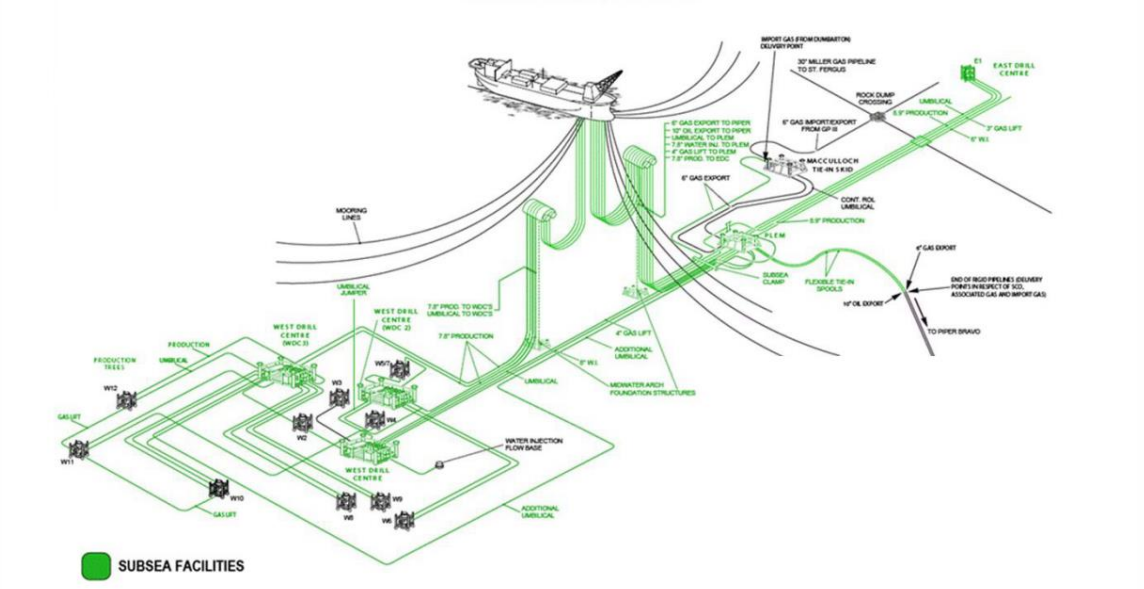
ConocoPhillips

MACCULLOCH FIELD DECOMMISSIONING PROJECT:

SUBSEA INFRASTRUCTURE AND ASSOCIATED INFIELD PIPELINES

ENVIRONMENTAL APPRAISAL FOR THE MACCULLOCH FIELD DECOMMISSIONING PROGRAMMES:



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REVISION C2

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ABBREVIATIONS, ACRONYMS AND UNITS

Definition	
%	**Percentage**
“	Inch(es)
<	Less than
°	Degree(s)
°C	Degrees Celsius
µm	Micrometre(s)
µPa	micro Pascal(s)
AHV	Anchor Handling Vessel
API	American Petroleum Institute (specific gravity)
BAT	Best Available Techniques
BEIS	Department for Business, Energy & Industrial Strategy
BEP	Best Environmental Practice
BOD	Biological Oxygen Demand
BODC	British Oceanographic Data Centre
CA	Comparative Assessment
CEMP	Coordinated Environmental Monitoring Programme
CHARM	Chemical Hazard Assessment and Risk Management
CO_2	Carbon Dioxide
CoP	Cessation of Production
CSV	Construction Support Vessel
dB	Decibel
dB_{ht} (species)	Sound level in decibels above the hearing threshold of a species
DCA	Decommissioning Operations (PETS)
DECC	Department of Energy & Climate Change
DP	Decommissioning Programme
DRA	Drilling Operations (PETS)
DSV	Dive Support Vessel
DTI	Department of Trade and Industry (became DECC, presently BEIS)
EA	Environmental Appraisal
EC	European Commission
EDC	East Drill Centre
EIA	Environmental Impact Assessment
ELD	Environmental Liability Directive
EMS	Environmental Management System
EoC	Exchange of Correspondence
EPA	Environmental Protection Act
EPS	European Protected Species
ERL	Effects Range - Low
EU	European Union
FEPA	Food and Environment Protection Act
FPSO	Floating Production Storage and Offtake vessel
FSU	Floating Storage Unit

GJ	Gigajoules
GMS	Global Marine Systems Limited
GPIII	Global Producer III
GRT	Gross register tonnage
HAZID	Hazard Identification Study
HAZOP	Hazard and Operability
HSE	Health and Safety Executive
Hz	Hertz
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organization
IoP	Institute of Petroleum
IOPP	International Oil Pollution Prevention
IPCC	Intergovernmental Panel on Climate Change
ITOPF	International Tanker Owners Pollution Federation
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
km	Kilometre(s)
km²	Kilometre(s) squared
LAT	Lowest Astronomical Tide
m	Metre(s) (All water depths are given to Lowest Astronomical Tide)
m/s	Metre(s) per second
MALSF	Marine Aggregate Levy Sustainability Fund
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZs	Marine Conservation Zones
mg/l	Milligram(s) per litre
mm	Millimetre(s)
MMO	Marine Management Organisation
MSFD	Marine Strategy Framework Directive
MWA	Midwater Arch
NCMPA	Nature Conservation Marine Protected Area
ND	No Data
NE	North east
NFFO	National Federation of Fishermen's Organisation
NIEA	Northern Ireland Environment Agency
NIFPO	Northern Irish Fish Producers' Organisation
nm	Nautical Mile
NMPi	National Marine Plan Interactive
NORM	Naturally Occurring Radioactive Material
NOx	Oxides of Nitrogen
NPD	Naphthalene Phenanthrene Dibenzothiophene
NRC	National Research Council
NSP	North Sea Producer
NSPCL	North Sea Production Company Limited
OBF	Oil based drilling fluids
OCNS	Offshore Chemical Notification Scheme

OD	Outside diameter
OGA	Oil and Gas Authority
OGP	Oil and Gas Producers (now International Association of Oil and Gas Producers)
OMS	Operating Management System
OPEP	Oil Pollution Emergency Plan
OPF	Organic phase fluids
OPOL	Oil Pollution Operator's Liability
OPPC	Oil Pollution Prevention and Control
OPRC	Oil Pollution Preparedness, Response and Co-operation
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSPAR	Oslo and Paris Conventions
OSRL	Oil Spill Response Limited
P&A	Plug and Abandonment
PAH	Polycyclic Aromatic Hydrocarbon
PARCOM	Paris Commission
PDi	Project Development International Limited
PETS	Portal Environmental Tracking System
PLA	Pipeline Operations (PETS)
PLEM	Pipeline End Manifold
POPA	Prevention of Oil Pollution Act
PPD	Public Participation Directive
ppm	parts per million
PRA	Production Operations (PETS)
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
ROV	Remotely Operated Vehicle
RPS	RPS Energy Limited
SAC	Special Area of Conservation
SBF	Synthetic based drilling fluids
SCOS	Special Committee on Seals
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fishermen's Federation
SMRU	Sea Mammal Research Unit
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSREP	Secretary of State for Energy and Climate Change
SOx	Oxides of Sulphur
SPL	Sound Pressure Level
SS.SMu.OMu	Offshore circalittoral mud
SS.SMu.OMu.LevHet	*Levinsenia gracilis* and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud
SSIV	Subsea (sub surface) isolation valve
Te	Tonne
THC	Total hydrocarbon concentration
THC	Total Hydrocarbon Concentration
U.K.	United Kingdom
UKCS	United Kingdom Continental Shelf

UKDMAP	United Kingdom Digital Marine Atlas
UKOOA	United Kingdom Offshore Operators Association (currently Oil and Gas UK)
UKOPP	United Kingdom Oil Pollution Prevention
UNCLoS	United Nations Convention on the Law of the Sea
VOC	Volatile Organic Compound(s)
WDC	West Drill Centre
WFD	Waste Framework Directive
WIA	Well Intervention Operations (PETS)
WOW	Wait on Weather

NON-TECHNICAL SUMMARY

This non-technical summary outlines the findings of the Environmental Appraisal (EA) conducted by ConocoPhillips (U.K.) Limited (ConocoPhillips) in support of the MacCulloch Decommissioning Programme.

The purpose of the EA is to understand and communicate the significant environmental impacts associated with the decommissioning options proposed under the decommissioning programme and to inform the decision-making process.

The MacCulloch infrastructure are located within United Kingdom Continental Shelf (UKCS) licence Block 15/24 in the central North Sea (Figure i).

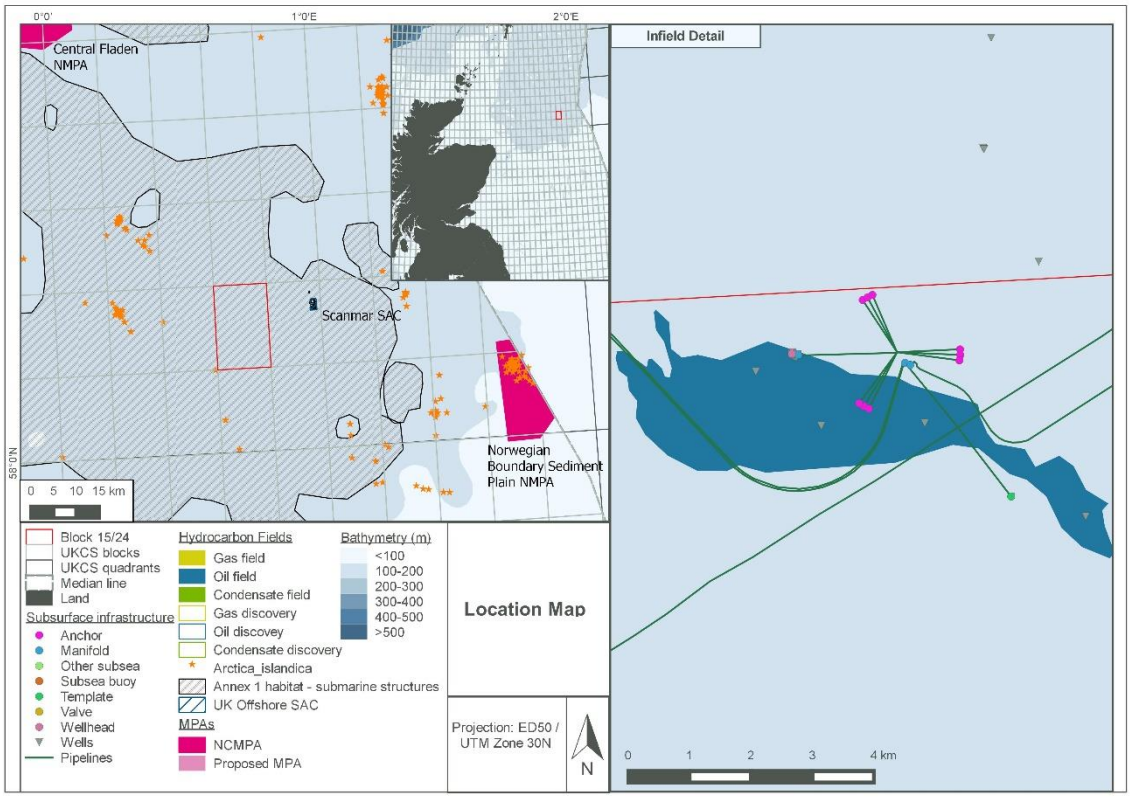

Figure i: Location of the MacCulloch infrastructure to be decommissioned

The FPSO was disconnected from the MacCulloch infrastructure in 2015 following a pipeline flushing programme, these works were conducted via an exchange of correspondence and an agreed approach with OPRED. Thereafter the vessel was taken to Teesside by the owners for reuse or recycling. This was achieved by cutting the risers and the mooring system chains. The risers, riser clamps and the two mid-water arch buoyancy tanks and associated tethers were removed. The mooring system was left for removal with the remainder of the subsea facilities. In 2017 the MacCulloch Owners undertook a well intervention campaign, installing 2 verified well suspension barriers (bridge plugs) in each well, one deep and one shallow, to isolate the X-mas trees from the reservoir pressure. Pressure gauges were installed in each well to allow ongoing monitoring of the well suspension barriers.

Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008. The

Petroleum Act sets out the requirements for a formal Decommissioning Programme which must be approved by the Department for Business, Energy & Industrial Strategy (BEIS) before the owners of an offshore installation or pipeline may proceed with decommissioning.

Under the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (BEIS Draft Guidance Notes) the Decommissioning Programme must be supported by an environmental assessment of the decommissioning proposals; the Environmental Appraisal fulfils that requirement.

The BEIS Guidance Notes state that an EA should include an assessment of the following:

- Significant impacts on the marine environment which may include exposure of biota to contaminants associated with the decommissioning of the installation; other biological impacts arising from physical effects; conflicts with the conservation of species with the protection of their habitats, or with mariculture; and, interference with other legitimate uses of the sea.
- Significant impacts on other environmental compartments, including emissions to the atmosphere, leaching to groundwater, discharges to surface fresh water and effects on the soil.
- The impacts of any explosives likely to be deployed subsea;
- Consumption of natural resources and energy associated with reuse and recycling.
- Interference with other legitimate uses of the sea and consequential effects on the physical environment.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

In addition, BEIS have advised the Oil and Gas Industry that under the Marine and Coastal Access Act 2009 (MCAA) and the Marine (Scotland) Act 2010 an Environmental Appraisal will be required for all licence applications relating to decommissioning operations.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom's international obligations on the decommissioning of offshore installations. The Decision prohibits the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore, and all installations with a jacket weight of less than 10,000 tonnes must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents.

OSPAR Decision 98/3 does not include the decommissioning of pipelines. There are no international guidelines on the decommissioning of disused pipelines. However, the UK Petroleum Act and Pipeline Safety Regulations 1996 provide a framework for the safe decommissioning of disused pipelines. The DECC Guidance Notes state that "Because of the widely different circumstances of each case, it is not possible to predict with any certainty what may be approved in respect of any class of pipeline". Therefore, all feasible pipeline decommissioning options should be considered and a Comparative Assessment made.

Scope of the MacCulloch Decommissioning Programme

The main elements of the MacCulloch programme includes the decommissioning of the following:

- Structures including the Pipeline End Manifolds (PLEM), Midwater Arch Buoyancy (MWA) bases, manifolds and wellheads;
- FPSO mooring system including drag anchors, mooring chains and spiral strand wire;
- Flowlines, jumpers and umbilicals;
- Mattresses and Grout bags; and
- Subsea Control Modules.

All field structures will be completely removed and recovered onshore for recycling, reuse (where possible) or disposal.

Decommissioning Studies

ConocoPhillips have conducted the following studies in support of the Decommissioning Program, planning process and option evaluation.

- Pipeline Degradation Study (PDi, 2015a).
- Pipeline Historical & Present Conditions Assessment (PDi, 2015b).
- Decommissioning Option Selection Report (PDi, 2015c).
- Marine growth Assessment (RPS, 2015a).

These studies have been used to determine the preferred decommissioning options and optimal engineering solutions. The conclusions from these are included within the Environmental Appraisal.

MacCulloch Environmental Monitoring Survey UKCS Block 15/24B July/ August 2012, Project Number: J36292, was a baseline survey carried out prior to decommissioning and is used as a pre-decommissioning dataset (Fugro, 2013).

Recommended Decommissioning Options

All subsea structures will be removed and brought to shore for reuse, recycling or disposal. Specialist studies, internal reviews and engineering assessments were undertaken to determine the optimum decommissioning options for the MacCulloch subsea structures, pipelines and wellheads. ConocoPhillips conducted a Comparative Assessment of the options for decommissioning of the infield pipelines and mattresses for the MacCulloch programme, as required under the Petroleum Act 1998. Table i provides an overview of the selected decommissioning options for the MacCulloch infrastructure.

Table i: Overview of selected decommissioning options for the MacCulloch infrastructure

Infrastructure	Decommissioning Option Selected	Possible Decommissioning Method
Grout bags	Full removal.	Removal via DSV to shore. Disposal via landfill – no recycling potential identified.
Mattresses		
Manifolds	Full removal.	Piles cut to 3 m below seabed surface. Recycle.
Midwater Arch clump weights and piles	Full removal.	Recycle.
Mooring chains and wire strands	Full removal	Cut and lift, transit to shore via AHV. Recycle.
Mooring anchors	Current state (decommissioned in situ).	
Jumpers	Full removal.	Cut and lift via a DSV. Transit to shore via CSV. Disposal via landfill.
Pipelines		
Umbilicals		
Subsea Clamp	Full removal.	Recycle.
Control modules	Full removal.	Recycle.

Environmental Setting and Sensitivities

The MacCulloch infrastructure is located in the central North Sea with ambient water depths ranging between 143 m Lowest Astronomical Tide (LAT) in the north to 150 m LAT in the south. Sediments in the decommissioning area comprise mud and cohesive sandy mud. Tidal currents in the central North Sea area are generally weak and are readily influenced by other factors such as winds and density driven circulation.

The MacCulloch decommissioning area is situated approximately 10.5 km west of the Scanner Pockmark Special Area of Conservation (SAC) and approximately 52 km northwest of the Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA). Neither of these Annex I habitats are expected to be negatively impacted by the decommissioning activities.

The Annex II species harbour porpoise, bottlenose dolphin, grey seal and harbour seal have been recorded in Quadrant 15 and surrounding quadrants. Harbour porpoise have been recorded in low to very high abundances in throughout the year, with the highest abundance recorded for Quadrant 15 during July (UKDMAP, 1998; Reid et al., 2003; Hammond et al., 2017). Reid et al, suggest there could be some bottlenose dolphin presence in the area, however, this is not supported by UKDMAP (1998) or Hammond et al. (2017). Grey and harbour seals have both been recorded in very low densities in the region, with no haul out or breeding sites in the vicinity of the MacCulloch decommissioning area (NMPI, 2018).

Tables ii and iii highlight the key physical, chemical, biological and socioeconomic sensitivities relevant to the MacCulloch area.

Table ii: Summary of environmental characteristics and sensitivities

Aspect	Detail
Site overview	
The MacCulloch subsea structure to be decommissioned is located within Block 15/24b in the UK sector of the central North Sea, 170 km NE of Peterhead in water depth of, approximately 146 m.	
Environmental Aspects <50 km	
Conservation Interests	
Offshore Marine Protected Areas and Annex I habitats	
Scanner Pockmark Special Area of Conservation (SAC)	Designated for submarine structures made by leaking gases (JNCC, 2018a, 2018b). Located 10.5 km east of the MacCulloch field.
Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA)	Designated due to the presence of ocean quahog (*Arctica islandica*), which is listed on an OSPAR threatened and/ or declining species (JNCC, 2018c). Located 52 km southeast of the MacCulloch field.
Offshore Annex II species	
Harbour porpoise	Sightings In Quadrant 15 and surrounding quadrants range from low to very high throughout the year. The highest abundance of harbour porpoise in Quadrant 15 has been recorded during July (high) (UKDMAP, 1998; Reid et al., 2003; Hammond et al., 2017).
Bottlenose dolphins	Reid et al., (2003) suggest there could be some bottlenose dolphin presence in the area, however, this is not supported by UKDMAP (1998) or Hammond et al. (2017).
Grey seals	Grey seal density along the decommissioning area ranges from 0 to 1 seals per 5 km^2 (NMPI, 2018). There are no haul-out or breeding sites in the vicinity of the MacCulloch decommissioning area.
Harbour seals	Harbour seal density along the decommissioning area ranges from 0 to 1 seals per 5 km^2 (NMPI, 2018). There are no haul-out or breeding sites near the MacCulloch decommissioning area.
Plankton	
Plankton in the area surrounding the MacCulloch subsea infrastructure is typical for this area of the North Sea. Dominant phytoplankton species are dinoflagellates of the genus Ceratium, including *C. fusus*, *C. furca* and *C. lineatum*. High numbers of the diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. are also present. The zooplankton community comprises *Calanus finmarchicus* and *C. helgolandicus* as well as *Paracalanus* spp., *Pseudocalanus* spp., *Acartia* spp., *Temora* spp. and cladocerans such as *Evadne* spp. (OESEA, 2016).	
Benthic environment	
Seabed sediments	The seabed sediments of the MacCulloch survey area were classified as the habitat SS.SMu.OMu, offshore circalittoral mud. The species present within the grab stations were broadly similar to the biotope SS.SMu.OMu.LevHet, offshore circalittoral mud and sandy mud (Fugro, 2013).
Benthic fauna	Macrofaunal analysis of the survey samples collected around the North Sea Producer FPSO, the produced water discharge location and the east and west drill sites indicated that numbers of taxa and individuals were moderate to high across the survey area and comparable with those recorded in previous surveys in the area (Fugro, 2013). Across the survey area, the macrofaunal communities comprised of species consistent with sediments of very fine and silty sands. Overall, approximately 48.8% of taxa were annelids, 25.3% arthropods, 16.7% molluscs, 3.7% echinoderms and 5.6% other phyla (e.g. nemerteans, phoronids and cnidarians) (Fugro, 2013).
Socioeconomic Aspects	

Aspect	Detail
Fish and shellfish – spawning and nursery areas	
Spawning areas	There are spawning areas for cod, *Nephrops* and Norway pout within ICES rectangle 45F0 and Block 15/24 (Coull et al., 1998; Ellis et al., 2010).
Nursery areas	There are potential nursery areas in the ICES rectangle 45F0 for anglerfish, blue whiting, cod, European hake, herring, ling, mackerel, *Nephrops*, Norway pout, sandeel, spotted ray, spurdog and whiting within ICES rectangle 45F0 and Block 15/24. Sprat also have potential nursery areas within ICES rectangle 45F0 (Coull et al., 1998). A high probability of age 0 (juveniles) anglerfish and medium probability for European hake have been reported within Block 15/24 (Aries et al., 2014).
Marine Mammals	
Cetaceans	Minke whale, killer whale, white-beaked dolphin, white-sided dolphin, Risso's dolphin and harbour porpoise have been sighted in the decommissioning area (Quadrant 15 and surrounding quadrants) (UKDMAP, 1998). Reid et al., (2003) also indicate the presence of bottlenose dolphins within Quadrant 15.
Seals	Grey and harbour seals can be potentially found in Block 15/24 and surrounding blocks in very low density (NMPI, 2018).

