0034</td></tr>
<tr><td colspan="2">Total length of mooring lines (1.8 km X 14)</td><td>25.2 km</td><td>0.0504</td></tr>
<tr><td rowspan="5">Total footprint</td><td>3 x DUTA</td><td>20 m^2 per DUTA</td><td rowspan="5">0.0014
(calculated assuming a worst case of 1m impact on each side of each structure)</td></tr>
<tr><td>12 x UETA</td><td>16 m^2 per UETA</td></tr>
<tr><td>4 x CDA</td><td>132 m^2 per CDA</td></tr>
<tr><td>3 x RET</td><td>10.5 2 m^2 per RET</td></tr>
<tr><td>1 x Manifold</td><td>22.5 m^2</td></tr>
<tr><td colspan="2">Total</td><td></td><td>0.0789</td></tr>
<tr><td colspan="4">[1] Note approximately 50% of risers and dynamic umbilicals are expected to remain floating in the water column prior to recovery. Total lengths provided here refer to 50% of the structures lengths.</td></tr>
</table>

Impacts from recovery activities may result in the direct physical injury of benthic species and the resuspension of sediments. In addition, interference with the seabed has the potential to cause resuspension of seabed sediments, which can impact on habitats/species outwith the immediate area of activity.

The resuspension of sediments can result in the smothering of epifaunal benthic species (see Gubbay, 2003, for a review). Whilst some species may be exposed to settlement of only a small layer of sediments and be unaffected, others may experience thicker smothering or be unable to tolerate any covering at all. Infaunal species that are found within the sediment may be less susceptible to negative impacts of smothering. Conversely, resuspension of fine particulate matter may clog the delicate filtering apparatus of suspension feeders, which can result in their removal from silty sediments.

Much of the seabed in the area of the Schiehallion and Loyal fields will have experienced similar impacts to date and any additional activity is not expected to significantly impact on the area. Removal of the infrastructure means that the seabed beneath the objects can begin recovery. Detailed site surveys conducted across the project area have not identified any sensitive habitats or species or those of particular conservation concern. In addition those benthic species that were identified tend to be widely distributed and would be expected to return to the disturbed area after the work in the area is completed.

Since the installation of the subsea infrastructure all cuttings discharges have been WBM (Water Based Mud) based and deposits have been widely dispersed with some local concentrations at the well heads. There will be a small amount of disturbance to sediments as described above and inevitably this will include some disturbance to the dispersed cuttings located away from the wellheads. However this disturbance is not expected to have a significant impact.

7.3 Discharges to sea

A number of permitted discharges will occur during the decommissioning and preparatory activities associated with the Decommissioning Programme. These discharges will be associated with activities such as:

- disconnections of the flowline to install seals (chemicals and oily water)
- testing of the blind seal plates from a vessel whereby will have discharge of one line length from vessel to subsea infrastructure
- pigging the risers (chemicals and oily water)
- laydown and retrieval of the risers which could result in potentially further oily water
- cutting FTPs prior to recovery if necessary to prevent snagging
- potentially cutting umbilical ends prior to recovery

The released chemicals will be permitted under the Offshore Chemical Regulations while the discharged oil will be permitted under the OPPC regulations. Once final chemical requirements are known, and prior to commencement of these activities, BP will submit the relevant PON15 applications supported by appropriate detailed chemical risk assessments to DECC under the OCR (offshore Chemicals Regulations) in order to obtain approval prior to chemical discharge.

It is unlikely that there will be any significant impacts to marine flora and fauna as a result of discharges to sea. Predicted discharge volumes are relatively small and water column impacts are expected to be short term and localised as the chemicals are expected to rapidly dilute in the high energy environment. In addition chemicals are selected both on their technical specifications and their environmental performance.

7.4 Underwater noise

The impacts of underwater noise caused by vessel activity and piling are considered in this section. The piling is associated with the UTC securing the risers and dynamic umbilicals to the seabed. It is acknowledged that this topic is of significance to stakeholders, there are legal implications if disturbance of cetaceans is likely and the assessment requires some detail in order to calculate the required metrics. Good practice in this topic is to calculate both sound pressure levels (in effect, loudness), and where these levels are above established impact thresholds also to calculate sound exposure levels (in effect, an overall dose taking time of exposure into account) so that a full assessment can be made to judge the likelihood of disturbance.

7.4.1 Vessel Noise

It is recognised that there is potential for noise associated with vessel operations to impact on the hearing structures of marine mammals and possibly fish (Popper and Hastings, 2009). As a result, vessel operations during the Decommissioning Programme should be considered a potential source of noise disturbance to the local marine environment (Richardson *et al*., 1995).

It is expected that peak vessel activity will occur whilst the risers, dynamic umbilicals and mooring lines are being disconnected from the FPSO. Up to six additional vessels will be on site during the disconnection activities. These will include vessels required to carry out the disconnections, two tugs required to hold the FPSO on station as the mooring lines are disconnected, a utility and a diver support vessel (Table 7-4). It can be assumed that all of these vessels will be DP vessels which are known to generate a high noise output relative to anchored vessels.