Cetaceans in Quadrant 15 and surrounding quadrants

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbour porpoise	L	M		L	**VH**	**L**	H	M	**L**	**L**		**VH**
Minke whale					**L**	L		**L**				
Common dolphin								**L**				
Killer whale											L	
Risso's dolphin							**L**					
White-beaked dolphin		**M**	M		**M**	**L**	**H**	**L**	**M**	**L**	M	**L**
White-sided dolphin							**VH**	**L**	**H**			

VH	Very high	H	High	M	Moderate	L	Low	No data

Seabirds
The most common species of seabird found in the MacCulloch area include: Arctic Skua, Arctic Tern, Black Guillemot, Common Gull, Cormorant, Fulmar, Gannet, Great Black-backed Gull, Great Skua, Guillemot, Herring Gull, Kittiwake, Lesser Black-backed Gull, Little Auk, Manx Shearwater, Razorbill, Puffin, Shag, Sooty Shearwater and Storm Petrel (Stone at al., 1995).
Seabird sensitivity: Seabirds density maps indicate that particularly fulmar and kittiwake are abundant in the area throughout the year (Kober et al., 2010). Seabird sensitivity to surface pollution has been recorded as medium to low between January and October with no data available for November and December in Block 15/24. Very high sensitivity was recorded in January and December in neighbouring Block 15/28 (Webb et al., 2016).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Block 15/18	5	5	5	4	4	5	5	5	4	4	ND	ND
Block 15/19	5	5	5	5	5	5	5	5	5	5	ND	ND
Block 15/20	5	5	5	5	5	4	5	5	5	5	ND	ND
Block 15/23	5	5	5	4	4	5	5	5	4	4	ND	ND
Block 15/24	5	5	5	5	5	4	5	5	4	4	ND	ND
Block 15/25	5	5	5	5	5	4	5	5	5	5	ND	ND
Block 15/28	2	5	5	4	4	5	5	5	4	4	ND	2
Block 15/29	5	5	5	5	5	5	5	5	4	4	ND	ND
Block 15/30	5	5	5	5	5	5	5	5	5	5	ND	ND

Key – seabirds sensitivity (ND – no data). Red denotes interpolated data.

1	Extremely high	2	Very high	3	High	4	Medium	5	Low	

Table iii: Summary of socioeconomic characteristics and sensitivities.

Socioeconomic	
Fisheries	Commercial fisheries landings were 4,707 tonnes with a value of £5,426,970 for 2017 within ICES rectangle 45F0. Demersal, pelagic and shellfish species were targeted with majority of catches attributed to pelagic species. In 2017 the main fishing gear were trawls (Scottish Government, 2018).
Shipping	Overall shipping density near the MacCulloch field is considered low (Scottish Government, 2017).
Oil and gas industries	There are several fields within 10 km of the MacCulloch field, including Nicol (4.8 km southeast), Donan (7 km northeast) and Galley (8.3 km southwest). The closest surface infrastructure is the FPSO Global Producer III, located 8.2 km northeast of the MacCulloch field. There are also 31 wells within Block 15/24 and 23 pipelines that intersect the block (UK Oil and Gas Data, 2018).
Offshore renewables	There are no current or proposed windfarms located within, or near Block 15/24 (Crown Estate, 2018).
Aggregate activities	There are no designated aggregate extraction areas near Block 15/24 (Crown Estate, 2018).
Carbon Capture and Storage (CCS)	Goldeneye CCS agreement for lease is located 63 km southwest from the MacCulloch Field (Crown Estate, 2018)
Military activities	There is no military activity expected within 100 km of the MacCulloch Field (Defra, 2018).
Wrecks	There are no chartered wrecks within Block 15/24 (NMPI, 2018)
Telecommunications	There are no submarine cables which intersect, or lie close to, Block 15/24 (NMPI, 2018).

Key Environmental and Societal Concerns

A risk assessment of the potential significant environmental impacts, between the proposed decommissioning activities and the local environment, identified a number of potential impacts requiring further assessment. The following summarises the conclusions from detailed assessments of the potential sources of significant impact.

Energy and emissions

Energy use and associated emissions resulting from the proposed MacCulloch decommissioning activities are mainly attributed to vessel and helicopter use and the manufacture of new materials to replace recyclable materials decommissioned in situ and sent to landfill.

The emissions from the decommissioning activities will only have a localised effect on air quality. The impact on air quality is unlikely to affect any sensitive receptors within the MacCulloch area as the impact is expected to be limited to the immediate vicinity. For this reason, there is unlikely to be a significant transboundary or cumulative impact on air quality.

Underwater noise

Man-made underwater noise has the potential to impact on fish species and marine mammals. Several activities associated with the proposed decommissioning activities will generate underwater noise. Based on the activities proposed, it is estimated that the sound levels would attenuate to ambient levels within a few kilometres of the sound source.

As such, it is unlikely that the sound produced from decommissioning activities would have an effect on fish behaviour that would be noticeable at the population level given the limited spatial extent of the sound generated.

The main marine cetacean species that occur in the MacCulloch areas are minke whale, killer whale, common dolphin, white-beaked dolphin, white-sided dolphin, Risso's dolphin and harbour porpoise. There are two species of pinniped present, harbour seal and grey seal. Records indicate that both species can occur in very low numbers in the area and due to the distance from shore (170 km) are unlikely to be present. These species are all subject to regulatory protection from injury or disturbance.

Vessel noise is thought to be the main source of persistent noise during the decommissioning activities and a worst-case scenario was modelled using a maximum of five vessels present at one location. Even with this worst-case approach, taking into account most recent NOAA thresholds of disturbance, subsea noise levels are unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by vessel noise in the immediate vicinity or by any other continuous noise source during the proposed activities. The individual and cumulative impacts from the MacCulloch decommissioning activities were not considered significant.

Seabed impacts

The proposed MacCulloch decommissioning operations will result in work being undertaken at or near the seabed. Therefore, there is the potential for localised long and short-term seabed disturbance.

There will be no long-term impact on the seabed resulting from the degradation of the pipelines and slow release of contaminants as they will be removed during the decommissioning process. The short to medium-term impacts associated with the decommissioning of the MacCulloch infrastructure include disturbance resulting from the removal of the pipelines, mattresses and manifold structures. Studies have shown that any impact from seabed disturbance and anchoring will be temporary but medium-term in this area of the North Sea. These activities will be controlled to minimise excavation activity and to ensure accurate placement of cutting and lifting thereby minimising the risk of sediment disturbance. None of these impacts have been assessed as significant.

Discharges to sea

There are no significant discharges to sea planned from any of the proposed MacCulloch decommissioning activities.

There is potential for some residual hydrocarbons and NORM scale to be present in the pipelines and a negligible amount of material during cutting of the pipelines will be discharged to sea. However, this is not likely to result in any significant impacts to the marine environment. There will be no long-term release of contaminants resulting from the degradation of the pipelines as they will be removed during the decommissioning process.

Societal impacts

The main socioeconomic impacts which may arise as a result of the decommissioning of the MacCulloch infrastructure will be a minor impact to fishing activities during the decommissioning operations in the MacCulloch area and transient loss of access for vessels during the decommissioning operations.

There is no expected potential for snagging hazards from seabed obstructions as all subsea infrastructure (excluding the buried anchors) is planned for complete removal and overtrawlability surveys will be conducted post removal. There is the potential for

increased collision potential based on increased vessel numbers operating in the vicinity of the decommissioning area.

These impacts will be reduced by minimising the number of vessels travelling to, or standing by, the MacCulloch subsea infrastructure once it has been decommissioned and taking notice of any relevant Notices to Mariners.

Accidental events

Accidental events, such as the release of hydrocarbons and chemicals, can result in a complex and dynamic pattern of pollution distribution and impact on the marine environment. Although the likelihood of such a spill is remote, there is a potential risk to organisms in the immediate marine and coastal environment, and a socioeconomic impact if a spill were to occur.

A worst-case scenario at the MacCulloch decommissioning area would result from a loss of diesel or chemicals from on-site vessels or collisions. Diesel and chemical spills will disperse and dilute quickly, with a very low probability of hydrocarbons reaching the coastline. The likelihood of a hydrocarbon or chemical spill occurring is low and will not contribute to the overall spill risk in the area. The current Oil Pollution Emergency Plans for the central North Sea Operations and Onshore Operations provide effective spill management in the case of an accidental event.

During the proposed operations, there is the potential for the loss of objects dropped overboard which may present a hazard to shipping, fishing activities and may also impact the seabed community within the drop zone. ConocoPhillips will endeavour to minimise the number of dropped objects and will secure items to prevent loss during the proposed decommissioning operations. The recovery of oil and gas related debris wherever practicable will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea.

Environmental Management

ConocoPhillips is committed to conducting activities in compliance with all legislation and operates an ISO14001 certified Environmental Management System (EMS). The EMS covers all aspects of ConocoPhillips' activities including exploration, drilling, production and decommissioning. All activities associated with the decommissioning of the MacCulloch infrastructure will be covered by this EMS.

ConocoPhillips is committed to minimising the environmental impact of its activities. Continuous improvement in environmental performance is sought through effective project planning and implementation, emission reduction, waste minimisation, waste management and energy conservation.

Conclusions

Overall, the Environmental Appraisal has evaluated the potential impacts, their significance and environmental risk reduction measures. This document concludes that ConocoPhillips have, or intend to, put in place sufficient safeguards to mitigate the potential environmental risks and to monitor the implementation of these measures. A summary of the impacts and planned mitigation measures are presented in Table iv.

In addition, the Environmental Appraisal has highlighted the positive impact that the decommissioning of the MacCulloch infrastructure will have on commercial fishermen

and other users of the sea, with the opening of areas of the sea which have previously been excluded for safety reasons.

Therefore, it is the conclusion of this Environmental Appraisal that the recommended options presented for the decommissioning of the MacCulloch infrastructure can be completed without causing significant adverse impact to the environment.

Table iv: Summary of potential impacts and planned mitigation measures

Potential sources of impact	Planned mitigation measures
Energy and Emissions	
CO_2 Emissions	• Vessels will be audited as part of selection and pre-mobilisation. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Vessels will use ultra-low sulphur fuel in line with MARPOL requirements. • Work programmes will be planned to optimise vessel time in the field. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.
Underwater Noise	
Underwater noise from decommissioning activities	• Machinery and equipment will be in good working order and well-maintained. • Helicopter maintenance will be undertaken by contractors in line with manufacturers and regulatory requirements. • The number of vessels utilising DP would be minimised where possible, considering mitigation proposed for other receptors.
Seabed Disturbance	
Subsea equipment cutting, excavation and lifting	• Cutting and lifting operations will be controlled by a remotely operated vehicle to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. • The requirements for further excavation will be assessed on a case-by-case basis and will be minimised to provide access only where necessary. Internal cutting will be used preferentially where access is available.
Discharges to Sea	
Residual hydrocarbons or solids in pipelines and subsea pipework	• All pipelines were cleaned during the Phase I decommissioning process completed in August 2015. • There will be no long-term release of residual contaminants as all pipelines will be removed. • Disposal of waste transported onshore for disposal will be provided by an approved waste management contractor, in compliance with ConocoPhillips existing standards, policies and procedures.
Societal Impacts	
Physical presence of decommissioning vessels causing potential interference to other users of the sea.	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Use of designated transit routes for all decommissioning vessels. • 24 hour manned bridge policy.
Damage to or loss of gear as a result of subsea obstructions decommissioned in situ, posing potential snagging risks.	• Subsea infrastructure (excluding the buried anchors) is planned for complete removal. • Post-decommissioning seabed clearance and an overtrawlability survey will be conducted on areas of potential snagging risk.

Potential sources of impact	Planned mitigation measures
Accidental Events	
All oil spills	The inventories will be minimised prior to removal and transport to disposal yard. In addition, the use of pipeline capping for instance, could be stated to avoid a release during the transportation. The ConocoPhillips OPEPs UK-00018 (CNS Oil Pollution Emergency Plan) and UK-00019 (Onshore Oil Pollution Emergency Plan) have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The OPEPs detail responsibilities for initial response and longer-term management, and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the size of the spill: • Tier 1 - standby vessel equipped with dispersants and spraying equipment; • Tier 2 - air surveillance and dispersant spraying through Oil Spill Response Ltd. (OSRL); and • Tier 3 - clean-up equipment and specialist staff available through OSRL. In addition, ConocoPhillips have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability Fund (OPOL).
Vessel collision	• Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	• In the event of an accidental spill to sea, vessels will implement their SOPEP.
Chemical spills from the decommissioning activities	• ConocoPhillips will conduct all operations in a controlled manner with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. • Chemical inventories have been removed during the decommissioning Phase I activities. • Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities.
Dropped object event from the decommissioning activities	All efforts will be made by ConocoPhillips to minimise the number of dropped objects. During the preparation for removals programme, items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects the MacCulloch infrastructure wherever practicable. The recovery of such debris will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea wherever possible.

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1.0 INTRODUCTION

This Environmental Appraisal (EA) supports the submission of two Decommissioning Programmes (DPs) for the MacCulloch Field:

- DP1 – MacCulloch subsea installation;
- DP2 – MacCulloch intra field pipelines for the associated notices served under Section 29 of the Petroleum Act 1998.

The North Sea Producer Floating Storage and Offtake (FPSO) vessel was removed from the field in August 2015 and decommissioning of this vessel is the responsibility of the vessel owners, therefore, is not considered in this EA.

1.1 Location of the MacCulloch Field

The MacCulloch Field lies in United Kingdom Continental Shelf (UKCS) of the central North Sea Block 15/24b, approximately 170 kilometres (km) from Peterhead on the northeast coast of Scotland and, approximately, 44 km from the UK/ Norwegian median line. The field lies in a water depth of approximately 146 m (Figure 1.1).

The MacCulloch Field was developed in 1996-1997 using an FPSO, the North Sea Producer. Production commenced via the FPSO in August 1997, the field had an expected life of ten years. This vessel was owned by the North Sea Production Company Limited (NSPCL).

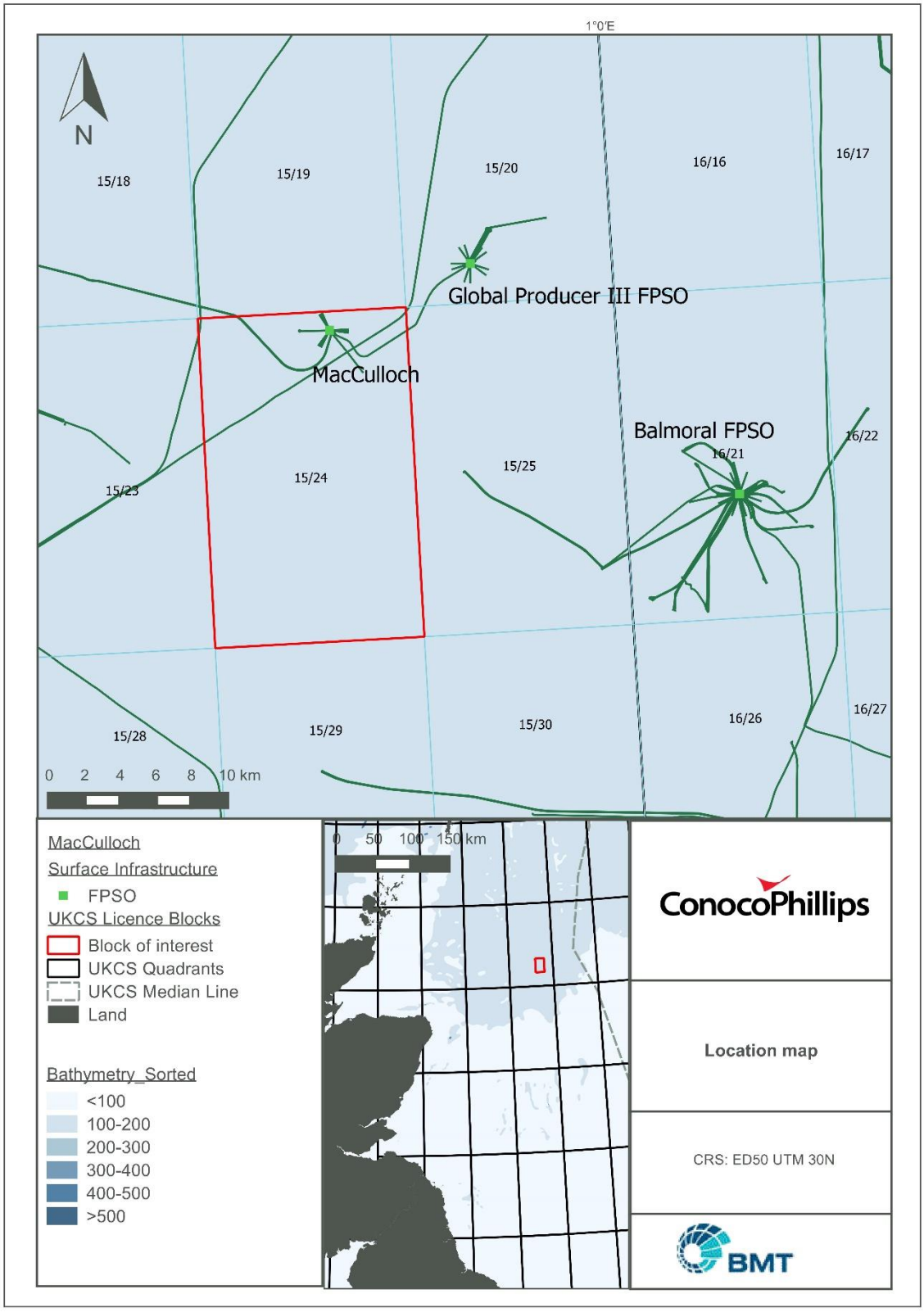

Figure 1.1: Location of the MacCulloch Field

1.2 Overview of MacCulloch Field and Operational History

The FPSO and subsea facilities were owned and operated by the NSPCL on behalf of ConocoPhillips.

The MacCulloch production was via two Drill Centres, west (WDC) and east (EDC), located 1.6 km and 2.9 km to the west and southeast of the vessel location, respectively. Ten gas lifted production wells produced through three flexible flowlines from WDC and one from EDC. Oil and gas were exported from the FPSO to the Repsol Sinopec Resources (RSR) operated Piper Bravo platform, through the RSR owned 10" oil pipeline and 6" gas pipeline (Figure 1.2).

The MacCulloch reservoir produced light crude, 32-37^{o} API. At the point of development, recoverable reserves were estimated at 58 mmbbls. At the Cessation of Production (CoP) on 3rd May 2015 the field had produced 119 mmbbls (a 50% recovery factor) from an initial estimated reservoir of 241 mmbbls.

Production declined from around 60,000 bbl/day at its peak, to around 7,200 bbl/day gross, with five wells remaining online and an average water cut of ~88%, prior to the CoP.

Decommissioning activities on the MacCulloch Field started on the 4th May 2015 following CoP.

The key target milestones within Phase 1 were as follow:

- 4th May 2015 Commencement of upstream flowlines flushing and cleaning;
- 22nd May 2015 Commencement of topsides flush and purge;
- 25th May 2015 Commencement of subsea flowline disconnection;
- 10th June 2015 Commencement of export pipelines flushing and cleaning;
- 6th July 2015 Commencement of riser disconnection;
- 13th July 2015 Commencement of mooring disconnection; and
- August 2015 NSP sailed away.

The first phase, involving thee disconnection and removal of the FPSO from the MacCulloch infrastructure, was completed by August 2015 and the vessel was taken to Teesside by the owners for reuse or recycling. During this initial phase of decommissioning works, pipelines were flushed and made hydrocarbon free and then risers were retrieved for recycling/ disposal.

In 2017 all the wells were successfully suspended with two isolation barriers (bridge plugs), using a Light Well Intervention vessel. Helix Well Enhancer Pressure gauges were installed in each well to allow ongoing monitoring of the well suspension barriers. The remaining MacCulloch infrastructure is envisioned to be decommissioned over a 5-year programme.

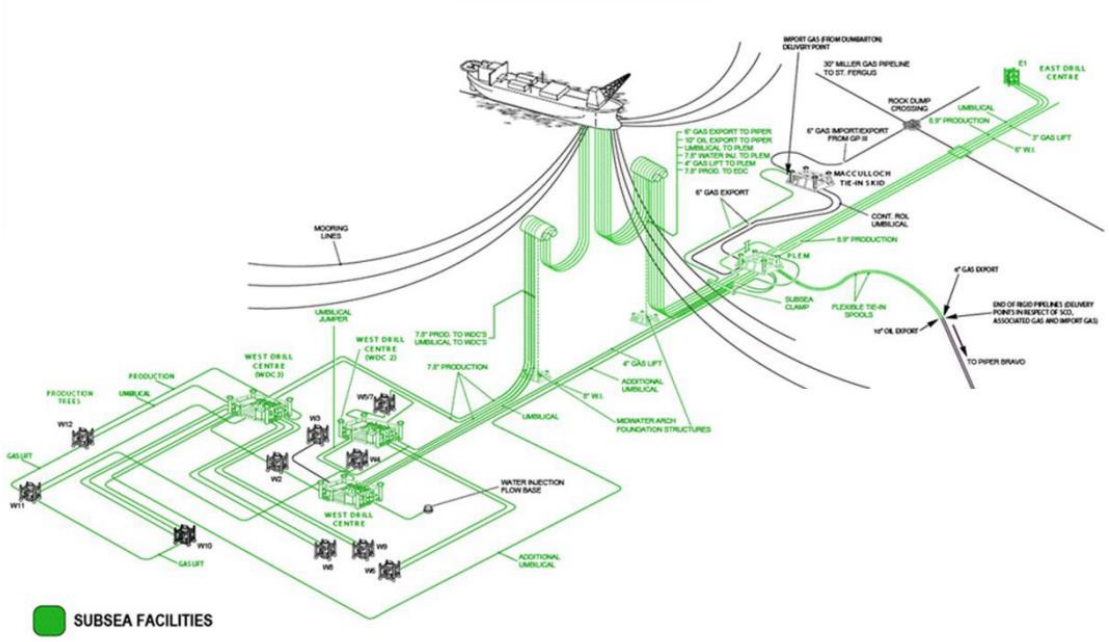

Figure 1.2: MacCulloch subsea facilities

The infrastructure highlighted in green in Figure 1.2 delineates the infrastructure for which the ConocoPhillips is responsible. In addition, the ConocoPhillips are also responsible for the mooring system, which currently rests on the seabed post disconnection from the FPSO.

1.3 Infrastructure not Included within Scope

Infrastructure not falling under ConocoPhillips' responsibility for decommissioning and not covered by this EA includes:

- The FPSO (owned by NSPCL)
- Rigid export pipelines (owned by Talisman-Sinopec)
- Infrastructure associated with the Dumbarton gas export tie-ins (owned by the Dumbarton Field owners, operated by Maersk Oil)

1.4 Overview of Decommissioned Infrastructure

The infrastructure within in the scope of the MacCulloch Decommissioning Project is summarised below, with full details of the infrastructure provided in the MacCulloch Field DPs:

- Two drill centres (EDC and WDC), comprising:
  - 13 wellheads;
  - Four manifolds (PLEM (including 2 SSIVs), WDCC1, WDC2, WDC3); and
  - 16 manifold piles.
- Two mid-water arch bases;
- Mooring system
  - Nine anchors connecting wires and chains;
- Fourteen flowlines;

- Five chemical/ control umbilicals;
- 510 concrete mattresses; and
- 98 tonnes of grout bags.

All drill cuttings were transferred to a skip and shipped onshore during the drilling of the MacCulloch wells (in line with ConocoPhillips' practice associated with wells drilled with oil-based muds). As a result, there are no contaminated drill cuttings present. This was confirmed with a survey conducted in 2012 (Fugro, 2013).

1.5 Purpose of the Environmental Assessment

EA is a systematic process of environmental assessment that considers how a project will change existing environmental conditions, and assesses the consequence and significance of such changes (Table 1.1). It is an iterative process that is generally initiated at a project's inception and provides an aid to project decision-making throughout the planning and design phases so that, where practical, potentially significant environmental effects can be mitigated at the source.

The purpose of the EA process is to understand and communicate the significant environmental impacts associated with the project options, to inform the decision-making process. To support the MacCulloch DPs, the EA process was conducted in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended). An EA document presents the findings of the environmental assessment (EA process) and has been prepared as part of the planning and consents process for the decommissioning of the MacCulloch Field Infrastructure.

Table 1.1: Key stages of the EA process for decommissioning

Environmental Assessment Stage	Description
Scoping	Allows the study to establish the key issues, data requirements, and impacts to be addressed in the EA and the framework or boundary of the study.
Consideration of alternatives	Demonstrates that other feasible approaches, including alternative project options, scales, processes, layouts, and operating conditions have been considered.
Description of project actions	Provides clarification of the purpose of the project and an understanding of its various characteristics, including stages of development, location and processes.
Description of environmental baseline	Establishes the current state of the environment on the basis of data from literature and field surveys, and may involve discussions with the authorities and other stakeholders.
Identification of key impacts and prediction of significance	Seeks to identify the nature and magnitude of identified change in the environment as a result of project activities and assesses the relative significance of the predicted impacts.
Impact mitigation and monitoring	Outlines the measures that will be employed to avoid, reduce, remedy or compensate for any significant impacts. Aspects of the project which may give rise to significant impact which cannot be mitigated to an acceptable or tolerable level of impact may need to be redesigned. This stage will feed back into project development activities.
Presentation of the Environmental Appraisal (EA)	Reporting of the environmental assessment process through production of an EA that clearly outlines the above processes. The EA provides a means to communicate the environmental considerations and environmental management plans associated with the project to the public and stakeholders.
Monitoring	Project impacts will be monitored during and after the decommissioning activities of the project to verify that impact predictions are consistent with the subsequent outcomes.

1.6 Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by Energy Act 2008 and 2016. The Petroleum Act 1998 (as amended) sets out the requirements for a formal DP, which must be approved by the Department for Business, Energy and Industrial Strategy (BEIS), before the owners of an offshore installation or pipeline may proceed.

At present there is no statutory requirement to prepare an Environmental Statement for decommissioning. However, under the *Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines* (BEIS, 2018a) the DP must be supported by environmental assessment and an EA fulfils this requirement.

The BEIS Guidance Notes state that an EA should include an assessment of the following:

- All potential impacts on the marine environment including exposure of biota to contaminants associated with the decommissioning of the installation; other biological impacts arising from physical effects; conflicts with the conservation of species with the protection of their habitats, or with mariculture; and, interference with other legitimate uses of the sea.
- All potential impacts on other environmental compartments, including emissions to the atmosphere, leaching to groundwater, discharges to surface fresh water and effects on the soil.
- Consumption of natural resources and energy associated with reuse and recycling.
- Interference with other legitimate uses of the sea and consequential effects on the physical environment.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

In addition, BEIS have advised the oil and gas industry that under the Marine and Coastal Access Act 2009 (MCAA) and the Marine (Scotland) Act 2010, an EA will be required for all licence applications relating to decommissioning operations.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom's (UK's) international obligations on the decommissioning of offshore installations. The Decision prohibits the dumping and leaving wholly or partly in place of offshore installations.

The Decision does not include the decommissioning of pipelines. There are no international guidelines on the decommissioning of disused pipelines. However, the UK Petroleum Act and Pipeline Safety Regulations 1996 provide a framework for the safe decommissioning of disused pipelines. The BEIS Guidance Notes state, "because of the widely different circumstances of each case, it is not possible to predict with any certainty what may be approved in respect of any class of pipeline". Therefore, all feasible pipeline decommissioning options should be considered and a Comparative Assessment (CA) carried out. Further regulatory drivers relevant to the MacCulloch Field DPs are provided in Appendix A.

The Decision is underpinned by the UNCLoS Convention, which entered into force in 1994 and was acceded by the UK in 1997. Article 60(30) specifically covers removal of abandoned or disused installations or structures. The UK has also signed up to the London Convention in 1972 (as amended), which is an agreement to ensure the prevention of marine pollution by dumping of wastes and other materials at sea.

Alongside this the UK Government has a moratorium on 'Dumping of Waste' which has been in force since 1999.

1.7 Report Structure

The structure for this EA is detailed in Table 1.2.

Table 1.2: The MacCulloch Field decommissioning EA structure

Section	Contents
Non-Technical Summary	A non-technical summary of the EA.
1. Introduction	An introduction to the project and the scope of the EA.
2. Methodology	The methodological approaches used in the environmental assessment process and a summary of the supporting reports and studies undertaken.
3. Project Description	A description of the decommissioning options and the recommended decommissioning option determined by a formal CA process.
4. Environmental and Socioeconomic Baseline	A description of the environmental and socioeconomic sensitives in the vicinity of the project area and the proposed decommissioning activities.
5. Initial Impact Screening	A provisional impact screening process to identify the potentially significant impacts for which further assessment will be undertaken and justification for any impacts/ receptors to be screen out.
6. Stakeholder Consultation	Details of the consultation process.
7. Energy and Emissions	Identification of potential sources of impact to environmental and societal receptors, cumulative and transboundary impacts, and details of practicable mitigation strategies.
8. Underwater Noise	
9. Seabed Footprint	
10. Societal Impacts	
11. Discharges to Sea	
12. Accidental Events	
13. Waste Management	Details the waste likely to be generated and the management processes to be implemented during decommissioning activities.
14. Environmental Management	A description of ConocoPhillips' environmental management procedures and how these will apply to the decommissioning of the MacCulloch Field infrastructure. This section also includes a register of commitments made within the EA.
15. Conclusions	Key findings and conclusions.
16. References	Sources of information used to inform the assessment.
Appendix A: Legislation	A summary of relevant environmental legislation.
Appendix B: Energy Use and Atmospheric Emissions Supporting Information	Additional information to support the Energy Use and Atmospheric Emissions Assessment (Section 7).

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2.0 METHODOLOGY

The EA systematically identifies significant environmental impacts and risks (potential impacts) associated with the project and assesses the requirement for impact/ risk mitigation measures. The objective of the EA process is to incorporate environmental considerations into project planning and design to ensure that best environmental practice is achieved.

This section of the EA describes the methods used to:

- Identify and evaluate the potential environmental (including social) impacts arising from the decommissioning of the MacCulloch infrastructure;
- Ensure an appropriate level of assessment is applied to the identified impacts, particularly those impacts identified as being significant; and,
- Identify actions needed, through design or management control, to avoid or mitigate the key anticipated impacts.

2.1 Environmental Assessment Process

An overview of the EA process used to identify and assess the impacts associated with decommissioning the remaining MacCulloch field infrastructure is provided within the DP and summarised in Section 1.5 of this EA document. For the EA the initial evaluation screening provides the context for the project, the options being considered and the environmental and socioeconomic setting. This is followed by risk identification and assessment in order to ascertain potentially significant impacts. The potential impacts then undergo a detailed assessment of the likelihood of impact and the subsequent consequences. Mitigation measures to eliminate or reduce the impacts are considered and a project specific environmental management plan is developed to assure compliance with environmental legislation and ConocoPhillips policies. Throughout the EA process consultation is conducted with the regulatory bodies and interested parties.

The potential impacts are assessed against matrices based upon the ConocoPhillips HSE Risk assessment Standard (Issue No.4). This assessment uses a likelihood and consequence matrix to score the impact to each group of receptors. This process is described in more detail in Section 5 of this EA document.

2.1.1 Screening

Screening is an integral part of the impact assessment process, the aim of which is to identify potential impacts to be assessed in greater detail within the EA. Screening is a two-stage process comprising:

- An initial identification of potential impacts, and
- A preliminary evaluation of significance based on available information.

An internal Screening Assessment was undertaken as part of the EA and it identified the potential environmental receptors and other considerations, which may be impacted by the proposed decommissioning operations (Figure 2.1).

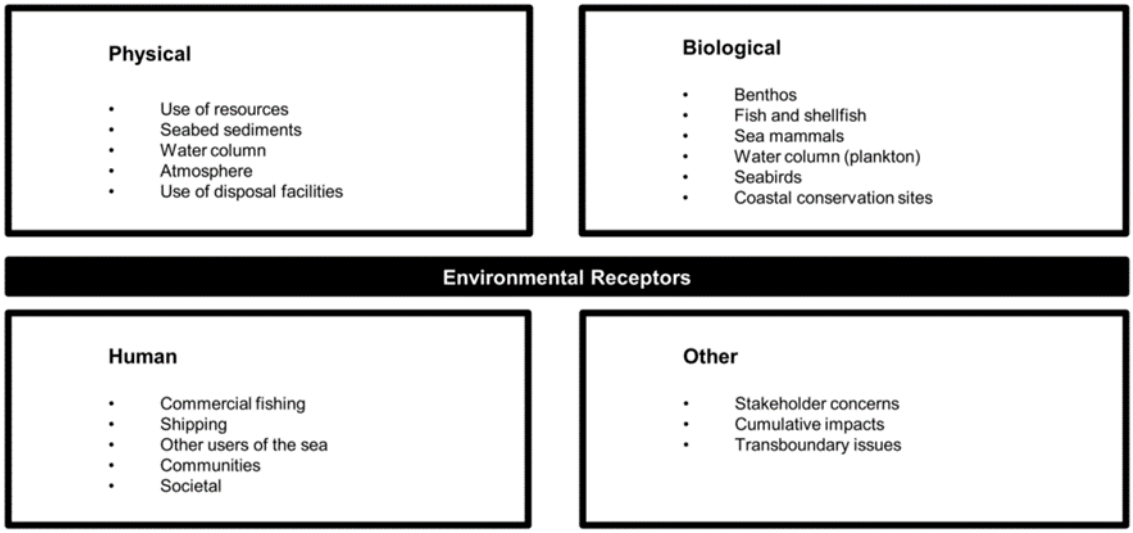

Figure 2.1: Environmental receptors

The activities identified during the screening exercise as having the potential to give rise to significant environmental or societal impacts or having specific stakeholder interest and require further discussion during the EA have been grouped into the following aspects.

- Seabed disturbance;
- Underwater noise;
- Accidental events;
- Energy use and gaseous emissions;
- Waste management.

These aspects were further validated and assessed through baseline assessments, modelling studies and stakeholder engagement.

2.1.2 Cumulative and transboundary impacts

The EA process also includes the identification of any potential cumulative or transboundary impacts that could be caused by the proposed decommissioning programme, when considered alongside other activities. The MacCulloch infrastructure is not located in any designated marine sites and there are no known decommissioning projects within 20 kilometres of the MacCulloch Field. Cumulative impacts occur as a result of a number of activities (e.g. discharges or emissions) combining or overlapping and potentially creating new and/ or increased impacts.

Transboundary impacts are those which could have an impact on the environment and resources beyond the boundary of UK waters. The Convention on Environmental Impact Assessment in a Transboundary Context (United Nations, 1991) addresses the need to enhance international co-operation in assessing transboundary environmental impacts.

2.2 Comparative Assessment

The MacCulloch pipelines and associated stabilisation materials were subject to a Comparative Assessment (CA) to identify the optimal decommissioning solution under the petroleum Act 1998. In order to determine the recommended decommissioning

options for this infrastructure, ConocoPhillips conducted a formal CA of possible decommissioning options to establish whether there were significant differences between the options considered and if so, which option performed the best.

Each decommissioning option was assessed against the five BEIS criteria:

- Technical feasibility;
- Environment;
- Societal:
- Safety; and
- Economic.

All pipeline and stabilisation material decommissioning options, including the subsequent selected option, are described in detail in the supporting CA reports (BMT, 2018). The CA identified full removal as the best performing option for both the pipelines and the stabilisation material. The primary drivers for these choices are provided in Table 2.1.

Table 2.1: Primary drivers behind selection of recommended option

Aspect	Feasibility	Safety	Environmental	Societal	Economic
Pipelines	Tried and tested removal methodology, not a probative length of pipeline to decommission.	Presents the lowest number of marine operations, therefore, reducing personnel exposure offshore.	No additional material required, seabed will recover over time. No residual degradation input of contaminated materials post decommissioning. Minimises post decommissioning monitoring. Lowest energy and emissions associated with this option.	No residual infrastructure to pose a risk to other users of the sea	Most cost efficient solution available. Approximately 33% more efficient than partial removal.
Stabilisation material	Majority of the mattresses are of polypropylene design.	Potential risks associated with removal and handling compared to leave in situ but these should be manageable through industry best practice.	No additional material required, no risk from degradation of plastics to the marine environment. Any seabed disturbance will recover over time. Minimises post decommissioning monitoring.	No or minimal residual infrastructure to pose a risk to other users of the sea	Marginal cost differential between full or partial removal, with full removal slightly more expensive (8% difference in cost).
Mooring system	Tried and tested methodology for removal, no major issues perceived in the removal process.	No significant risks perceived.	Minimises post decommissioning monitoring. Lowest energy and emissions associated with this option.	No residual infrastructure (the anchors proposed for in situ decommissioning are suitably buried) to pose a risk to other users of the sea	Most cost efficient solution. Approximately 50% more efficient than partial removal.

3.0 PROJECT DECRIPTION

This section provides a further detail of the MacCulloch infrastructure outlined in Section 1.4 and the proposed decommissioning options selected.

3.1 Overview

The removal and cleaning operations for the FPSO and pipeline cleaning and disconnection work was completed in September 2015. An Exchange of Correspondence (EoC) document was submitted for the removal of a number of pieces of infrastructure necessary to facilitate the disconnection and float-off of the FPSO. The EoC provided a vehicle for ConocoPhillips to execute decommissioning activities outside of an approved decommissioning programme being in place for the MacCulloch Field. In order to facilitate approval of the EoC, sufficient information and data were provided to BEIS to justify the decommissioning activities required and any anticipated impacts were discussed. The EoC included the removal of all risers, riser clamps and the two mid-water arch buoyancy tanks and associated tethers. All of the risers were removed when the FPSO sailed away in 2015.

The remaining pipeline infrastructure, stabilisation materials and mooring system are the focus of this EA. The infrastructure highlighted in Section 1.4 is described further in the following sections (Section 3.2, Tables 3.1 and 3.2). A CA was undertaken for this infrastructure and Table 3.3 presents the recommended options in each case.

3.2 Infrastructure to be Decommissioned

The project will include the decommissioning and removal of the following:

- Structures including the Pipeline End Manifolds (PLEM), Mid-water Arch (MWA) bases and manifolds;
- FPSO mooring system including drag anchors, mooring chains and spiral strand wire;
- Flowlines, jumpers and umbilicals;
- Mattresses and grout bags; and
- Subsea control modules.