In terms of direct physical injuries to hearing structures in marine mammals, it appears from the available data that the noise levels and exposure times associated with vessel use during decommissioning are below those found to cause even temporary changes in hearing sensitivity (Southall *et al*., 2007). Combining the relatively short exposure time with the fact that the Schiehallion and Loyal development already has a number of vessels associated with it, is expected that though the vessels associated with the decommissioning activities will add to the background noise, the overall impact is not expected to be significant.

7.4.2 Piling

As part of the Decommissioning Programme, 18 existing piles (one associated with each riser and one associated with each dynamic umbilical) will be decommissioned by driving them to at least 1 m below the seabed. These piles are 36 inches (0.9 m) in diameter and 28 m in length. Piling will be conducted using an S90 Hammer manufactured by IHC. It is expected that each pile will take approximately 65 minutes of piling, including approximately 30 minutes of soft-start. Therefore, the duration of piling for all 19 piles is approximately 20 hours. Piling will not be continuous; the majority of the time infield will be spent on vessel movements, over-boarding the pile, installation of suction piles, etc. The offshore schedule indicates that typically one but at most two piles will be decommissioned in any 24 hour period. Piling is scheduled from July until the end of September.

The impact on marine mammals of noise generated by piling is assessed here by modelling the received sound exposure level (SEL) and comparing with precautionary thresholds for injury and disturbance. SEL is a measure of integrated pressure squared over time, normalised to 1 second, and is used as an indication of energy dose.

As the Schiehallion field is approximately 130 km from the nearest coastline, it is not expected that seals will regularly occur in the area; therefore, this assessment focuses on cetaceans.

7.4.2.1 Modelling

To represent the characteristics of sound produced during the piling operations, a third octave band source SEL spectrum was taken from Thomsen *et al*. (2006). These measurements were made at 400 m from the source during piling of a 1.5 m diameter pile for construction of the FINO-1 research platform (ITAP, 2005). They were back calculated to 1 m by Thomsen *et al*. (2006). Since the riser piles have a smaller diameter (0.9 m), the source levels generated are likely to be lower; therefore, use of this spectrum is conservative.

The source spectrum was weighted for marine mammal hearing by applying the Southall *et al*. (2007) M-weightings for each marine mammal hearing type – low frequency, mid frequency and high frequency hearing (Table 7-6). The M-weightings and resulting weighted piling source spectra are shown in Figure 7-1. The resulting broadband source levels for each hearing type are given in Table 7-7

The duration of piling is assumed to be 65 minutes for each pile. It is assumed that at most two piling operations occur in any 24 hour period.

The propagation of sound away from the piling operations was modelled assuming a transmission loss of 15log10(R), where R is distance from the source in metres. This transmission loss is intermediate between cylindrical and spherical spreading (Richardson *et al*., 1995).

Table 7-6 Hearing types of marine mammals occurring in the Schiehallion and Loyal area (Southall *et al*., 2008).

Marine mammal hearing type	Approximate hearing range	Species potentially occurring in the Schiehallion area
Low frequency	7 Hz – 22 kHz	Minke whale, sei whale, fin whale.
Mid frequency	150 Hz – 160 kHz	White-sided dolphin, long-finned pilot whale, killer whale, sei whale, sperm whale, white-beaked dolphin, Risso's dolphin, common dolphin.
High frequency	200 Hz – 180 kHz	Harbour porpoise.

Table 7-7 Estimated source SEL for piling.

Hearing type	Broadband source SEL (dB re 1 μPa^2s-m)
Unweighted	206.1
Low-frequency cetacean	206.0
Mid-frequency cetacean	203.6
High-frequency cetacean	202.8