The quantity and weight of infrastructure under consideration by the MacCulloch DPs are summarised in Tables 3.1 and 3.2.

Table 3.1: Summary of MacCulloch Field infrastructure covered by this EA

Item description	Quantity	Total length or dimensions (km)	Total weight in air (Te)
Flowlines	14	22.9	1,125.1
Umbilicals	5	5.7	638.10
Jumpers	54	2.9	110.21
Structures and piles	6	N/A	698.00
Mattresses	510	N/A	3,060.00
Grout	3,920	N/A	98.00
Subsea Control Modules	10	N/A	20.00

Source: PDi, 2014; ConocoPhillips, 2018a

A detailed inventory of the MacCulloch Field is provided in the MacCulloch Field Subsea Infrastructure – Stage 1 Materials Inventory report (D3 Consulting, 2015) and has been summarised in Table 3.2.

Table 3.2: MacCulloch Field infrastructure to be decommissioned

		Infrastructure								
		Rock-placement	Mattresses	Grout bags	Flowlines and umbilicals	Jumpers	Mooring system	Manifolds (including PLEM)	Mid-water arch bases	Total (Te)
Materials (Te)	Concrete	N/A	1,663.2	80.4	N/A	N/A	N/A	N/A	N/A	**1,743.6**
	Iron and steal	N/A	Unknown	N/A	1,575.1	96.7	1,530.0	320.0	260.0	**3,781.8**
	Plastic	N/A	Unknown	N/A	148.7	N/A	N/A	N/A	N/A	**148.7**
	Marine growth	N/A	7.1	0.2	39.4	1.1	26.6	139.4	62.4	**276.2**
	Other*	N/A	N/A	N/A	N/A	N/A	N/A	1.0	0.8	**27,436.8**
	Total	**N/A**	**1,670.3**	**98.0**	**1,763.2**	**97.8**	**1,556.6**	**460.4**	**323.2**	**33,404.5**

Source: D3 Consulting, 2015; ConocoPhillips, 2018a

*Other constitutes mixed construction and demolition wastes other than those mentioned in codes 170901, 170902 and 170903.

3.2.1 Structures

All field structures will be completely removed and recovered onshore for recycling, reuse (where possible) or disposal. It is anticipated that structures will be offloaded to a specialist decommissioning facility where they will be cleaned and over 97% of the materials will be recycled. ConocoPhillips will ensure that all structures, which are removed for recycling, re-use or disposal, will be transferred to a recognised and licensed decommissioning and disposal contractor.

Manifolds

The MacCulloch Field has three manifolds located at the West Drill Centre (WDC, WDC2 and WDC3). The WDC manifold contains the subsea controls and gas lift distribution system for the three original wells at the West Drill Centre. The WDC2 manifold commingled produced fluids from production wells 15/24b-W4 9when online) and 15/24b-W11. WDC3 distributed gas lift to production wells 15/24b-W8 and 15/24b-W11 and 15/24b-W12. The WDC3 manifold also allowed hydrocarbons from production wells 15/24b-W8, 15/24b-W10 and 15/24b-W12 to be diverted to either production flowlines 1 or 2. Each manifold is held in place using four piles, one at each corner (Figure 3.1).

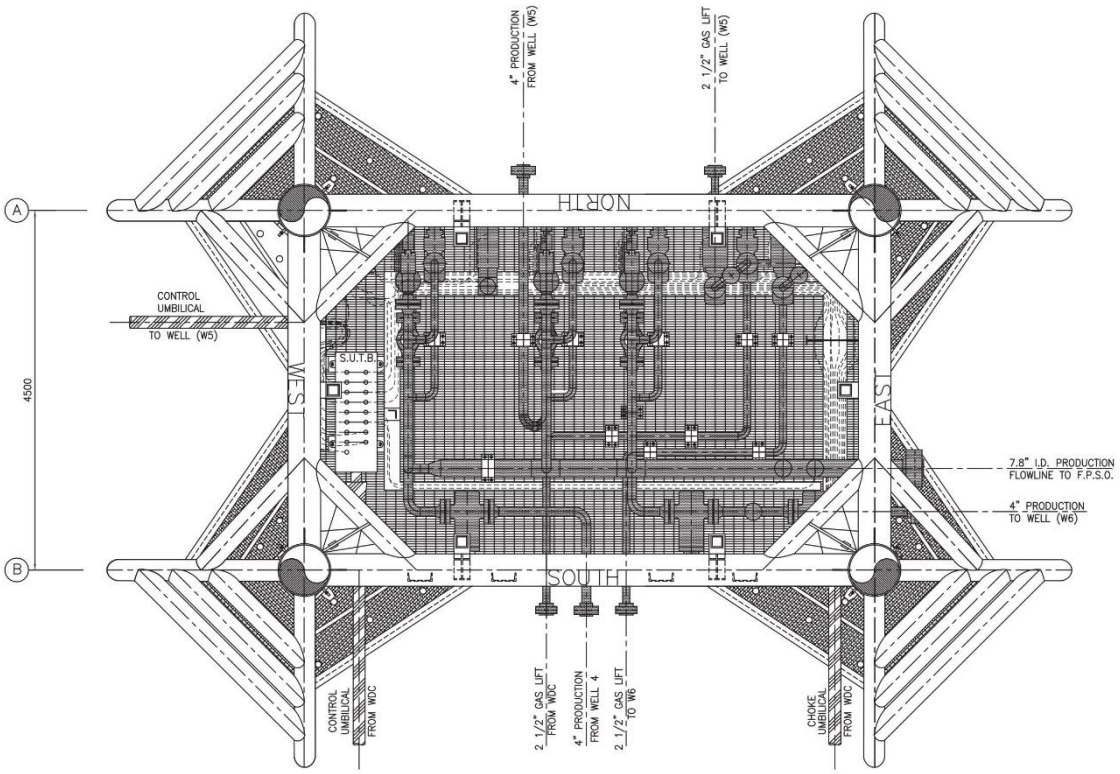

Figure 3.1: Plan view drawing of indicative MacCulloch manifold

A steel gravity base PLEM located 125 m southeast of the former FPSO location, distributed gas lift to the East and West drill centres, and contains the control facilities for the East Drill Centre. The 10” oil and 6” gas export pipelines to the piper Bravo platform are also routed via the PLEM. The gas export pipeline from the Dumbarton Field FPSO, the Global Producer III (GPIII), is tied into the 6” gas export line to the Piper Bravo platform, upstream of the PLEM in the MacCulloch tie-in skid. The MacCulloch tie-in skid

is outwith the scope of this decommissioning project. The PLEM is held in place with four piles, one at each corner (Figure 3.2).

The manifolds and the PLEM piles will be severed below the seabed by divers, and the structures will be recovered by a Construction Support Vessel (CSV).

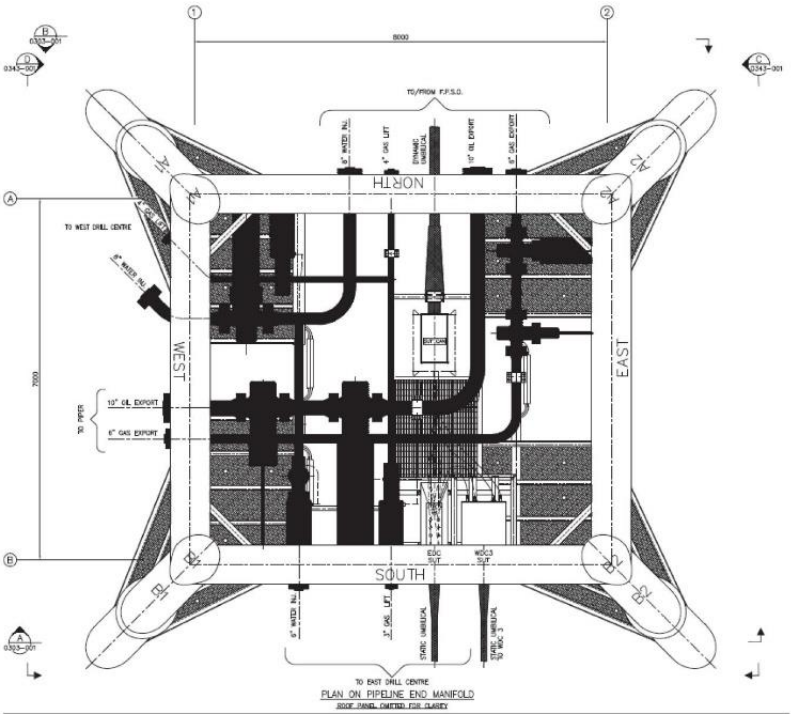

Figure 3.2: Plan view drawing of the MacCulloch development PLEM

MWA bases

Following the disconnection and removal of the FPSO, a number of structures were temporarily stored on the seabed (wet stored). MWA bases will be removed using a CSV under this programme.

An as left survey will be performed at each structure location, following removal to ensure the area is free of any remaining debris or dropped objects.

Wellheads

The MacCulloch Field has a total of 13 production trees. A typical tree structure is shown in Figure 3.3. During the FPSO disconnection, all tree valves were integrity tested and then disconnected from the flowlines. Blind flanges were installed and tested in place of the flowlines. Wells are currently subject to a visual and cathodic protection inspection regime during this period of suspension until the full Plug and Abandonment (P&A) programme is completed. The wells will be P&A'd in accordance with the Oil and Gas UK guidance for the suspension and abandonment of wells. This will include the removal of the wellheads. The P&A programme is outside of this decommissioning programme EA.

Figure 3.3: Typical tree structure

Subsea control units

There are 10 subsea control modules, which are associated with the monitoring, control and shut down functions for the subsea wells. These will all be removed from the seabed and recovered to shore for recycling/ reuse.

3.2.2 Flowlines, umbilicals and jumpers

The subsea production trees were tied back to the FPSO flexible risers by four flexible flowlines. Table 3.3 presents all the flowlines and umbilicals associated with the MacCulloch Field. Flowline survey data collected in 2010, 2012 and most recently in 2014, did not identify any areas of reportable freespan.

Data collected from ROV inspections during 2014 were analysed to ascertain the present condition of the flowlines. The total length of exposed flowline/ umbilical was calculated to be 995 m (ConocoPhillips, 2018a). This represents 4.3% of the total length of the flowlines and umbilicals for the whole field. The total length of flowlines/ umbilicals covered by mattresses was found to be 1,602 m, which represents 6.9% of the total length of flowlines and umbilicals for the whole field (ConocoPhillips, 2018a) (as shown in Table 3.3).

For the purpose of the MacCulloch decommissioning project, jumpers are considered to be any flowline or umbilical that links two structures over a short distance. Based on this definition the MacCulloch Field consists of 54 jumpers with a maximum diameter of 10”. All jumpers will be removed.

During the disconnection operations for the FPSO, all flowlines and umbilicals were cleaned and disconnected from the risers, trees, manifolds and tie-in skid. This included the cleaning of the oil and gas export lines. Rigid export pipelines were disconnected from the flexible pipelines. The following were conducted in order to disconnect the flowlines at the trees:

1. Confirmation of flooding from the FPSO and completion of isolation and barrier testing operation for the tie-in skid;
2. Installation by divers of flowline rigging to support the connection and restrain the movement of the flowline while disconnection was taking place;

3. Hold backs were attached between the flexible flowline and the tree structure or dead man anchor in case the flexible had any memory and sprung when the flange was disconnected. Air bags were attached to the flexible flowlines;
4. Divers assessed the preferred method of disconnection of the grayloc clamps;
5. Divers removed bolts from the grayloc clamp;
6. Divers de-rigged the flowline;
7. Pulled the flowline from the spool and placed flowline down on the seabed away from the tie-in skid;
8. Divers tie-wrapped and tagged the flowline to aid recognition during recovery operations; and
9. Confirmation that the flowline had been disconnected from the MacCulloch tie-in skid spool piece.

The flexibles and umbilicals at the PLEM, WDC, WDC2 and WDC3 were cut using a 4 tonne heavy-duty subsea hydraulic sheer.

During the CA process, a number of decommissioning options were considered for the flowlines and umbilicals. Based on the outcome of the CA, the recommended decommissioning option for the flowlines and umbilicals was full removal.

Table 3.3: Summary of flowline and umbilical inventory

Pipeline number	Description	Total length (km)	Year of installation	Contents	Status of line	Length exposed (m) [matressed]*	% exposed
PL1326	7.8" Production Flowline #1	1.6	1996	Crude oil	Not in use	16 [178]	1.00 [11.66]
PL1327	7.8" Production Flowline #2	1.4	1996	Crude oil	Not in use	20 [131]	1.43 [8.77]
PL1328	7.8" Production Flowline #3	1.5	1996	Crude oil	Not in use	38 [153]	2.53 [10.69]
PL1329	8" Production Flowline #4	2.8	1996	Crude oil	Not in use	83 [297]	2.96 [10.45]
PL1330	4" Gas Lift Flowline	2.3	1996	Gas	Not in use	65 [89]	2.83 [4.88]
PL1331	3" Gas Lift Flowline	2.8	1996	Gas	Not in use	57 [76]	2.03 [2.74]
PL1332	8" Water Injection Flowline	2.0	1996	Chemicals	Not in use	52 [131]	2.60 [7.14]
PL1333	6" Water Injection Flowline	2.8	1996	Chemicals	Not in use	49 [115]	1.75 [4.09]
PL1334 PL1334.1-5	Chemical/ Control Umbilical	2.3	1996	Chemicals, Hydraulic fluids	Not in use	562 [0] surface laid [160]	24.4 [**]
PLU1334JW10	Chemical/ Control Umbilical	0.1	1996	Chemical, Hydraulic fluids	Not in use	surface laid [**]	N/A [**]

PLU1334JW11	Chemical/ Control Umbilical	0.1	1996	Chemical, Hydraulic fluids	Not in use	surface laid [**]	N/A [**]
PLU1334JW12	Chemical/ Control Umbilical	0.1	1996	Chemical, Hydraulic fluids	Not in use	surface laid [**]	N/A [**]
PL1335	Chemical/ Control Umbilical	3.0	1996	Power	Not in use	53 [272]	[9.48]
PL1336	10” Oil Export	0.1	1996	Crude oil	Not in use	on seabed, within PLEM [0]	N/A
PL1337	6” Gas Export	0.1	1996	Gas	Not in use	on seabed, within PLEM [0]	N/A
PL2569	2.5” Gas Lift	0.1	1996	Gas	Not in use	surface laid [**]	N/A [**]
PL2571	2.5” Gas Lift	0.1	1996	Gas	Not in use	surface laid [**]	N/A [**]
	Field Total	**23.2**				**995 [1,602]**	**4.3 [6.9]**

Source: ConocoPhillips, 2018a

* Lengths rounded to nearest metre; **Unknown

3.2.3 Stabilisation materials

The stabilisation materials at the MacCulloch Field primarily consist of concrete mattresses and grout bags. These had been deployed across the field to provide stabilisation and protection cover to the pipelines, pipeline crossings and subsea equipment deployed across the field. All the mattresses are connected using polypropylene and although their age is not exactly known, they were all manufactured post 1995. An estimated total of 510 concrete mattresses is expected to be associated with the MacCulloch subsea infrastructure. The dimensions of the mattresses have been estimated from engineering drawings for the field, and generally are 6 m long, 3 m wide and 0.3 m high. An indicative example of the mattress configuration used is represented in Figure 3.4

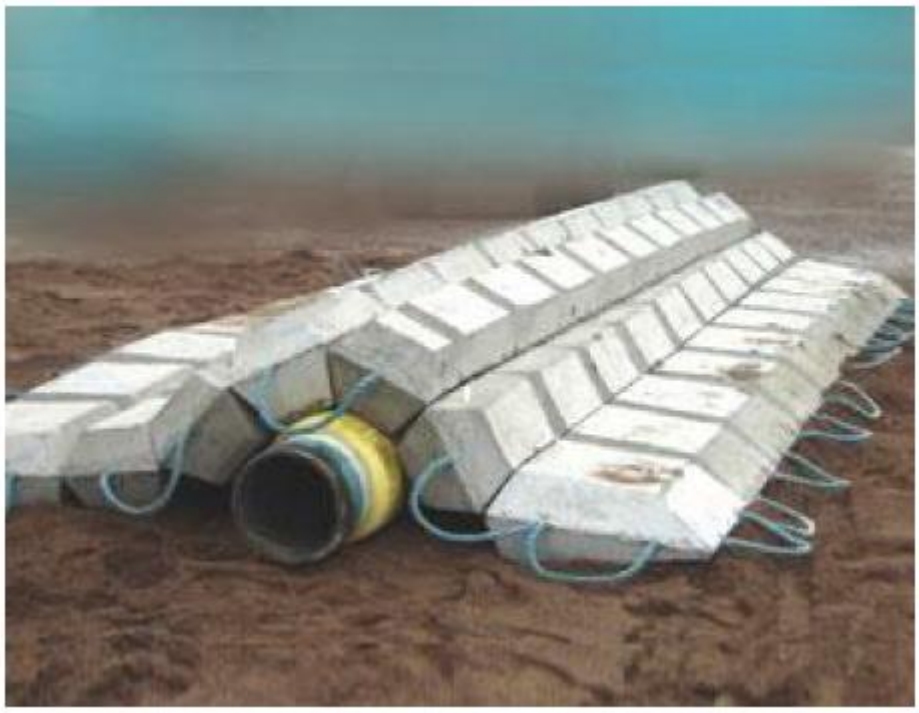

Figure 3.4: Example of concrete mattresses

Given the age and burial status of the concrete mattress deployed in the MacCulloch Field and the hydrodynamic conditions present within the region there should be no technical issues preventing the safe removal of these structures. However, for the purposes of ensuring all aspects of the project were thoroughly assessed ConocoPhillips undertook a CA of all viable removal options for the concrete mattresses. This assessment recommended the mattresses to be decommissioned in situ, but there was a marginal difference between this option and full removal. On this basis and accounting for the fact that the CA recommended full removal of the pipelines there would be no real justification to leave the mattresses behind following the removal of the pipework. Therefore, ConocoPhillips propose to remove all exposed concrete mattresses, however, in the event of practical difficulties or unacceptable safety risk OPRED will be consulted. These mattresses will be returned to shore for recycling or reuse, where possible.

There are approximately 98 tonnes of grout bags (approximately 2,800 individual grout bags) deployed on the seabed within the field. ConocoPhillips will endeavour to remove

all exposed grout bags, however, in the event of practical difficulties OPRED will be consulted.

It is currently proposed that the method of removal for both the mattresses and grout bags would be by means of a CSV and a speed loader recovery system.

3.2.4 Mooring system

There are nine anchors and mooring chains to be decommissioned on the MacCulloch Field, full details of these are provided in the DP and the materials inventory report (ConocoPhillips, 2018a; PDi, 2015c) and the MacCulloch Field Inventory Report (PDi, 2014). The anchors are buried and, since removal would involve extensive seabed disturbance, they will be left in situ.

The mooring lines were connected to the FPSO turret and held in position using a typical anchor leg layout. The mooring lines each consist of 425 m of chain and 650 m of spiral strand wire terminating at drag anchor. When the FPSO was disconnected from the mooring chains, these chains were deposited on the seabed, until the remaining subsea infrastructure will be decommissioned. The mooring system was assessed as part of the CA and the recommendation was for the anchors to be left in situ. The mooring chains and wires will be lifted and at the point of burial, the chains/ wires will be excavated to a nominal depth (minimum of 0.6 m below mean seabed) and cut. The cut chains will be recovered and transported to shore for reuse or recycling. On completion, overtrawlability trials will be undertaken at each anchor location.

3.3 Overview of the CA Process and Selected Options

This section provides a summary of the CA process and summaries the main decommissioning options considered for the MacCulloch decommissioning project. In line with legislative requirements, where consideration had been given for aspects of the infrastructure to be decommissioned in situ, ConocoPhillips undertook a CA which assessed the technical feasibility, safety, environmental, societal and economic aspects associated with each of the proposed decommissioning options for the pipelines, stabilisation materials and mooring system and provided a recommend decommissioning method for each.

3.3.1 MacCulloch CA process

To support the process a number of independent studies were commissioned, these included:

- Pipeline Degradation Study (PDi, 2015a).
- Pipeline Historical & Present Conditions Assessment (PDi, 2015b).
- Decommissioning Option Selection Report (PDi, 2015c)
- Marine Growth Assessment (RPS, 2015).