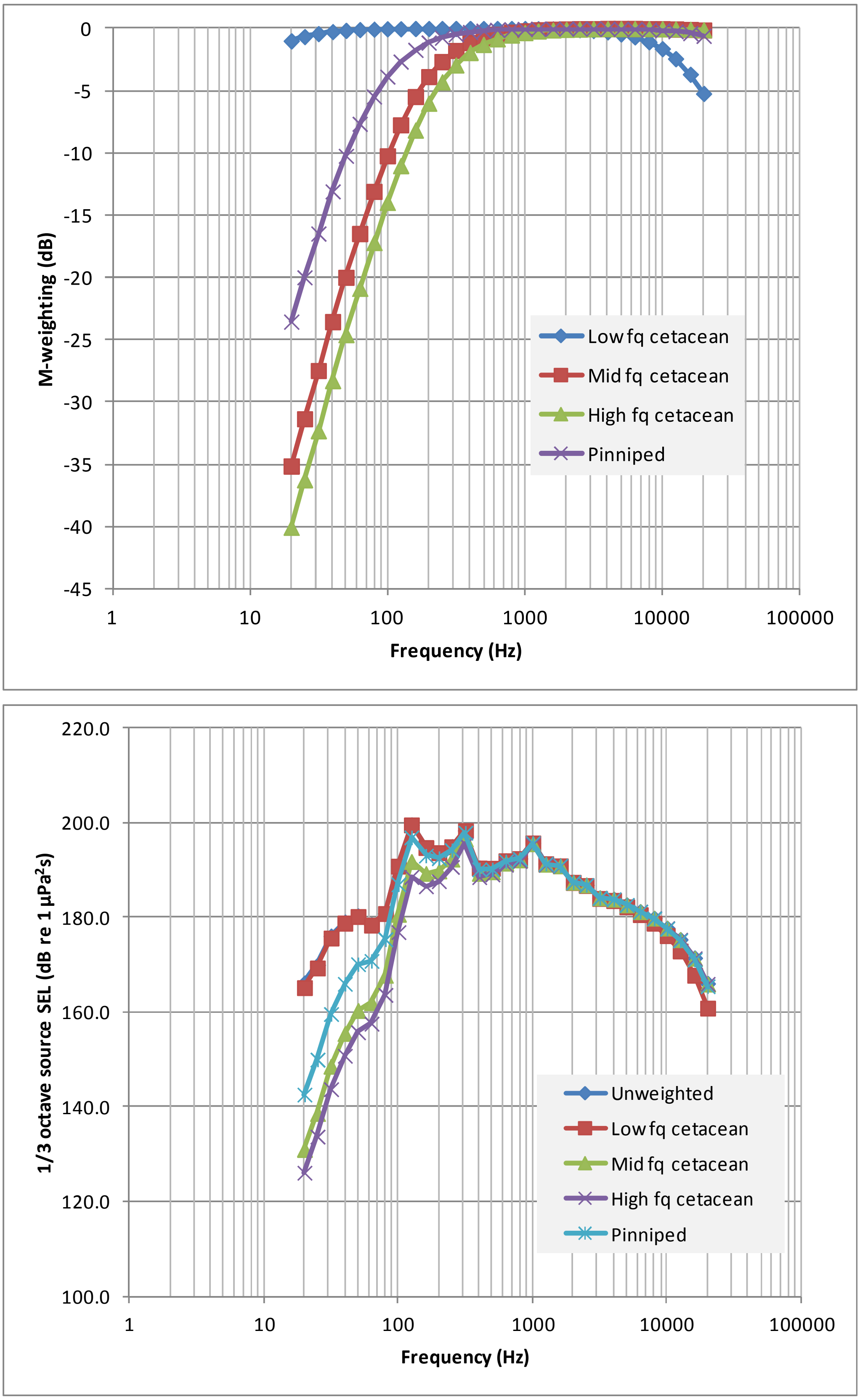


Figure 7-1 M-weightings for marine mammal hearing types and resulting weighted source spectrum for piling.

In order to calculate the total SEL experienced by an animal, it is necessary to make assumptions about the movement pattern of the animal over time. To compare with the Southall *et al*. (2007) recommendations, the calculation of SEL should be based on the animal's behaviour over a 24-hour period. This is extremely difficult to predict. Therefore, three scenarios have been modelled to capture a range of potential behaviour:

- Stationary animal – a worst case assuming that an animal remains in one location for the duration of the operation.
- Fleeing animal - a more likely scenario of an animal displaying avoidance behaviour by moving away from the noise.
- Transiting animal – assuming that an animal moves towards the sound and away again, e.g. to investigate the source.

Stationary animal

In this scenario, an animal is assumed to remain at a fixed distance from the piling operations for 24 hours and is therefore exposed to two piling operations. The received SEL for each hammer blow is determined by the distance of the animal from the source.

Figure 7-2 shows the received unweighted SEL over one pulse and over 24 hours (two piling operations) for a stationary animal as a function of distance from the source. Also shown are the Southall *et al*. (2007) thresholds for injury from single or multiple pulses and for disturbance from a single pulse. A summary of the results for the piling sound weighted for each marine mammal hearing type is given in Table 7-8.

The results indicate that:

- the zones of injury and disturbance vary with marine mammal hearing type, with low-frequency hearing cetaceans experiencing a higher SEL than mid or high frequency hearing cetaceans;
- the Southall *et al*. (2007) SEL threshold for injury may be exceeded within 2.1 m to 3.4 m of the source for a single pulse and 820 m to 1,400 m of the source for 24 hours of piling operations, assuming the animal remains in the same position over this period; and
- the SEL threshold for disturbance may be exceeded within 21 m to 35 m of the source for a single pulse (Southall *et al*. (2007) do not define a threshold for disturbance from multiple pulses).

These results are extremely conservative as they assume that an animal remain fixed in one location for the full 24 hour period.