The CA covered three distinct groupings of infrastructure where a leave in situ decommissioning method had been screened as a viable consideration, these were:

- Flowlines and umbilicals;
- Stabilisation materials (concrete mattresses and grout bags); and
- FPSO mooring system.

All feasible decommissioning options for the subsea infrastructure were considered prior to the start of the option selection process and these were detailed in the PDi Option Selection Report (PDi, 2015c).

A high level screening assessment was undertaken to refine these options further prior to the full CA; justification was provided in the CA report for any options that were screened out at that stage (Table 3.4). The shortlisted options, which were carried forward to the full CA, are presented in Table 3.5.

Separate assessments and scoring was applied to the three groupings of infrastructure, then the scores were weighted and normalised to allow comparison between the criteria. The assessment criteria and matrices were based on ConocoPhillips' Health, Safety and Environment Risk Matrix Standard (Issue No.4).

Table 3.4: Decommissioning options screened out and justification

Flowlines and umbilicals	
Option	**Justification**
Decommission in situ – No intervention	Discarded – Residual risk and liability to other users of the sea is present due to over 1,000 m of pipeline being exposed. This appears to be relatively stable over time but unmitigated presents a degree of risk. This option also will require a monitoring programme post decommissioning.
Decommission in situ – Burial of exposed sections	Discarded – There is no technical or safety reason to justify decommissioning in situ and leaving a legacy risk to other uses of the sea or the associated cost uncertainty of monitoring the pipeline post decommissioning.
Decommission in situ – Rock placement on exposed sections	Discarded – There is no technical or safety reason to justify decommissioning in situ and leaving a legacy risk to other uses of the sea or the associated cost uncertainty of monitoring the pipeline post decommissioning.
Stabilisation materials	
Option	**Justification**
Decommission in situ – No intervention	Discarded – Risk and liability present due to risk of fishermen snagging on material.
Remove from pipeline and leave on seabed	Discarded – Risk and liability present due to risk of fishermen snagging on material.
Relocate mattress and cover with rock	Discarded – Did not meet the ConocoPhillips' decommissioning philosophy due to the addition of further substrate and increased environmental disturbance and impact and energy and emissions required in the operation.
Relocate and bury mattresses in an excavated hole	Discarded - There is currently no known industry experience of performing this operation to the scale considered in MacCulloch. The challenge associated with backfilling such an excavation is significant.
Reuse mattresses	Discarded – This option has been discounted on the basis that ConocoPhillips have identified no potential reuse locations at MacCulloch for concrete mattresses.
Mooring system	
Option	**Justification**
Decommission in situ – No intervention	Discarded – The residual liability risk to other users of the sea due to surface laid anchor chain.
Decommission in situ – Burial of exposed sections	Discarded – There is no known experience for trenching a mooring line. The alternative to use a mass flow excavator is deemed impracticable. There is also uncertainty over trenching equipment to be used and whether a specific weather window would be required.

Table 3.5: Shortlisted decommissioning options considered during the CA

Flowlines and umbilicals		
Decommissioning options	**Method**	**Description**
Partial removal and burial	Cut and lift	Only exposed/ spanned sections of pipeline would be removed. Cut ends of pipelines would be covered by rock-placement. Reasonable attempts to remove all mattresses would be undertaken where safe to do so. Any remaining pipeline would be left open, ends covered with rock and flooded with seawater. Ongoing survey monitoring required post-decommissioning.
Full removal	Cut and lift*	Pipelines would be exposed using jetting methods (as required) and would be removed by cutting with an underwater pipe cutter. Cut pipeline sections would then be lifted onto a vessel for transportation to shore. Reasonable attempts to remove all mattresses would be undertaken where safe to do so. No ongoing monitoring required post-decommissioning.
Stabilisation material		
Decommissioning options	**Method**	**Description**
Decommission in situ (with remedial action if required)	Leave mattresses in situ	Decommission mattresses in current state. Any mattresses which require overtrawl remediation would be covered with rock. Ongoing survey monitoring would be required.
Full removal	Mattresses lifted and removed for onshore disposal	All mattresses will be completely removed from the seabed and returned to shore. It is assumed a speed loader will be used to recover the mattresses. No ongoing survey required post-decommissioning.
Mooring system		
Decommissioning options	**Method**	**Description**
Partial removal	Cut and recover exposed mooring string	Only exposed/ spanned sections of mooring system would be removed. Any remaining mooring system would be left buried. Ongoing monitoring would be required.
Full removal	Complete removal by cut and lift	The mooring system will be completely removed from the seabed and recovered to shore. No-ongoing monitoring required.

*Alternatively cutting and pulling out the lines is also considered. However, as a worst-case scenario with the biggest potential impact, only cut and lift is discussed further.

3.3.2 CA results

The following section presents a summary of the CA results. Full details of the CA process and the workshop results can be found in the MacCulloch CA Report (BMT, 2018). The recommended options following the comparative assessment are presented in Table 3.6.

Table 3.6: CA recommendations

Infrastructure type	Recommendation
Flowlines and umbilicals	**Full removal** – Removes any ongoing liability and negates any requirements to further monitoring or remediation post-decommissioning. However, it should be noted that there may be some elements of the pipework such as crossings which may not be feasible to remove. In these instances, it may be possible to consider decommissioning these elements in situ, providing they be accurately mapped and a suitable monitoring programme is agreed with OPRED.
Stabilisation materials	**Decommissioned in situ** – the CA would support a decommission in situ approach and has already demonstrated that there are minimal impacts from this providing adequate mitigation is put in place. Given that OPRED expects operators to target a clean seabed post-decommissioning, ConocoPhillips can find no evidence to justify decommissioning the mattresses in situ unless there is a failure during the removal of a mattress. In this case, ConocoPhillips has considered the risk of decommissioning in situ the mattresses and any residual risk, liability and monitoring commitments and has decided to fully remove all concrete mattresses where safe to do so. Should there be a technical issue during the removal and a mattress cannot be safely removed, the CA supports a decommission in situ approach providing adequate mitigations and suitable monitoring programme is put in place.
Mooring system	**Full removal** (where physically possible) – Given that the anchors are significantly buried, physical removal may be difficult. If removal is attempted, there will be a degree of sediment disturbance and a residual seabed depression left behind which would most likely require remediation (via rock-placement).

ConocoPhillips have decided to deviate from the recommended option for the stabilisation material and the mooring system. The rationale for the deviation from "decommission in situ" for the stabilisation material was on the grounds that ConocoPhillips are planning to remove all pipelines, which will require to move mattresses to gain access, therefore, could find no evidence to justify leaving the stabilisation material behind, unless there is failure during the removal process. As a result, mattresses would be removed at the same time. This will also minimise any residual risk to other users of the sea in the future. The rationale for departing from the recommendation of "full removal" for mooring system was that further analysis of the current state of burial indicates that the anchors are significantly buried in the sediment and would pose negligible risk to other users of the sea. To excavate the seabed would cause disturbance to the seabed and the water column, given the relatively stable seabed this may take a number of years to return to its natural state. As a result, ConocoPhillips are proposing a partial removal scenario where the anchor chains will be removed to at least 0.6 m below mean seabed and the anchor piles will be decommissioned in situ with an ongoing monitoring programme, as agreed with BEIS.

3.4 Post-decommissioning Activities

Recent surveys of the MacCulloch facilities have identified minimal debris accumulation throughout the production life of the field (Fugro, 2013). Debris surveys by ROV will be conducted to ensure that this debris and arising from decommissioning activities is identified and recovered. An overtrawl trial will be conducted within the 500 m safety exclusion zone and around the East and West drill centres. Upon verification of the seabed clearance by an independent organisation, a clearance certificate will be provided by the Scottish Fishermen's Federation (SFF) and presented to BEIS.

3.4.1 As left surveys

Surveys will be carried out for the areas where infrastructure has been removed. Surveys will also be carried out for the areas where elements of the flowlines and umbilicals, stabilisation materials and the mooring system have been decommissioned in situ due to technical issues arising during removal.

3.4.2 Monitoring programme

Following the initial post decommissioning survey work, ConocoPhillips will undertake a monitoring programme for any infrastructure that remains in situ. The format and duration of this monitoring programme will be agreed with BEIS once all decommissioning activities have ceased and the final fate is known of the infrastructure being decommissioned and to what extent, if any, this infrastructure has been decommissioned in situ.

3.5 Project Schedule

The proposed schedule for undertaking the decommissioning activities at the MacCulloch Field is presented in Figure 3.5. The schedules time windows for the subsea infrastructure do not indicate continuous work, but rather show the anticipated timescale for decommissioning activities, whilst allowing for flexibility with contractors to achieve an efficient and cost effective decommissioning project. The schedule does not account for the ongoing survey and maintenance regime for any infrastructure decommissioned in situ as the proposed options primarily aim to remove the subsea infrastructure unless technical issues prevent this from being possible.

ConocoPhillips anticipates that the removal of pipeline and subsea infrastructure will be completed in one summer season (Figure 3.5).

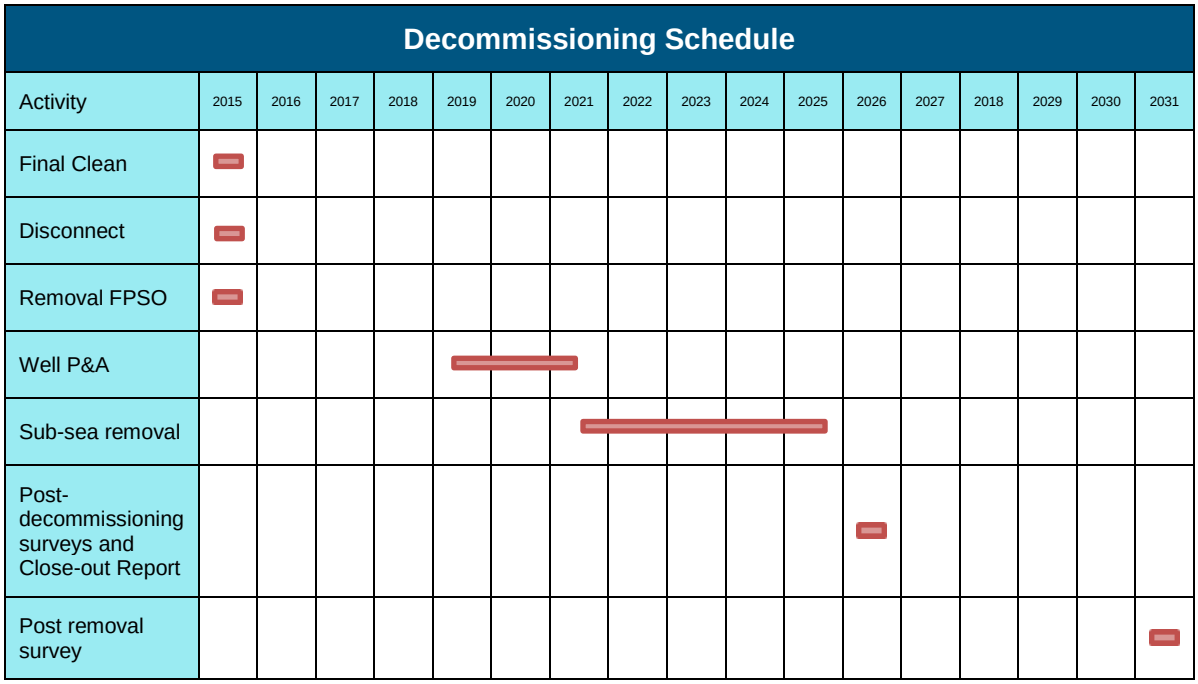

Figure 3.5: Anticipated project schedule

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4.0 ENVIRONMENTAL AND SOCIOECONOMIC BASELINE

This section describes the baseline environmental setting of the proposed area within which decommissioning activities will occur and only discusses those components of the physical, chemical, biological and socioeconomic environments that might be sensitive to the potential impacts arising as a result of the proposed activities. An understanding of the environmental and socioeconomic sensitivities at the local and regional level informs the assessment of the environmental societal impacts and risks associated with decommissioning activities.

The MacCulloch subsea infrastructure is located within the UKCS Block 15/24 in the central North Sea (Figure 1.1).

Table 4.1 provides a summary of the environmental and societal baseline within the vicinity of the MacCulloch Field.

Table 4.1: Summary of Environmental and societal sensitivities in the vicinity of the MacCulloch Field

Aspect	Detail
Site overview	
The MacCulloch subsea structure to be decommissioned is located within Block 15/24b in the UK sector of the central North Sea, 170 km NE of Peterhead in water depth of, approximately 146 m.	
Environmental Aspects <50 km	
Conservation Interests	
Offshore Marine Protected Areas and Annex I habitats	
Scanner Pockmark Special Area of Conservation (SAC)	Designated for submarine structures made by leaking gases (JNCC, 2018a). Located 10.5 km east of the MacCulloch Field.
Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA)	Designated due to the presence of ocean quahog (*Arctica islandica*), which is listed on an OSPAR threatened and/ or declining species (JNCC, 2018b). Located 52 km southeast of the MacCulloch Field.
Offshore Annex II species	
Harbour porpoise	Sightings In Quadrant 15 and surrounding quadrants range from low to very high throughout the year. The highest abundance of harbour porpoise in Quadrant 15 has been recorded during July (high) (UKDMAP, 1998; Reid et al., 2003; Hammond et al., 2017).
Bottlenose dolphins	Reid et al., (2003) suggest there could be some bottlenose dolphin presence in the area, however, this is not supported by UKDMAP (1998) or Hammond et al. (2017).
Grey seals	Grey seal density along the decommissioning area ranges from 0 to 1 seals per 5 km^2 (NMPI, 2018). There are no haul-out or breeding sites in the vicinity of the MacCulloch decommissioning area.
Harbour seals	Harbour seal density along the decommissioning area ranges from 0 to 1 seals per 5 km^2 (NMPI, 2018). There are no haul-out or breeding sites near the MacCulloch decommissioning area.
Plankton	

Aspect	Detail
Plankton in the area surrounding the MacCulloch subsea infrastructure is typical for this area of the North Sea. Dominant phytoplankton species are dinoflagellates of the genus Ceratium, including *C. fusus*, *C. furca* and *C. lineatum*. High numbers of the diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. are also present. The zooplankton community comprises *Calanus finmarchicus* and *C. helgolandicus* as well as *Paracalanus* spp., *Pseudocalanus* spp., *Acartia* spp., *Temora* spp. and cladocerans such as *Evadne* spp. (OESEA, 2016).	
Benthic environment	
Seabed sediments	The seabed sediments of the MacCulloch survey area were classified as the habitat SS.SMu.OMu, offshore circalittoral mud. The species present within the grab stations were broadly similar to the biotope SS.SMu.OMu.LevHet, offshore circalittoral mud and sandy mud (Fugro, 2013).
Benthic fauna	Macrofaunal analysis of the survey samples collected around the North Sea Producer FPSO, the produced water discharge location and the east and west drill sites indicated that numbers of taxa and individuals were moderate to high across the survey area and comparable with those recorded in previous surveys in the area (Fugro, 2013). Across the survey area, the macrofaunal communities comprised of species consistent with sediments of very fine and silty sands. Overall, approximately 48.8% of taxa were annelids, 25.3% arthropods, 16.7% molluscs, 3.7% echinoderms and 5.6% other phyla (e.g. nemerteans, phoronids and cnidarians) (Fugro, 2013).
Socioeconomic Aspects	
Fish and shellfish – spawning and nursery areas	
Spawning areas	There are spawning areas for cod, *Nephrops* and Norway pout within ICES rectangle 45F0 and Block 15/24 (Coull et al., 1998; Ellis et al., 2010).
Nursery areas	There are potential nursery areas in the ICES rectangle 45F0 for anglerfish, blue whiting, cod, European hake, herring, ling, mackerel, *Nephrops*, Norway pout, sandeel, spotted ray, spurdog and whiting within ICES rectangle 45F0 and Block 15/24. Sprat also have potential nursery areas within ICES rectangle 45F0 (Coull et al., 1998). A high probability of age 0 (juveniles) anglerfish and medium probability for European hake have been reported within Block 15/24 (Aries et al., 2014).
Marine Mammals	
Cetaceans	Minke whale, killer whale, white-beaked dolphin, white-sided dolphin, Risso's dolphin and harbour porpoise have been sighted in the decommissioning area (Quadrant 15 and surrounding quadrants) (UKDMAP, 1998). Reid et al., (2003) also indicate the presence of bottlenose dolphins within Quadrant 15.
Seals	Grey and harbour seals can be potentially found in Block 15/24 and surrounding blocks in very low density (NMPI, 2018).

Cetaceans in Quadrant 15 and surrounding quadrants

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbour porpoise	L	M		L	**VH**	**L**	H	M	**L**	**L**		**VH**
Minke whale					**L**	L		**L**				
Common dolphin								**L**				
Killer whale											L	
Risso's dolphin							**L**					
White-beaked dolphin		**M**	M		**M**	**L**	**H**	**L**	**M**	**L**	M	**L**
White-sided dolphin							**VH**	**L**	**H**			

VH	Very high	H	High	M	Moderate	L	Low		No data

Aspect	Detail
Seabirds	
The most common species of seabird found in the MacCulloch area include: Arctic Skua, Arctic Tern, Black Guillemot, Common Gull, Cormorant, Fulmar, Gannet, Great Black-backed Gull, Great Skua, Guillemot, Herring Gull, Kittiwake, Lesser Black-backed Gull, Little Auk, Manx Shearwater, Razorbill, Puffin, Shag, Sooty Shearwater and Storm Petrel (Stone at al., 1995).	
Seabird sensitivity	Seabirds density maps indicate that particularly fulmar and kittiwake are abundant in the area throughout the year (Kober et al., 2010). Seabird sensitivity to surface pollution has been recorded as medium to low between January and October with no data available for November and December in Block 15/24. Very high sensitivity was recorded in January and December in neighbouring Block 15/28 (Webb et al., 2016).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Block 15/18	5	5	5	4	4	5	5	5	4	4	ND	ND
Block 15/19	5	5	5	5	5	5	5	5	5	5	ND	ND
Block 15/20	5	5	5	5	5	4	5	5	5	5	ND	ND
Block 15/23	5	5	5	4	4	5	5	5	4	4	ND	ND
Block 15/24	5	5	5	5	5	4	5	5	4	4	ND	ND
Block 15/25	5	5	5	5	5	4	5	5	5	5	ND	ND
Block 15/28	2	5	5	4	4	5	5	5	4	4	ND	2
Block 15/29	5	5	5	5	5	5	5	5	4	4	ND	ND
Block 15/30	5	5	5	5	5	5	5	5	5	5	ND	ND

Key – seabirds sensitivity (ND – no data); red – interpolated data

1	Extremely high	2	Very high	3	High	4	Medium	5	Low

Socioeconomic	
Fisheries	Commercial fisheries landings were 4,707 tonnes with a value of £5,426,970 for 2017 within ICES rectangle 45F0. Demersal, pelagic and shellfish species were targeted with majority of catches attributed to pelagic species. In 2017 the main fishing gear were trawls (Scottish Government, 2018).
Shipping	Overall shipping density near the MacCulloch field is considered low (BEIS, 2017).
Oil and gas industries	There are several fields within 10 km of the MacCulloch field, including Nicol (4.8 km southeast), Donan (7 km northeast) and Galley (8.3 km southwest). The closest surface infrastructure is the FPSO Global Producer III, located 8.2 km northeast of the MacCulloch field. There are also 31 wells within Block 15/24 and 23 pipelines that intersect the block (UK Oil and Gas Data, 2018).
Offshore renewables	There are no current or proposed windfarms located within, or near Block 15/24 (Crown Estate, 2018).
Aggregate activities	There are no designated aggregate extraction areas near Block 15/24 (Crown Estate, 2018).
Carbon Capture and Storage (CCS)	Goldeneye CCS agreement for lease is located 63 km southwest from the MacCulloch Field (Crown Estate, 2018)
Military activities	There is no military activity expected within 100 km of the MacCulloch Field (Defra, 2018).
Wrecks	There are no chartered wrecks within Block 15/24 (NMPI, 2018)
Telecommunications	There are no submarine cables which intersect, or lie close to, Block 15/24 (NMPI, 2018).