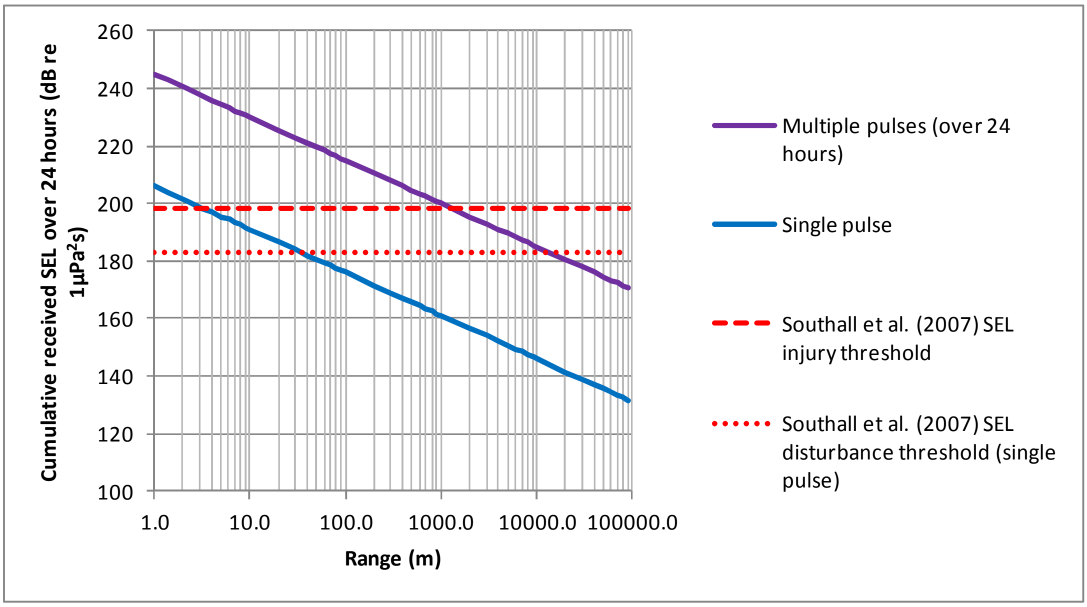


Figure 7-2 Received SEL with distance from the piling operations assuming a stationary animal.

Table 7-8 Estimated distance to injury and disturbance thresholds for different marine mammal hearing types.

Impact	Threshold (dB re 1 μPa^{2}s)[1]	Distance to threshold (m) (2 s.f.)			
		Unweighted	Low-frequency cetacean	Mid-frequency cetacean	High-frequency cetacean
Injury (single pulse)	198	3.4	3.4	2.4	2.1
Injury (24 hrs)	198	1,400	1,300	930	820
Disturbance (one pulse)	183	35	34	24	21
[1]Southall *et al*. (2007)					

Fleeing animal

This scenario assumes that an animal exposed to the noise from the piling would display avoidance behaviour, swimming away from the source at a fixed speed and height above the source.

Figure 7-3 shows the received SEL for each hammer blow and the cumulative received SEL as the animal moves away from the source at 5 m/s. This travelling speed has been assumed for a similar assessment carried out for piling noise (Theobald *et al*., 2009). Various swimming speeds were used here and the conclusions were unchanged. An assumption has to be made about where the animal is situated in the water column. Two examples are shown: (a) the animal flees at 1 m above the source and (b) the animal flees at 25 m above the source.

Table 7-9 shows the cumulative SEL received by the fleeing animal, i.e. the SEL from exposure to repeated hammer blows. This is calculated for various depths of the animal in the water column, from just above the source to just below the sea surface. Red cells show exceedance of the threshold for injury.

The results indicate that the Southall *et al*. (2007) SEL threshold for injury from a multiple pulse may be exceeded for an animal situated less than approximately 25 m from the source when the piling operation begins. However, this varies with marine mammal hearing type; the zone of injury are smaller for mid and high-frequency cetaceans, which hear a lower proportion of the sound from the piling than low-frequency cetaceans.

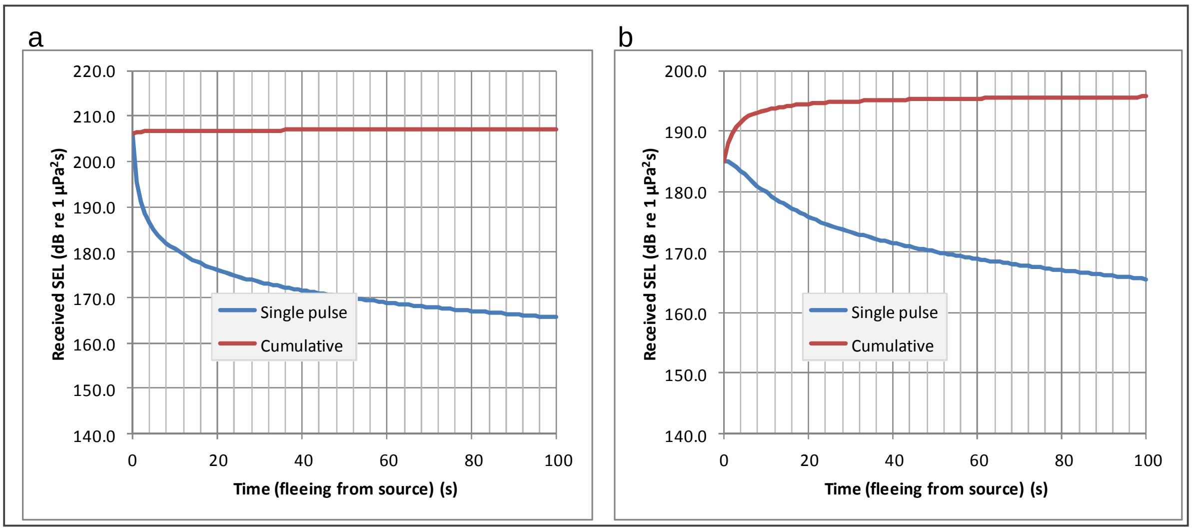


Figure 7-3 Received single pulse and cumulative SEL for one piling operation as animal flees from source assuming animal is (a) 1 m above the seabed and (b) 25 m above the seabed.