4.1 Pre-decommissioning Environmental Baseline Survey (EBS)

ConocoPhillips commissioned an environmental sampling programme around the MacCulloch Field in August 2012. The main objectives of the programme were to determine the current status of the seabed quality at the MacCulloch Field and investigate any evidence of features that might qualify as protected habitats in the area.

A total of 18 sampling locations were identified, that included eight push cores from within 10 metres and 20 metres (utilising a cruciform sampling plan) of the North Sea Producer FPSO and four from around the east and west drill centres (Table 4.2 and Figure 4.1). Sediment samples were also collected from the area below the produced water discharge point and outward along the dominant northerly current. A single reference sample station to the north was also collected at five kilometres from the FPSO (station 9) (Fugro, 2013).

Samples were collected for quantitative macro-faunal analysis (three replicates) and a separate sample for chemical and physical analysis were retrieved by framed van Veen grab (station 9 and stations 14 to 18) and push cores collected by ROV (all other stations).

Table 4.2: Environmental sample station positions and sample method

Station Number	Distance and Bearing from Centre*		Averaged Actual Sampling Locations*		Sampling Method
	(metres)	(°)	Easting	Northing	
MacCulloch FPSO					
1	10	202	366837.84	6467209.97	Push core
2	20	202	366833.00	6467200.62	Push core
3	10	338	366837.34	6467226.96	Push core
4	20	338	366832.50	6467236.83	Push core
5	10	22	366844.60	6467228.11	Push core
6	20	22	366848.25	6467237.61	Push core
7	10	158	366845.29	6467209.33	Push core
8	20	158	366848.39	6467200.37	Push core
9	5000	0	366840.49	6472218.51	Grab
Produced Water Discharge Point					
10	0	0	366840.63	6467218.80	Push core
11	20	0	366841.29	6467238.92	Push core
12	50	0	366839.89	6467268.08	Push core
13	100	0	366840.96	6467318.56	Push core
14	1000	0	366841.32	6468218.41	Grab
West Drill Centre					
15	111	0	365140.10	6467382.75	Grab
16	112	275	365028.97	6467280.10	Grab
East Drill Centre					
17	52	93	368492.23	6464651.19	Grab
18	100	3	368444.94	6464748.94	Grab

* All positions are based upon International Spheroid European Datum 1950 (ED50) using the Universal Transverse Mercator (UTM) Projection, Zone 31N, referenced to a central meridian of 0° east.

Source: Fugro, 2013

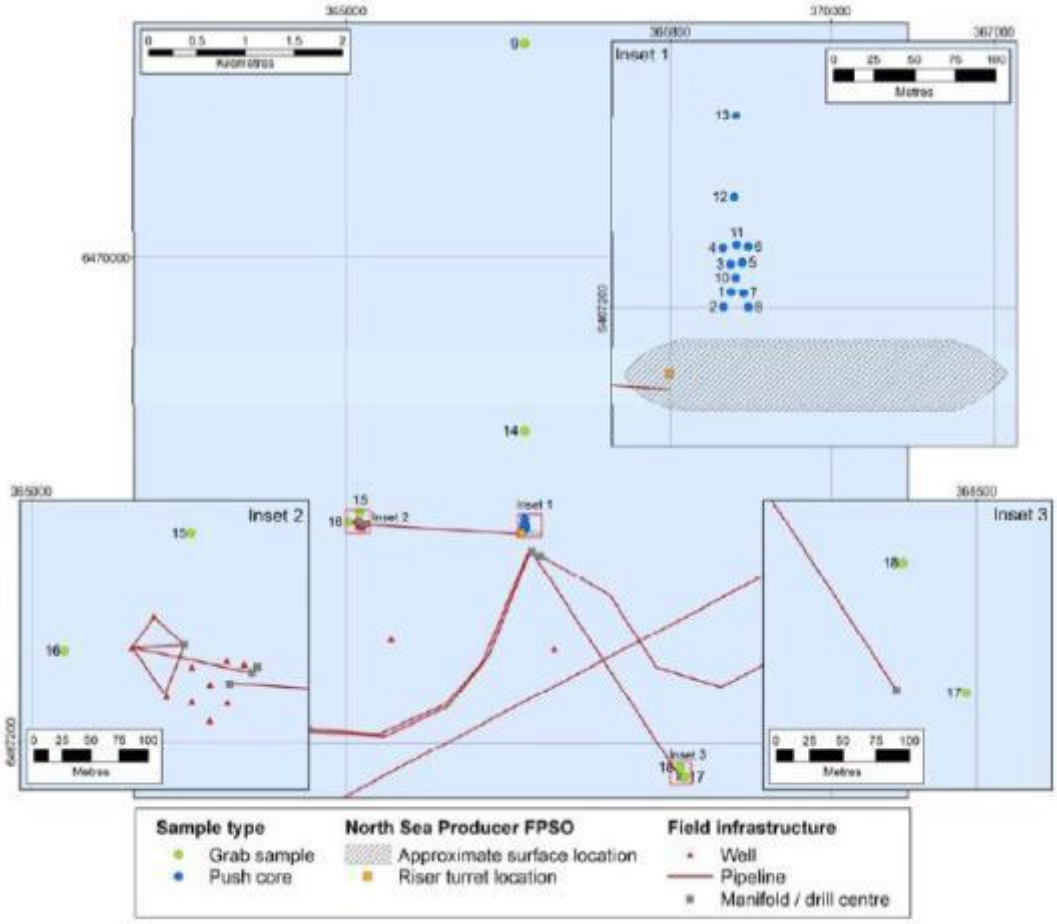


Figure 4.1: MacCulloch Field environmental monitoring programme sample locations (Fugro, 2013)

4.2 Physical Environment

4.2.1 Bathymetry

Ambient water depths within the immediate vicinity of the MacCulloch decommissioning area range from 143.4 m LAT in the north to 150.1 m LAT in the south. The seabed generally shoals towards the south at a gradient of <1°. The difference between LAT and MSL is 1.0 m at the MacCulloch Field (Gardline, 2016).

4.2.2 Tides and water circulation

Tidal currents in the central North Sea area are generally weak and are readily influenced by other factors such as winds and density driven circulation. This results in a relatively atypical pattern to the tidal currents. Tidal current in the MacCulloch area are between 0.50 and 0.25 m/s, for maximum spring and neap tides, respectively (ABPmer, 2018).

4.2.3 Waves

The annual mean wave height at the MacCulloch area varies between 2.3 and 2.5 m (ABPmer, 2018). The seasonal variation is provided in Table 4.3.

Table 4.3: Seasonal variation in wave heights

Spring wave hight	Summer wave height	Autumn wave height	Winter wave height
2.01-2.25 m	1.51-1.75 m	2.51-2.75 m	3.01-3.25

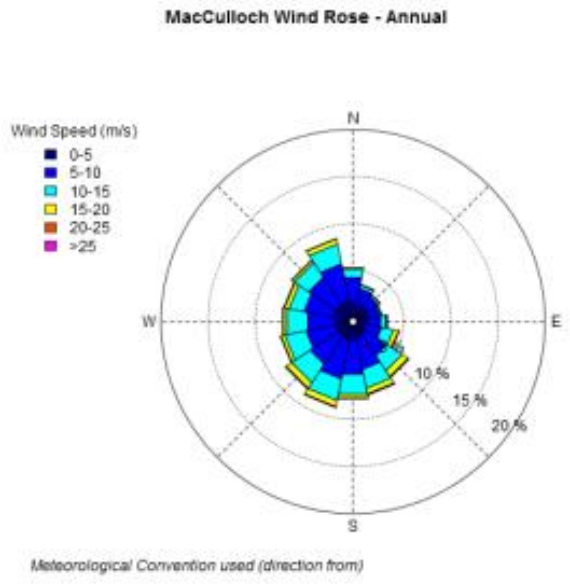
Source: ABPmer (2018)

4.2.4 Wind

The major difference in meteorological conditions between the northern and central North Sea is the relative increased frequency of strong winds and gales north of 57° North (DTI, 2001).

Wind direction in the central North Sea can occur from any direction, but winds from the southwest and north northeast tend to dominate. The frequency of gales exceeding Beaufort force 7 in winter is greater in the north. Typical wind speeds in winter range from 6 to 11 m/s, occasionally increasing to 17-32 m/s. In April and July in the offshore waters of the central North Sea are highly variable and there is greater incidence of northwesterly winds (OESEA, 2016).

In this area of the central North Sea wind speeds range between 8 and 13 m/s are recorded (ABPmer, 2018). The wind rose presenting the annual wind regime for the MacCulloch area for years 2008-2013 is presented in Figure 4.2.



Source: US Navy (NOGAPS) 2015; data period Jan 2008 – Dec 2013

Figure 4.2: Annual wind rose for the MacCulloch Field area for 2008-2013

4.2.5 Temperature and salinity

The water column in the central North Sea is generally stratified in summer when the water becomes layered according to different temperature and subsequent density characteristics of the different water bodies. In general a warmer thinner layer of water overlies a deeper cooler layer. This stratification begins to break down in September due to the increased severity of wind mixing and gales and seasonal cooling of surface waters (OESEA, 2016).

Surface sea temperatures within the development area range from 6.2°C to 13.8°C. Seabed temperatures range from 6.2°C to 8.5°C. Salinity at the surface and seabed measures between 34.9 and 35.2% (Table 4.4).

Table 4.4: Quarterly average sea temperature and salinity

		Quarter 1	Quarter 2	Quarter 3	Quarter 4
Average Sea Temperature (°C)	Surface	6.91	8.74	13.06	9.74
	Seabed	6.95	6.54	7.02	8.04
Average Salinity (%)	Surface	35.12	35.04	34.96	35.12
	Seabed	35.13	35.13	35.14	35.17

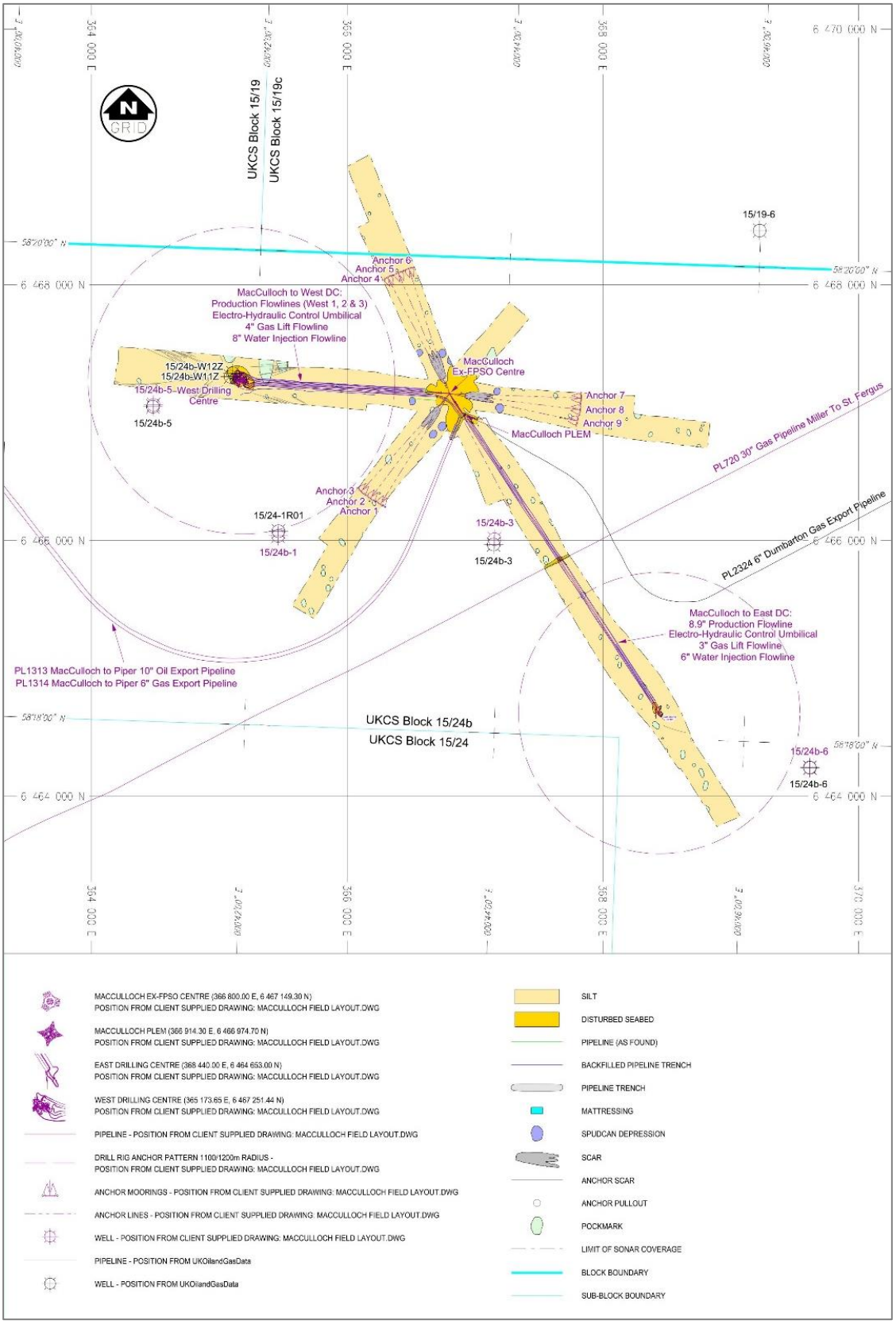
Source: NMPi (2015) [HOLD] –please provide reference

4.2.6 Sediment characteristics and features

The sediments present in the vicinity of the MacCulloch infrastructure have been classified as course silt, medium silt or very fine sand. The median particle diameter values ranged from 24 to 70 µm (Fugro, 2013).

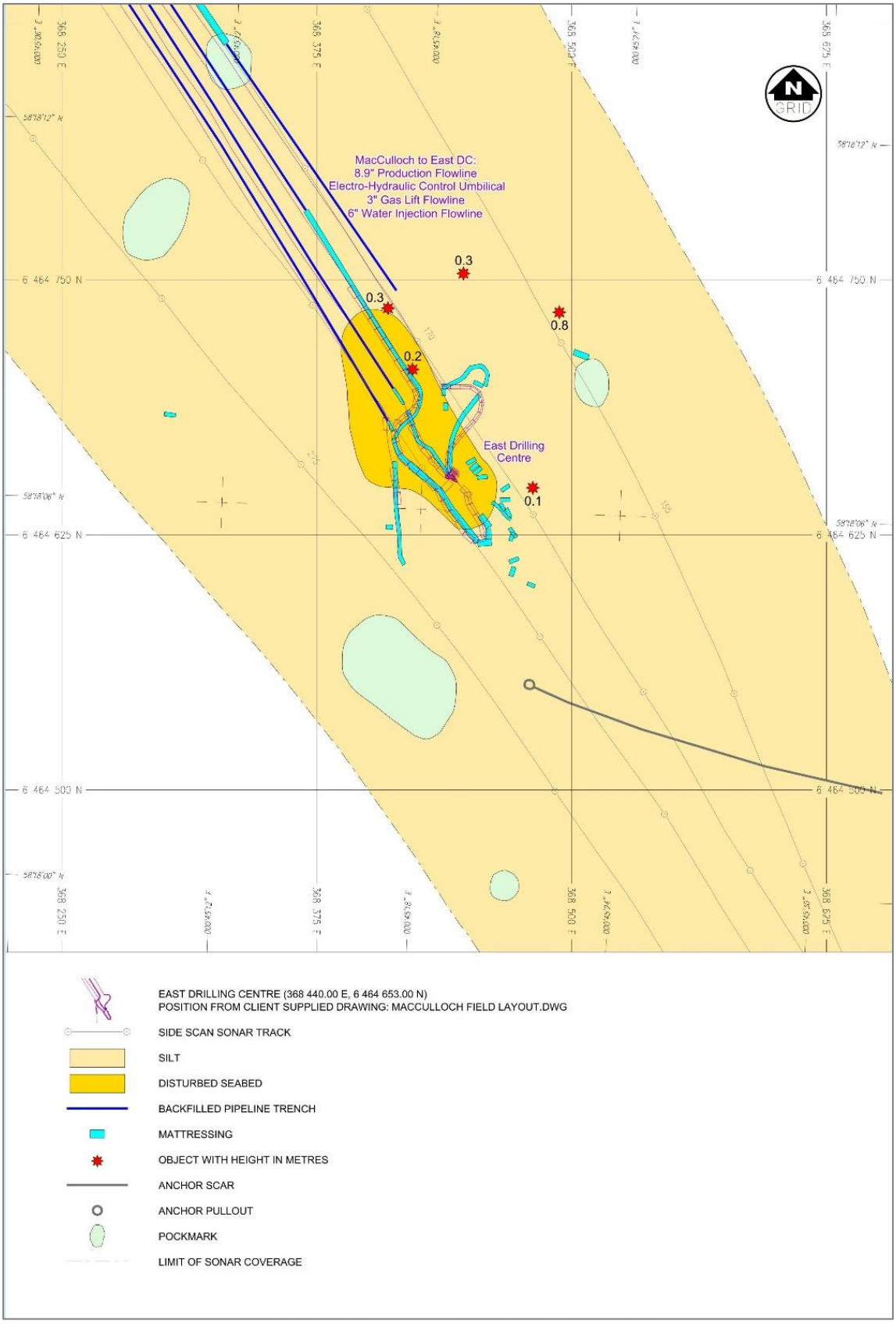
There are a number of pockmarks present in the vicinity, varying in size between <10 and 190 m across, with depths of up to 5.5 m below the surrounding seabed and gradients of up to 13° (Figures 4.3 to 4.7) (Gardline, 2016). The EBS did not find any active pockmarks in the decommissioning area (Fugro, 2013).

Three clusters of deep anchor scars are present, which relate to the FPSO removal activities (Figures 4.3 to 4.7). These scars are up to 240 x 70 m across and 6.5 m deep, with gradients of up to 34°. Several large spud can depressions are also present , where the FPSO had been centred, with depressions up to 70 m across and 1.5 m deep, and gradients of up to 10° (Gardline, 2016).