Table 7-9 Estimated received SEL over one piling operation and over 24 hours for different marine mammal hearing types assuming a fleeing animal.

Vertical distance above source (m)	Cumulative SEL (one piling operation) (dB re 1 µPa2s)				Cumulative SEL (24 hours) (dB re 1 µPa2s)			
	Unweighted	Low-fq cetacean	Mid-fq cetacean	High-fq cetacean	Unweighted	Low-fq cetacean	Mid-fq cetacean	High-fq cetacean
1	207	207	204	204	210	210	207	207
5	200	200	198	197	203	203	201	200
10	198	198	196	195	201	201	199	198
25	196	196	193	192	199	199	196	195
50	194	194	191	190	197	197	194	193
100	192	192	189	188	195	195	192	191

Transiting animal

This scenario assumes that an animal transits the location of the piling operations, perhaps to investigate the source. The animal is modelled as travelling towards the source and then away at a fixed height above the seabed, at a constant speed of 5 m/s, starting 500 m from the source.

Figure 7-4 shows the received SEL for each hammer blow and the cumulative received SEL as the animal transits the source. Again, the results are shown for the examples of (a) an animal at 1 m above the source and (b) an animal at 25 m above the source.

Table 7-10 shows the cumulative SEL received by the transiting animal. The results indicate that the Southall *et al*. (2007) SEL threshold for injury from a multiple pulse may be exceeded for an animal situated less than approximately 50 m from the source when the piling operation begins. Again, this varies with marine mammal hearing type.

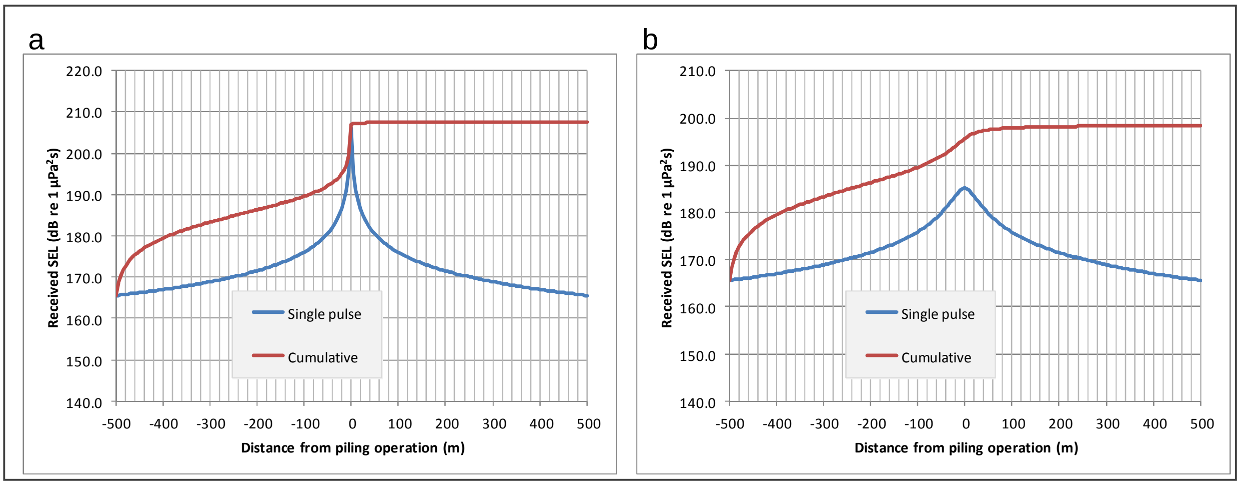


Figure 7-4 Received single pulse and cumulative SEL for one piling operation as animal travels towards source and away again assuming animal is (a) 1 m above the seabed and (b) 25 m above the seabed.

Table 7-10 Estimated received SEL over one piling operation and over 24 hours for different marine mammal hearing types assuming a transiting animal.