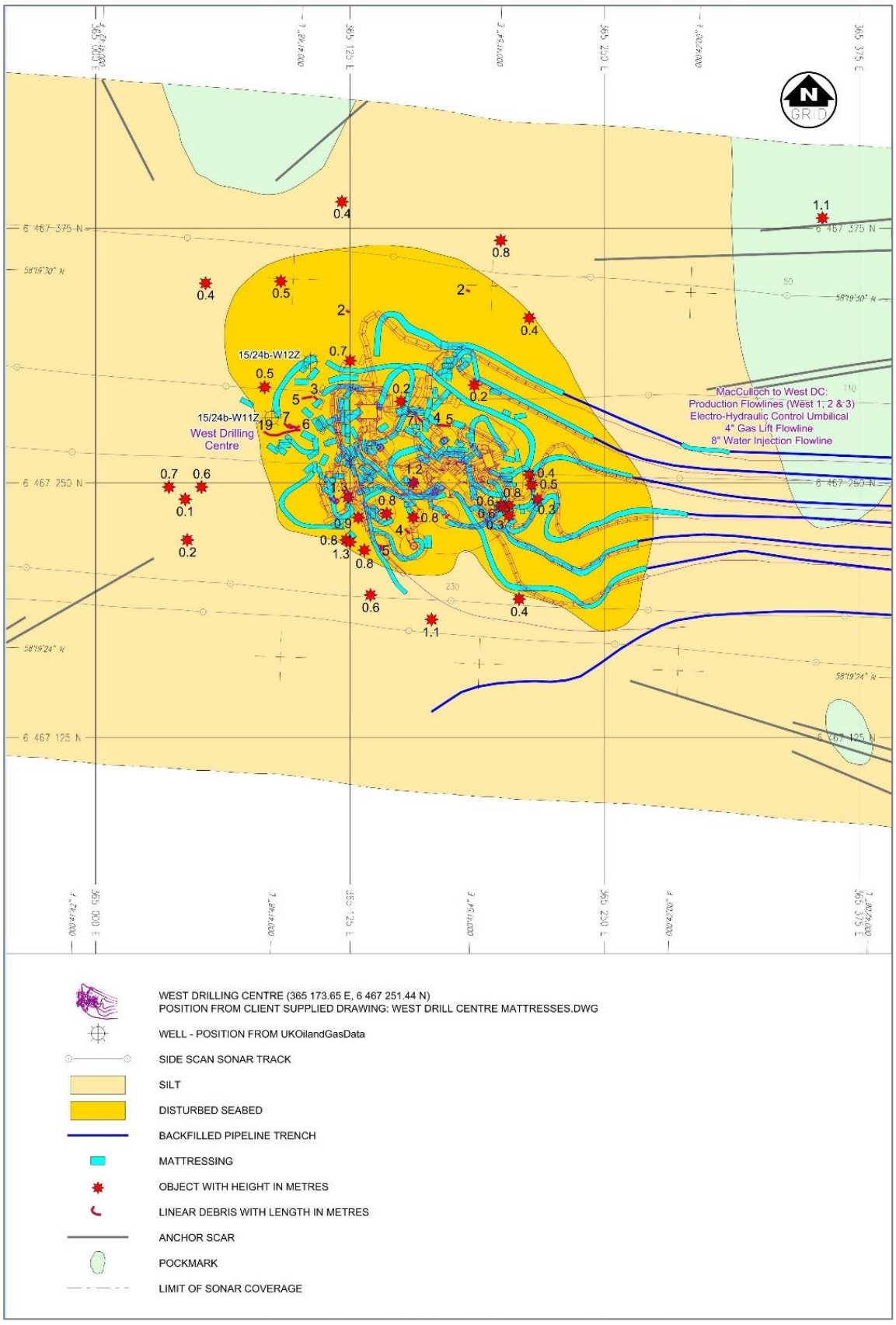
Source: Fugro, 2013. Scale 1:40,000 ED50/UTM zone 31 (3°E)

Figure 4.3: Seabed features across the MacCulloch Field



Source: Fugro, 2013. Scale 1:2,500 ED50/UTM zone 31 (3°E)

Figure 4.4: Seabed features at the MacCulloch east drill centre



Source: Fugro, 2013. Scale 1:2,500 ED50/UTM zone 31 (3°E)

Figure 4.5: Seabed features at the MacCulloch west drill centre

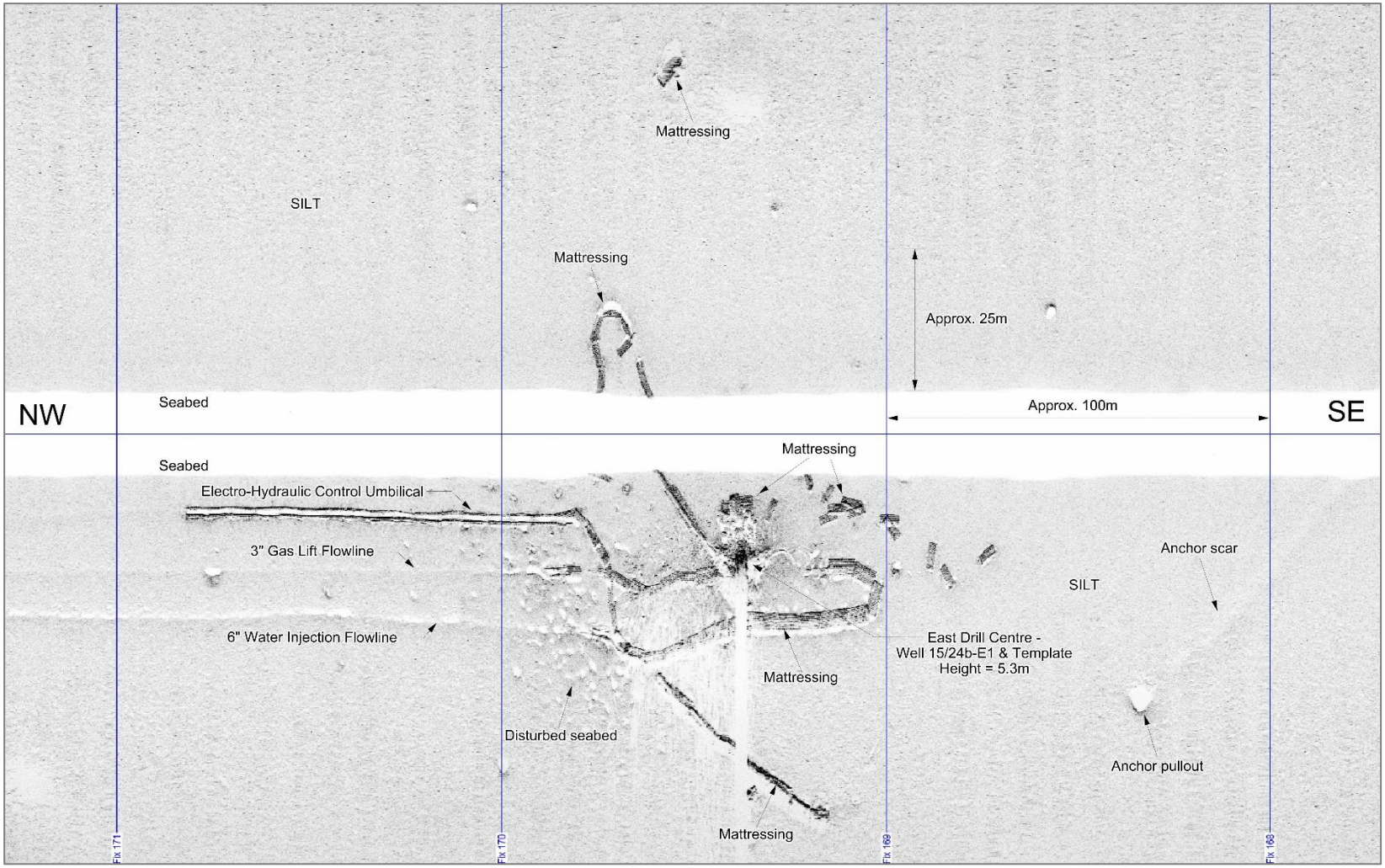


Figure 4.6: Side scan sonar of the seabed in the vicinity of the east drill centre

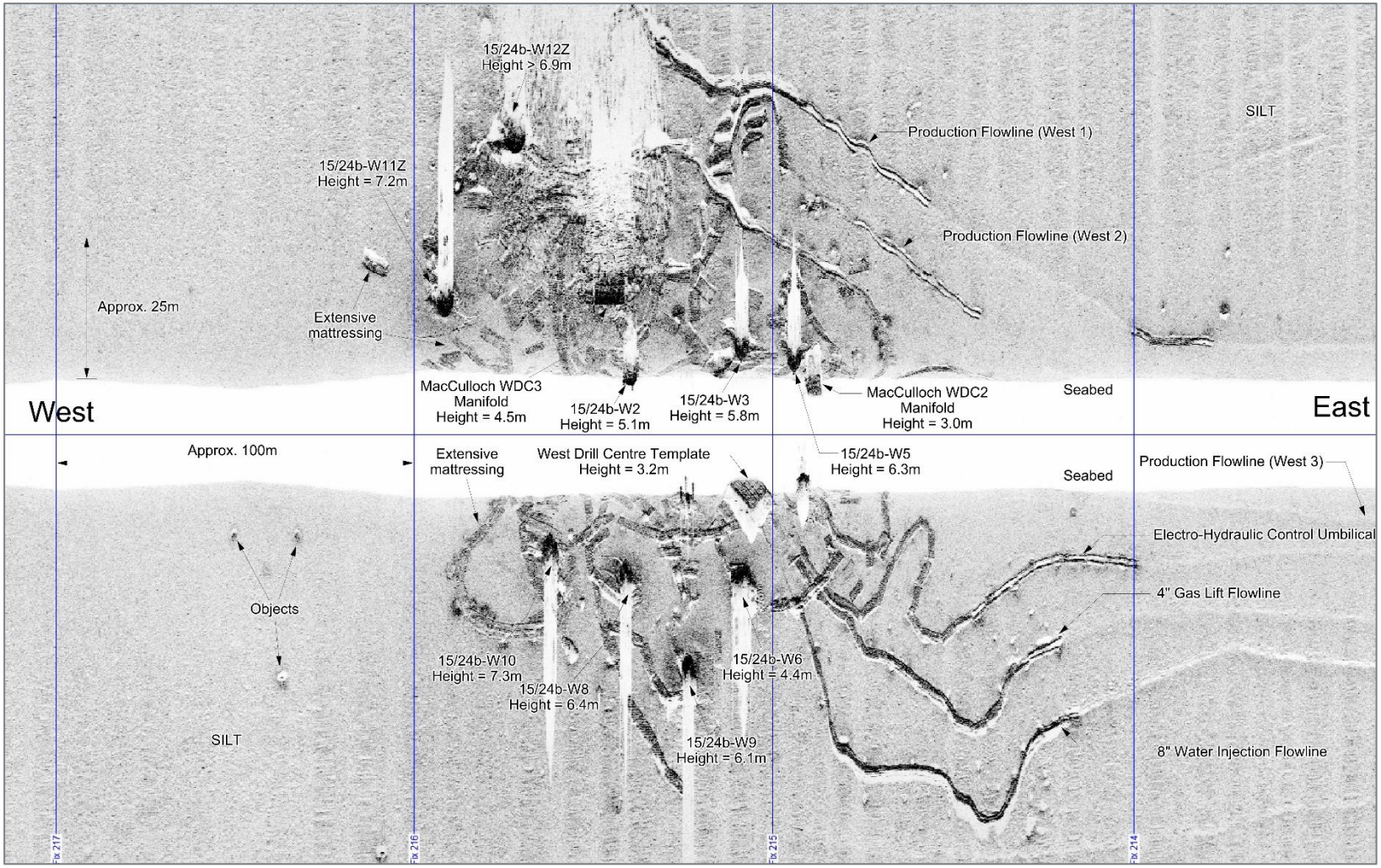


Figure 4.7: Side scan sonar of the seabed in the vicinity of the east drill centre

4.3 Chemical Environment

The gas chromatographic profiles obtained for the surface sediments collected from the MacCulloch survey area were broadly similar (Fugro, 2013). The chemical make-up of the samples suggests that there is a contribution to the sediment of weathered hydrocarbon material, probably originating from anthropogenic sources.

These contributions are typically attributed to discharges from historic and current shipping activities, although other sources i.e. terrestrial land run-off, natural seeps, etc., will also contribute to a weathered 'background' signal. The range of hydrocarbons recorded was typical for sediments collected from this area of the North Sea (UKOOA, 2001, via Fugro, 2013).

Relatively high recorded ratios of odd to even carbon chain length alkanes (over the nC_{21} to nC_{36} carbon range) are due to the dominance of odd-chain length alkanes (NC_{27} to nC_{31}) and associated with inputs from land run-off (Fugro, 2013).

Total hydrocarbon concentrations (THC) measured in the surface sediments collected from the area in July/ August 2012 were comparable to the average background concentration calculated from environmental survey data collected between 1975 and 1995 in the central North Sea area (UKOOA, 2001). The MacCulloch survey THC values fall within the range of THC levels recorded for sediments remote from anthropogenic activities according to the North Sea Quality Status Report (NSTF, 1993).

Sediment total 2 to 6 ring Polycyclic Aromatic Hydrocarbon (PAH) concentrations in the sediments were broadly comparable to the concentrations measured in the vicinity previously and the central North Sea region (Oil and Gas UK, 2018; UKOOA, 2001). The concentrations of the specific PAH compounds listed in the assessment criteria document (OSPAR, 2009a) recorded in sediments collected as part of the 2011 survey were all below the reported ERL thresholds.

The proportion of petrogenically derived naphthalenes, phenanthrenes and dibenzothiophenes (or NPD) to total aromatic material present in these sediments indicates a mixed petrogenic and pyrolytic source of aromatic material in these sediments probably originating from a combination of terrestrial run off and atmospheric deposition.

Elemental concentrations in the grab station sediments were, in general, spread across relatively narrow ranges. In all cases for metals tested from the MacCulloch survey area, the concentrations recorded in the sediments were of no environmental concern. Average values for mercury, cadmium and lead were lower than the OSPAR effect range-low (ERL) thresholds (OSPAR, 2009b), and can be described as characteristic of natural background levels (Table 4.5).

Higher levels of total barium were recorded around the east and west drill locations, presumably due to the deposition of barites (weighting agent in drilling muds) on the seabed during drilling operations. Increased concentrations of other metals, e.g. arsenic, cadmium, copper, lead, strontium and vanadium were typically recorded where sediment barium content was elevated. It is known that barites often contain significant quantities of other trace metals (NRC, 1983; Chow and Snyder, 1980), therefore, it is likely that most of these metals would also be associated with historic drilling mud deposition.

In all cases for metals tested from the MacCulloch survey area the concentrations recorded in the sediment were of no obvious environmental concern (the average values

for mercury, cadmium and lead were lower than the OSPAR ERL threshold) and can be described as natural background concentrations.

Table 4.5: Comparison of average metals concentrations (ugg-1 dry weight) recorded at MacCulloch with available OSPAR sediment ERL (effect range-low)

Station	MacCulloch – Survey Average	Background/Low Concentrations	OSPAR Effect Range – Low (ERL)[1]
Mercury	0.01	0.05	0.15
Cadmium	0.05	0.20	1.20
Lead	10.0	25.0	47.0
1. ERL concentrations normalised to 2.5% organic carbon for organic contaminants and 5% aluminium for metals.			

Source: Fugro, 2013

4.4 Biological Environment

4.4.1 Habitat characterisation and benthic fauna

The seabed habitat around the MacCulloch Field is classified as mud and cohesive sandy mud in the offshore circalittoral zone (Fugro, 2013). Within this habitat a variety of faunal communities can develop, depending upon the level of silt/ clay and organic matter contents in the sediment (JNCC, 2015).

Moderate to high numbers of taxa and individuals have been recorded within the MacCulloch area (Fugro, 2013). Macrofaunal communities were found to be broadly similar to the biotope "*Levinsenia gracilis* and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud and sandy mud". Communities comprised of annelids, arthropods, molluscs, echinoderms and other phyla (e.g. nemerteans, phoronids and cnidarians) (Fugro, 2013).

No evidence of Annex I habitats or communities of conservation importance were recorded during the environmental survey (Fugro, 2013).

4.4.2 Marine growth survey

A marine growth assessment was undertaken to assess the composition and weight of marine growth present on the subsea infrastructure associated with the MacCulloch Field in preparation for the removal of the infrastructure. Video footage from ROV inspection and maintenance surveys was reviewed in order to identify species types and to estimate the average thickness of marine growth and the average percentage cover across the MacCulloch subsea components (RPS, 2015a).

The results of the site-specific ROV footage analysis suggests that, based on the available scientific literature and reports from other decommissioning environmental assessments, the species composition and abundance observed on the structures were typical for this part of the North Sea. No non-native, invasive species were observed throughout the video analysis process.

A small amounts of *Lophelia pertusa* were observed in ROV footage on PL1327 (Production Riser 2), PL1328 (Production Riser 3) and PL1330 (Gas Lift Riser). Reefs of the cold-water coral *L. pertusa* are listed under Annex I of the EC Habitats Directive. However, the amount of *L. pertusa* observed (as demonstrated in the representative

example video footage shown in Figure 4.8) were not present in sufficient abundance to constitute a reef-like structure. Therefore, the small amounts of *L. pertusa* found were not considered as 'significant', and currently not protected under UK legislation on man-made structures.

Source: RPS (2015a)

Figure 4.8: Representative example of ROV video footage showing presence of *L. pertusa* on PL1327

4.4.3 Marine conservation areas

The Scanner Pockmark Special Area of Conservation (SAC) and Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA) lie within 10.5 and 52 km, respectively, of the MacCulloch Field (Figure 4.9). SACs are sites that have been adopted by the European Commission (EC) and formally designated by the government of each country in whose territory the site lies, while NCMPAs are areas designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009, for the conservation of important marine biodiversity and geodiversity out to 200 nm (JNCC, 2018a).

- The Scanner Pockmark SAC contains large blocks of the Annex I habitat "submarine structures made by leaking gases" (JNCC, 2018b). These habitats lie in the base of the pockmark and support fauna more typically associated with rocky reef as well as micro-organisms known as 'chemosynthesizers', which utilise the discharged methane and its by-product, hydrogen sulphide (Judd, 2001), and a potentially symbiotic nematode (*Astomonema southwardorum*) which is unique to the site (Austen et al., 1993). Condition of qualifying feature is considered unfavourable. Some of the pockmarks appeared to have infilled due to slope failure, interrupting gas migration and likely obscuring seabed features previously present such as

MDAC or bacterial mats, which could be caused by natural or anthropogenic causes (JNCC, 2018b). “Submarine structures made by leaking gases” are recorded within the PMF list, indicated to receive appropriate protection and conservation measures (SNH, 2014).

- The Norwegian Boundary Sediment Plain NCMPA was created to protect the ocean quahog (*A. islandica*) aggregations in the area including sands and gravel as their supporting habitat, designated as an OSPAR threatened and/ or declining species (JNCC, 2018c). Condition of qualifying feature is considered unfavourable (JNCC, 2018c). Ocean quahog is a low or limited mobility species recorded on the PMF list and indicated to receive appropriate protection and conservation measures (SNH, 2014).

Scottish National Marine Plan

The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 established a legislative and management framework for the marine environment, allowing the competing demands on the sea to be managed in a sustainable way across all of Scotland’s seas (Scottish Government, 2015). Under the Marine (Scotland) Act 2010 Scottish Ministers must prepare and adopt a National Marine Plan covering Scottish inshore waters. In addition, the Marine and Coastal Access Act 2009 requires Scottish Ministers to seek to ensure that a marine plan is in place in the offshore region when a Marine Policy Statement is in effect (Scottish Government, 2015).

The Scottish and UK Governments published a marine plan for Scotland’s inshore waters and a marine plan covering Scottish offshore waters in a single document collectively referred to as the National Marine Plan. The National Marine Plan has been prepared in accordance with, and gives consideration to, EU Directive 2014/89/EU which came into force in July 2014 (Scottish Government, 2015). The Directive introduces a framework for maritime spatial planning and aims to promote the sustainable development of marine areas and the sustainable use of marine resources.

In accordance with Article 5(3) of the Directive, a wide range of sectoral uses and activities have been considered within the National Marine Plan.

The General Policies of the National Marine Plan introduce General Policy 9 (Natural Heritage), which concerns the development and use of the marine environment. The policy states that development and use of the marine environment must not result in significant impact on the national status of PMF. Supporting the National Marine Plan, the Strategy for Marine Nature Conservation in Scotland’s seas sets out aims and objectives to achieve sustainable development and use, including the protection and, where appropriate, enhancement of the health of the Scottish marine area. Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC) and Marine Scotland have been working together to develop a priority list of marine habitats and species in Scotland’s sea known as PMFs. The list contains 81 habitats and species considered to be of conservation importance in Scotland’s seas (SNH, 2014), that will help to focus future conservation action and marine planning, direct research and education and promote a consistent approach to marine nature conservation advice (Marine Scotland, 2011). Habitats and species on the PMF list in the vicinity of Block 15/24 area are acknowledged within this document.

Block 15/24 is located approximately 170 km northeast of Peterhead on the Scottish coastline (NMPI, 2018). The proposed operations are within the area covered by the

Scottish National Marine Plan; the interactive NMPi map has been used where appropriate to inform this assessment (NMPi, 2018).