Vertical distance above source (m)	Cumulative SEL (one transit) (dB re 1 µPa^{2}s)				Cumulative SEL (24 hrs) (dB re 1 µPa^{2}s)			
	Unweighted	Low-fq cetacean	Mid-fq cetacean	High-fq cetacean	Unweighted	Low-fq cetacean	Mid-fq cetacean	High-fq cetacean
1	208	208	205	204	211	211	208	207
5	202	202	200	199	205	205	203	202
10	201	201	198	198	204	204	201	201
25	198	198	196	195	201	201	199	198
50	197	197	194	193	200	200	197	196
100	194	194	192	191	197	197	195	194

7.4.3 Discussion

This assessment is conservative for the following reasons:

- The source spectrum is taken from measurements of piling of a larger diameter pile, which is likely to be noisier than piling of the riser piles .
- Duration of the piling operation includes a 30 minute soft-start period. In reality, piling during the soft start contributes towards driving in the pile. Therefore, the duration is a precautionary overestimate.
- The source level has been modelled as constant throughout the piling period. During the soft start period, the hammer power and, therefore, source level would be lower than modelled here, in which case an animal may have the opportunity to move away from the source before the noise level exceeded injury thresholds.
- The assessment is based on the worst case of two piling operations per day. The offshore schedule indicates that more typically only one pile will be driven per day. Therefore, over a 24 hour period the received SEL would be lower than presented here.

Based on the conservative assessment conducted here, assuming that an animal would avoid prolonged noise exposure by moving away from the operations, it is concluded that the potential for injury would be limited to within a few tens of metres of the source. This potential would be mitigated for by applying the measures recommended by JNCC of marine mammal observation within a 500 m mitigation zone and soft start of the piling.

Low-frequency hearing cetaceans have the greatest potential for injury from the piling noise as their hearing range coincides with the main frequencies of sound generated by piling. Low frequency hearing types include the minke, sei and fin whale, all of which occur in the Schiehallion area.

7.5 Production of Waste

The waste generated as a part of the Decommissioning Programme will be a combination of both hazardous (special) and non-hazardous wastes.

BP has in place a Waste Management Plan developed to identify, quantify (where possible) and discuss available disposal options for waste resulting from all of the field suspension activities (Field Suspension Waste Management Plan; FSWMP) including those from the decommissioning activities. The plan will be used in conjunction with the current asset Waste Management Plan (WMP) and the Inventory of Hazardous Materials (IHM) to determine the fate of recovered structures and their contents.

Where possible, materials will be recycled or sold and reused. The FSWMP also reviews the relevant environmental legislation and describes any additional permit requirements. It will be used alongside the existing Schiehallion Waste Management Plan, which manages routine operational waste on the vessel.

Waste management options will take account of the waste hierarchy (SEPA, 2012) shown in Figure 7-5, with reduction in volume of waste being the preferred option. Existing waste disposal routes and contractors will be used where possible. The fate of key materials in the operation is shown in Table 7-11.

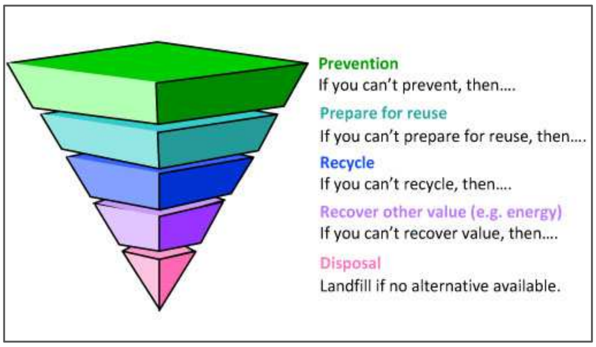


Figure 7-5 SEPA Waste Hierarchy (SEPA 2012).

Table 7-11 Fate of key materials and waste hierarchy

Waste Hierarchy	Fate of Materials
Reduce/Prevent	FPSO is being sold for operations elsewhere. All wells, majority of subsea equipment being retained for field restart
Re-use	Flexible lines are being repositioned where possible
Recycle	Steel from recovered pipelines, structures and moorings will be recycled. Recyclable materials from riser wall matrix, liners and umbilical internals will go into recycling chain
Recover	Any non-recyclable materials from deconstruction of risers and umbilicals will go to energy recovery where possible
Disposal	Any residual material not suitable for any form of recycle/recovery will be landfilled

7.5.1 RadioactiveMaterial

There are three potential sources of radioactive material on the Schiehallion FPSO. These are

- the nucleonic sources within the FPSO's processing unit associated with the density profile measurement and level control instruments;
- the radioactive materials found within the smoke detectors that are currently fitted throughout the FPSO; and
- Low Specific Activity (LSA) scale, a

type of naturally occurring radioactive material (NORM) deposit which may build up inside pipes and other production equipment.

The base case with respect to the nucleonic sources and the smoke detectors is that the FPSO is sold with them *in situ*. Hence these sources are not considered further here.

7.5.1.1 LSA / NORM

The presence of NORM deposits is a recognised phenomenon in the oil and gas industry. To date two instances of LSA / NORM contamination have been detected at the Schiehallion and Loyal development, both of which were associated with subsea valves.

In current operations, when breaking containment of the systems, BP procedures dictate that systems are monitored and in some instances sampled for LSA / NORM contamination. To date there has been very little NORM found on the Schiehallion. To verify this, a number of samples were taken earlier this year and NORM monitoring has been carried out during breaking of containment operations

During decommissioning activities there will be Radiation Protection Services (RPS) trained personnel competent in the use of radioactivity detection monitors onboard the FPSO. Topsides will be monitored for the presence of LSA / NORM, however containment will not be broken. In the unlikely event that LSA/ NORM is detected the Schiehallion FPSO has in place the required Authorisation (Radioactive Substances Act, 1993) to allow it to dispose of the contamination offshore.

RPS trained personnel will also be on board the vessels used to recover the subsea infrastructure and will monitor all items as they come on board for the presence of LSA / NORM. In the unlikely event that one or more items is found to be contaminated, the items will be contained and sealed and shipped to shore for treatment following the yards Management Systems.

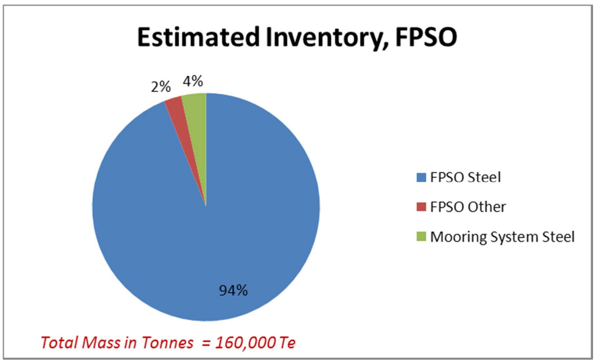
7.5.2 Non Hazardous Waste

As discussed in Section 2 a number of subsea infrastructures will be recovered as part of the Schiehallion and Loyal Decommissioning Programme Phase I. In addition to the inventory represented by the FPSO itself, which will be put back into service after sale, it is anticipated that approximately 9,000 tonnes of materials will be recovered from the seabed, some of which relates to pipelines and associated structures, and rest of which relates to the installation (the mooring system). The composition of these materials is summarised in Figure 7-6, divided into the installation and pipeline scopes.

Following the FSWMP the recovered items will where possible be reused, sold or recycled.

Primary sources of liquid waste associated with the decommissioning activities are associated with the purging and flushing of the subsea infrastructure and the seawater used to filled the topsides processing train (approximately 5,000 m^3) and to stabilise the COTs (approximately 15,000 m^3) whilst the FPSO is under tow.

The flushing fluids will be offloaded to the Loch Rannoch shuttle tanker and processed at SVT. The stabilising fluids from the COTs and processing train will be emptied into barges and taken to an approved treatment plant once it has reached its ISL.



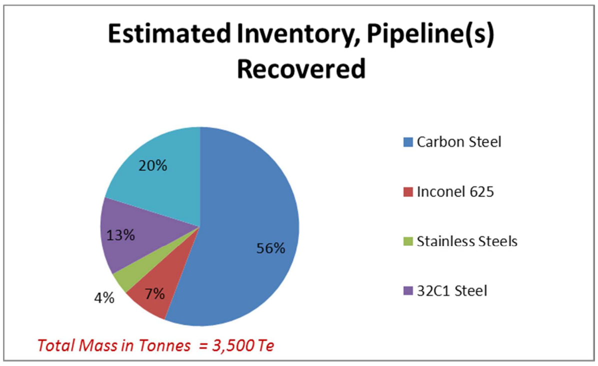


Figure 7-6 Estimated composition of items to be recovered.

8 Further Assessment of Potential Socio-Economic Impacts

Potential socio-economic impacts associated with the planned decommissioning activities include interaction with fishers, commercial shipping, and other oil and gas infrastructure. There is no military activity, renewable or aggregate industries or tourism associated with the area. Possible socio-economic impacts associated with accidental events are considered in Chapter 9.

8.1 Fishing

The Schiehallion and Loyal development is in an area (ICES rectangle 49E5) of relatively low fishing effort in terms of days at sea representing less than 0.2% of the total reported UK fishing effort by UK vessels over 10 m.

Exclusion zones are in place at the FPSO and at each of the drill centres. During decommissioning and after the FPSO has left the field these exclusion zones will remain in place. No additional exclusion zones will be introduced. Hence the Schiehallion and Loyal Decommissioning Programme Phase I is not anticipated to impact on the area available to fishers working in the area. Schiehallion is within an Offshore Development Area which warns other sea users of increased vessel activity and potential seabed obstructions. In addition a guard vessel will remain in operation in the area throughout the Quad204 workscope.

8.2 Shipping

Shipping in the area is considered low (DECC, 2012). A maximum of six additional vessels will be on site at any one time during the decommissioning activities. These six additional vessels will be associated with the disconnection of the risers, dynamic umbilical and mooring lines.

The increase in vessel activity associated with the decommissioning activities will primarily be within the exclusion zones and are therefore unlikely to impact on general shipping activity not associated with the Schiehallion and Loyal development.

As well as having a number of important European shipping lanes, including ferry routes, the North Sea is a major fishing ground. In addition it is a well developed region in terms of the oil and gas industry, aggregates and renewable energy. These industries combined with the shipping lanes make it one of the busiest sea areas in Europe.

Prior to towing, a towing plan will be submitted and it is expected the tow route will follow a predefined shipping lane. In addition a notice to mariners will be issued to ensure vessel traffic in the area is aware of the presence of the FPSO.

9 Accidental Events

Impacts associated with accidental events occurring whilst the decommissioning activities are being carried out could result in aspects such as discharges to sea and disturbance to the seabed. The potential for socio-economic impacts is also considered.

Accidental events specifically associated with the decommissioning activities are considered. Potential accidental events associated with the preparatory works such as shutting in of the wells and those associated with the FPSO once it is off-station are not considered. They were included in the EIA matrix for completion; however, are outwith the scope of the Schiehallion and Loyal Decommissioning Programme Phase I. The risks from these activities are not changed from those already present and managed during routine operations.

The potential for accidental events leading to discharges to sea or disturbance to the seabed has been identified.

9.1 Discharges to Sea

Following well shut-in there is the potential for accidental discharges to occur from the flowlines as a result of:

- Failure of the BSPs on the jumpers resulting in discharges of MeOH.
- Failure of ROVDB resulting in discharges of oily water and preservation fluids.
- Damage to pipelines resulting from corrosion, dropped objects and interaction with fishing vessels. Worst case discharge volumes would match the largest flowline (1,167 m^3). During decommissioning this discharge is likely to be of oily water and flushing or preservation fluids.
- Accidental releases when disconnecting the risers (after flushing) at the elbow due to inaccessibility.

All unplanned discharges will be reported to DECC via the PON1 process.

It is unlikely that there will be any significant impacts to marine flora and fauna as a result of discharges to sea. Predicted accidental discharge volumes are relatively small and water column impacts are expected to be short term and localised as the chemicals are expected to rapidly dilute in the high energy environment. In addition chemicals are selected both on their technical specifications and their environmental performance.

Given the distance from the nearest median line (35 km from the Faroe-UK median) and the prevailing current conditions these potential discharges are not expected to have a transboundary impact.

It should be noted that OPEP duties will transfer to the guard vessel when the Schiehallion FPSO leaves the field.

9.2 Disturbance to Seabed

Accidental disturbance to the seabed could result from dropped objects; for example, when laying the mooring lines or when recovering the infrastructure.

Any additional disturbance to the seabed in the area of the Schiehallion and Loyal fields is not expected to significantly impact on the area. Detailed site surveys conducted across the project area have not identified any sensitive habitats or species or those of particular conservation concern. In addition those benthic species that were identified tend to be widely distributed and would be expected to return to the disturbed area following the disturbance.

All dropped objects will be reported to DECC via a PON2 and BP will aim to recover all dropped objects. Those not recovered will be entered into FishSafe.

9.3 Socio-Economic Impacts

None of the potential accidental events are expected to impact on other sea users in the area. Discharges are expected to disperse quickly whilst all dropped objects will be recovered where possibly. If not possible they will be entered on FishSafe making fishers in the area aware of their presence. In addition the development lies in an Offshore Development Area, which often deters other sea users from entering the region.

10 Conclusions

To fully exploit the remaining Schiehallion and Loyal reserves and the more recently discovered reservoirs in the area it was deemed necessary to replace the existing Schiehallion FPSO. Replacement of the FPSO requires suspension of production at the fields in order to allow the Schiehallion to be towed away and to allow the replacement FPSO to be installed. This document considered the environmental and socio-economic impact of the activities associated with the Decommissioning Programme (Schiehallion and Loyal Decommissioning Programme Phase I) to be carried out as part of the field suspension.

The ESIA process considered the consequence of each activity in terms of regulatory, environmental and stakeholder effects and the duration / frequency of each activity. Combined, these gave a significance value. None of the planned decommissioning activities were found to have a significant impact on the environment.

Accidental events were also considered in terms of the regulatory, environmental and stakeholder effects and the probability of the event occurring. Accidental events identified potentially to have a significant impact include the loss of flushing fluids. However the use of chemicals of low toxicity, the flushing of production lines to a low concentration of residual oil in water and the implementation of emergency responses as detailed in the Schiehallion's OPEP (Oil Pollution Emergency Plan) reduces the risk to insignificant. When the Schiehallion FPSO leaves the field, OPEP duties will transfer to the guard vessel.

10.1 Mitigation Measures

In addition to the routine environment management activities for example contractor vessel audits and legal requirements to report discharges and emissions, BP will put in place the following mitigation measures to minimise the impact of the decommissioning activities:

- JNCC guidelines will be adhered to with respect to the pile driving. These include the use of a soft start, the presence of a marine mammal observer on board and delaying driving by 20 minutes from when a marine mammal has been observed within 500 m of the piling area.
- To reduce emissions the decision was taken to install a new temporary generator to supply power when the main generators were not required
- The FPSO will be towed gross hydrocarbon free and minimum volumes of stabilising fluids will be used in the COTs for towing. In addition the FPSO will be towed with only half its diesel capacity on board.

Following the ESIA process it can be concluded that activities associated with the Schiehallion and Loyal Decommissioning Programme Phase I are unlikely to significantly impact the environment. Impacts on other sea users for example shipping traffic and fishers are also considered insignificant.

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