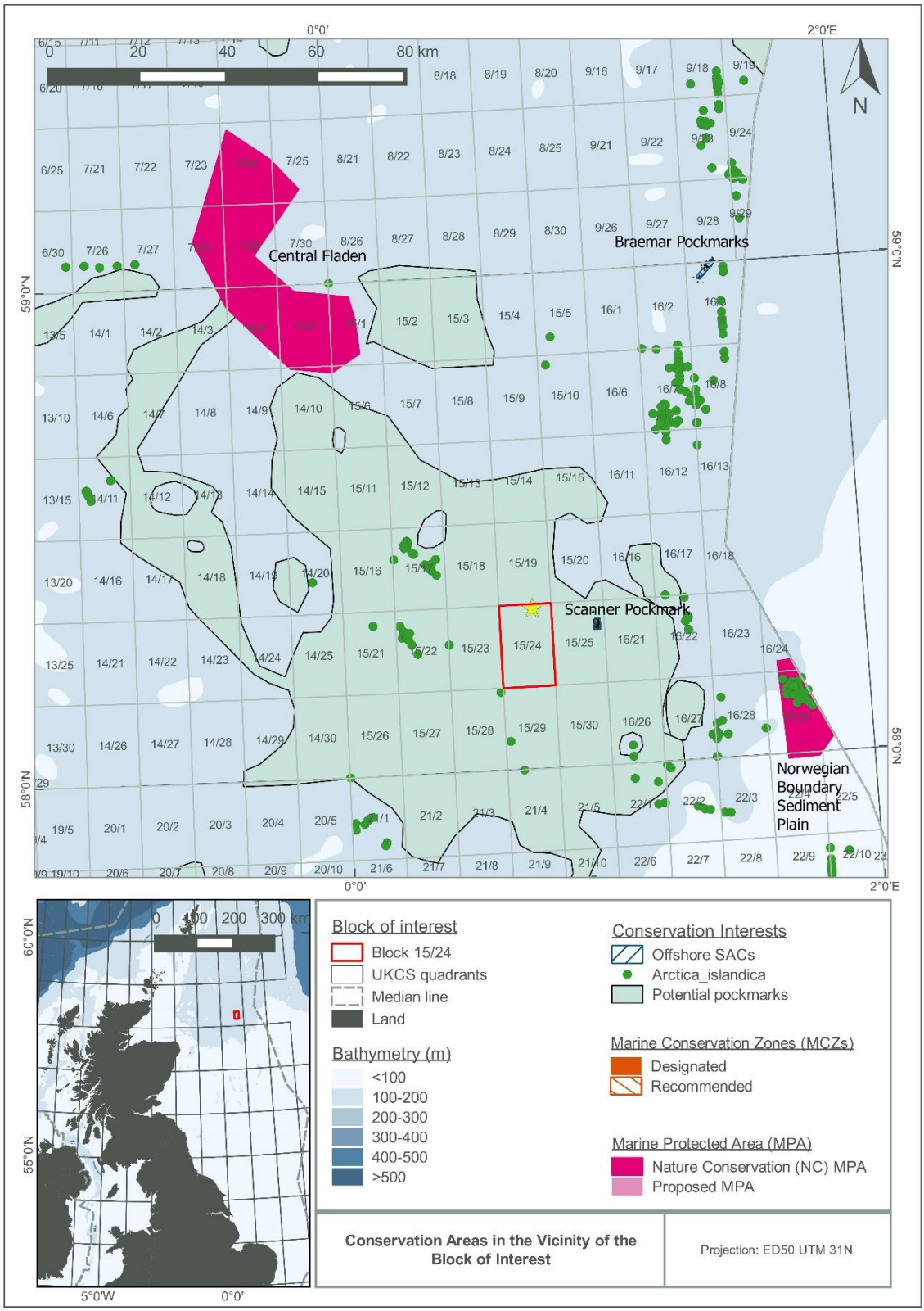


Figure 4.9: Conservation areas in the vicinity of MacCulloch Field

4.4.4 Seabird sensitivities

Planned offshore oil and gas operations do not normally affect seabirds (DTI, 2001), however, they are vulnerable to oiling from surface oil pollution. This occurs either by direct toxicity through ingestion or hypothermia as a result of the birds' inability to waterproof their feathers. Certain species become flightless during the moulting season, (particularly auk species such as guillemot (*Uria aalgae*), razorbill (*Alca torda*) and puffin (*Fratercula arctica*) consequently spending a large amount of time on the water surface. This will make them particularly vulnerable to surface oil pollution (DTI, 2001).

The most abundant seabird species found in the central and northern areas of the North Sea are fulmars (*Fulmarus glacialis*), kittiwakes (*Rissa tridactyla*) and guillemots, gulls (*Larus spp*.) and gannets (*Morus bassanus*) which are likely to be present for most the year (OESEA, 2016). During the breeding season, the foraging ranges of adult seabirds are restricted by their need to return to their breeding sites to protect nests and eggs or feed their young. During this period the majority of breeding birds occur within 50 to 100 km of the coast.

Kober et al. (2010) analysed European Seabirds at Sea (ESAS) density data for seabirds within the British Fishery Limit collected over 30 years to identify 'hotspots,' with a view to assigning these areas a marine SPA status. Several hotspots for seabirds have been identified around UK, however, none of these overlap with the MacCulloch area. Based on those data seabirds density surface maps were developed. The maps were generated using Poisson kriging, a special interpolation technique, to generate continues density surface maps for 32 species and seabirds' assemblages. Table 4.6 presents predicated maximum monthly density of seabirds in the MacCulloch area (Kober et al., 2010).

Seabird sensitivity to surface pollution has been recorded as low to medium between January and October in the Block 15/24, with no data available in November and December. Very high sensitivity was recorded in January and December in neighbouring Block 15/28 (Table 4.1; Webb et al., 2016).

Table 4.6: Predicted monthly surface density of seabirds in the MacCulloch area

Species	Season	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Fulmar	breeding												
	winter												
European storm petrel	breeding												
Gannet	breeding												
	winter												
Pomarine skua	additional												
Arctic skua	breeding												
Great skua	breeding												
	winter												
Black-legged kittiwake	breeding												
	winter												
Great black-backed gull	winter												
Common gull	breeding												
Lesser black-backed gull	breeding												
Herring gull	winter												
Arctic tern	breeding												
Common guillemot	breeding												
	additional												
	winter												
Razorbill	breeding												
	winter												
Little auk	winter												
Atlantic puffin	winter												
All species combined	breeding												
	summer												
	winter												

Key						
Seabirds density (numbers per km^2)	Not recorded	<1.0	1.0 – 5.0	5.1 – 10.0	10.1 – 20.0	>20.0

4.4.5 Marine mammals

Marine mammals may be vulnerable to the effects of oil and gas activities and can be impacted by noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001). Of the nine species of marine mammals recorded in the area, all have low to medium abundance with the exceptions of harbour porpoise, white-beaked dolphin and white-sided dolphin, which have periods of high to very high abundance throughout the year (UKDMAP, 1998; Reid et al., 2003; NMPI, 2018).

Of four Annex II species recorded in the offshore UK waters (JNCC, 2018d), only harbour porpoise have been recorded in the MacCulloch area in significant numbers.

In the second UK report on implementation of the Habitats Directive, the conservation status of harbour porpoise in UK waters was assessed as favourable with medium confidence, and the species is expected to survive and prosper under the current conservation approach (JNCC, 2018f).

Harbour porpoise and other marine mammals species listed in Table 4.1 are mobile species on the PMF list, indicated to receive appropriate protection and conservation measures (SNH, 2014).

4.4.6 Fish and shellfish

The MacCulloch infrastructure is located within International Council for the Exploration of the Sea (ICES) Rectangle 45F0. This rectangle coincides with spawning grounds for cod (*Gadus morhua*; January to April), *Nephrops* (*Nephrops norvegicus*; throughout the year) and Norway pout (*Trisopterus esmarkii*; January to April). Generally, the area is considered to be a low intensity spawning area (Ellis et al., 2010; Coull, et al., 1998) (Figure 4.10).

The MacCulloch infrastructure also lie within nursery grounds for anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*), herring (*Clupea harengus*), ling (*Molva molva*), mackerel (*Scomber scombrus*), sandeel (*Ammodytidae sp*.), spotted ray (*Raja montagui*), spurdog (*Squalus acanthias*, spiny dogfish), *Nephrops*, cod, European hake (*Merluccius merluccius*), haddock (*Melanogrammus aeglefinus*), Norway pout and whiting (*Merlangius merlangus*) (Aires et al, 2014; Ellis et al., 2010; Coull, *et al*., 1998) (Figures 4.11 to 4.14). These species are present throughout the year.

In the vicinity of the MacCulloch infrastructure, recent data indicates the probable presence of Age 0 group fish (Aires et al., 2014). Age 0 group fish are defined as fish in the first year of their lives or those that can be classified as juveniles. The predictive model for this group uses previously identified nursery grounds data from Coull et al. (1998), combined with environmental habitat variables. The results provide the probability of the presence of Age 0 group fish within areas that have defined and predictable environmental habitat specifications for the development of juveniles.

Anglerfish, blue whiting, cod, herring, ling, mackerel, Norway pout, sandeel, spurdog and whiting are mobile species on the PMF list, indicated to receive appropriate protection and conservation measures (SNH, 2014). Of those cod and spurdog are indicated as vulnerable on the IUCN red list of threatened species (IUCN, 2019).

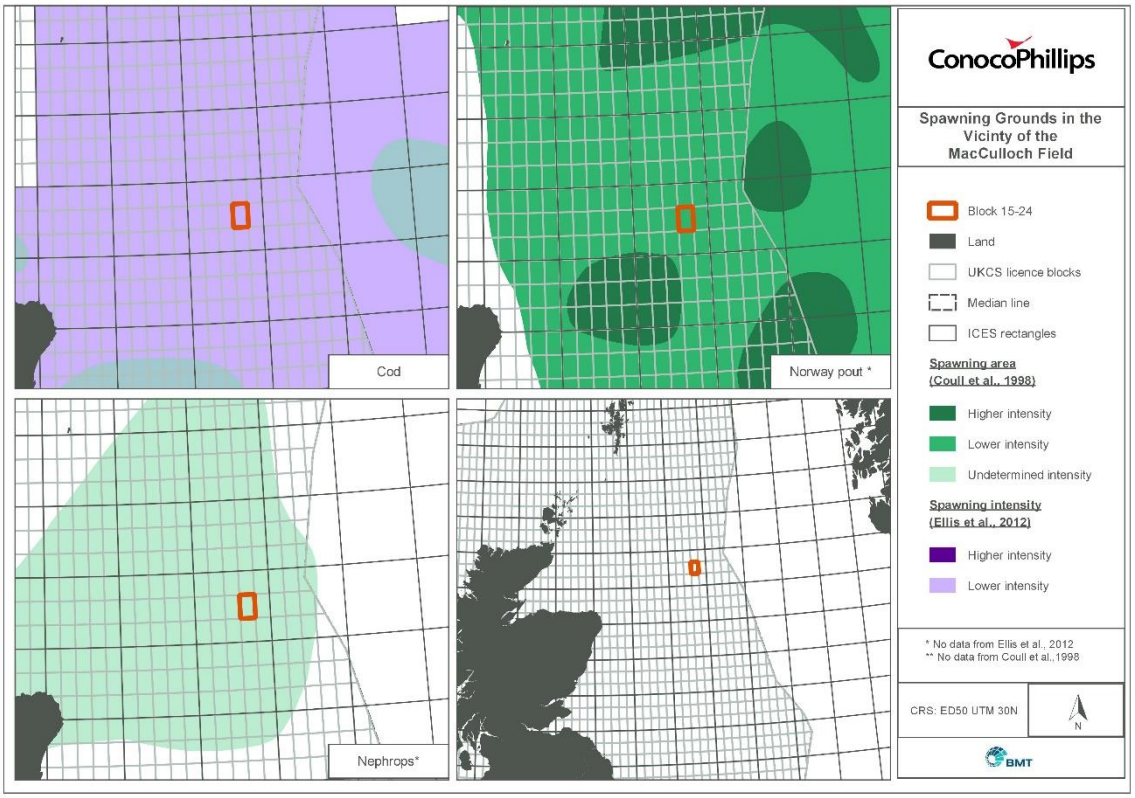


Figure 4.10: Spawning areas in the vicinity of the MacCulloch infrastructure

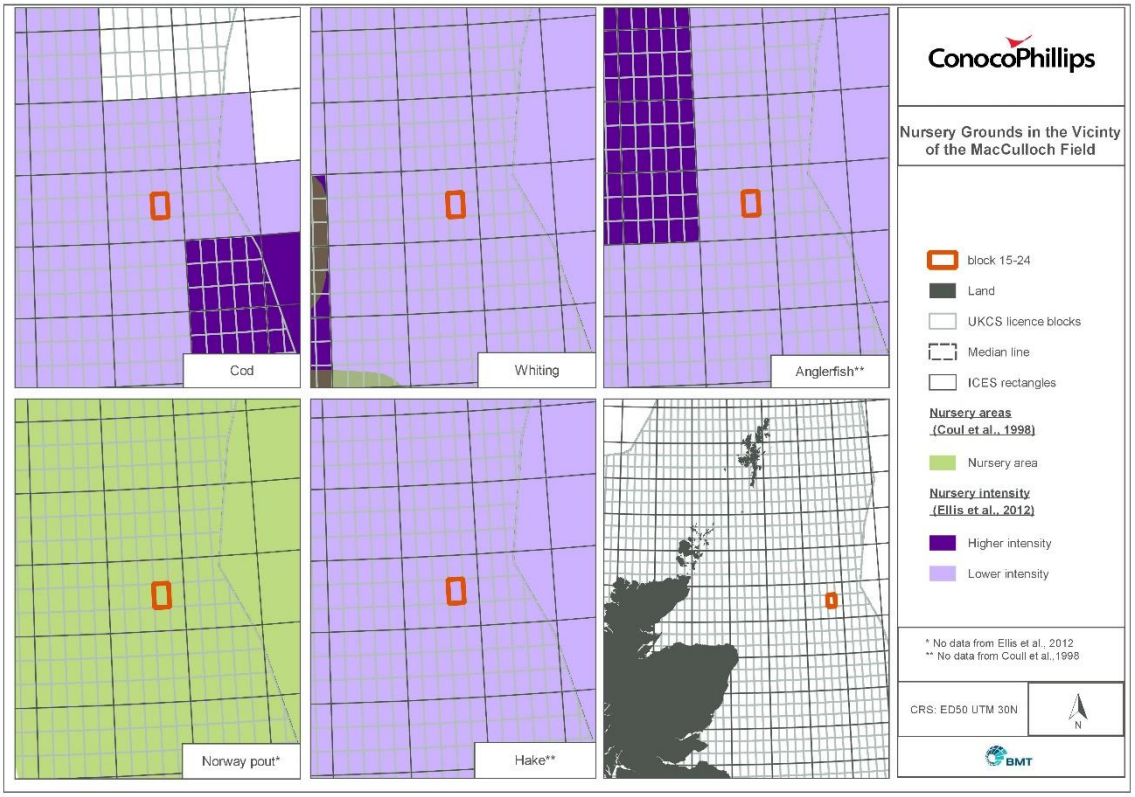


Figure 4.11: Nursery areas in the vicinity of the MacCulloch infrastructure

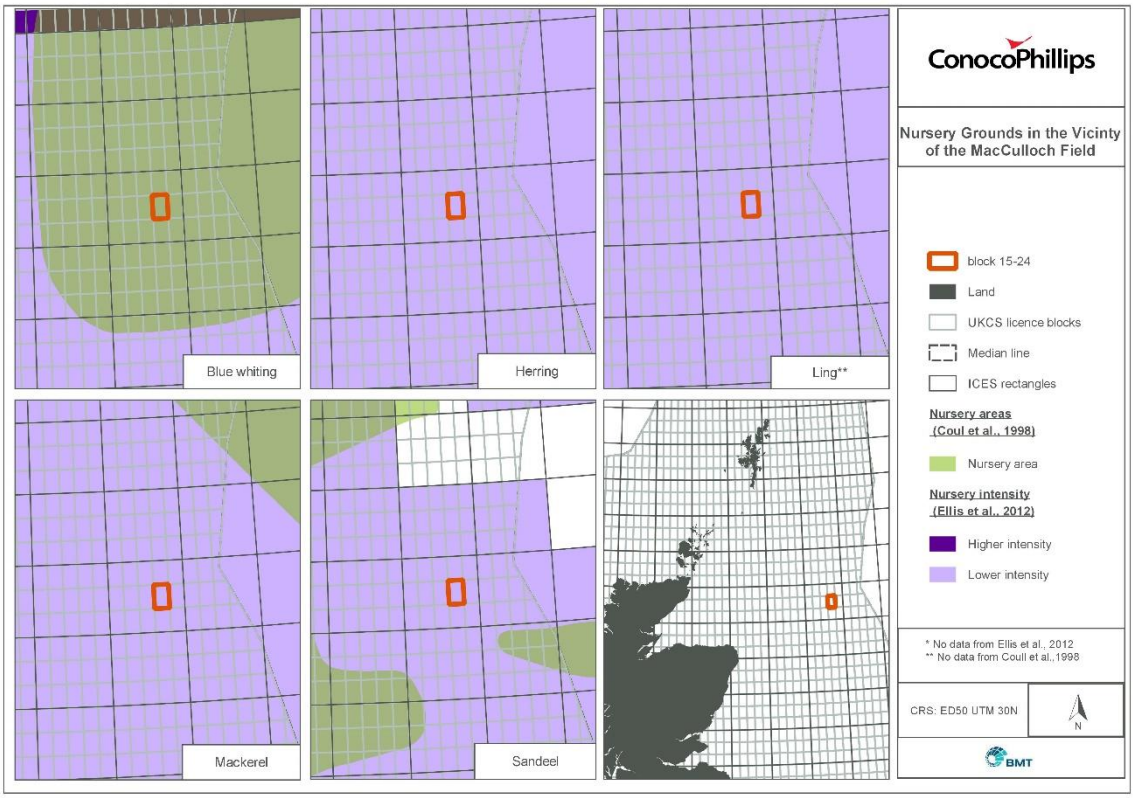


Figure 4.12: Nursery areas in the vicinity of the MacCulloch infrastructure

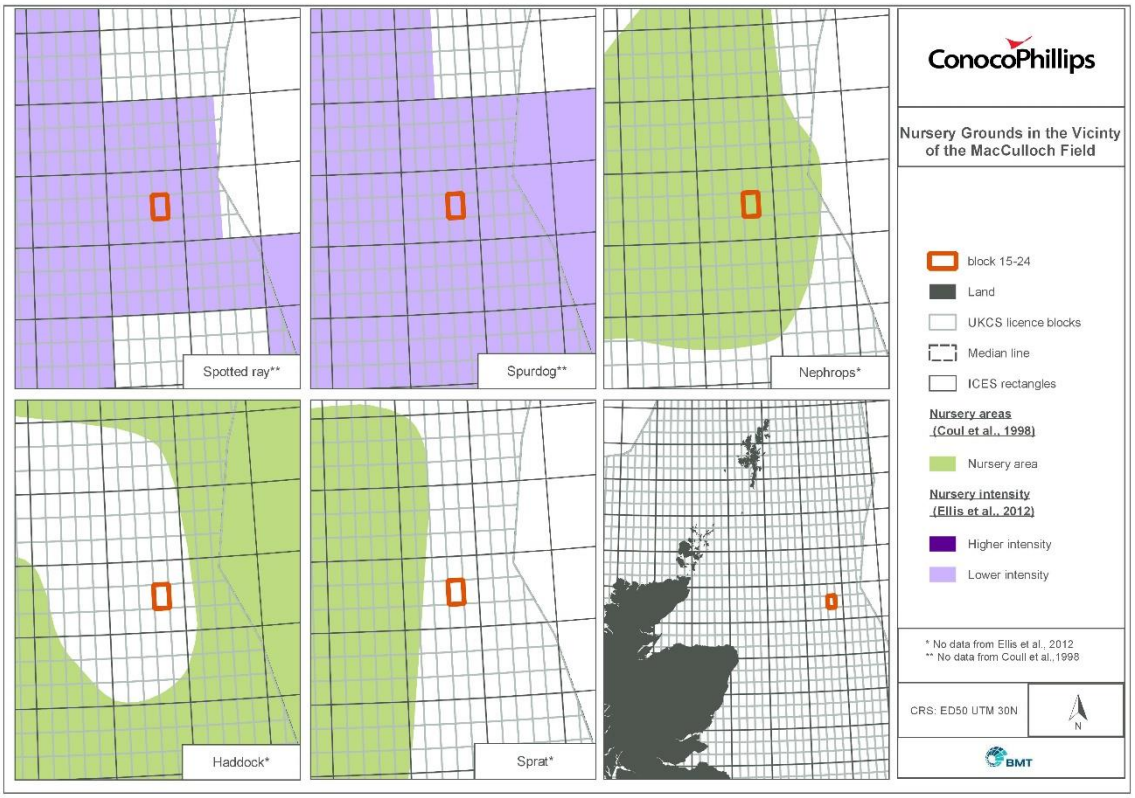


Figure 4.13: Nursery areas in the vicinity of the MacCulloch infrastructure

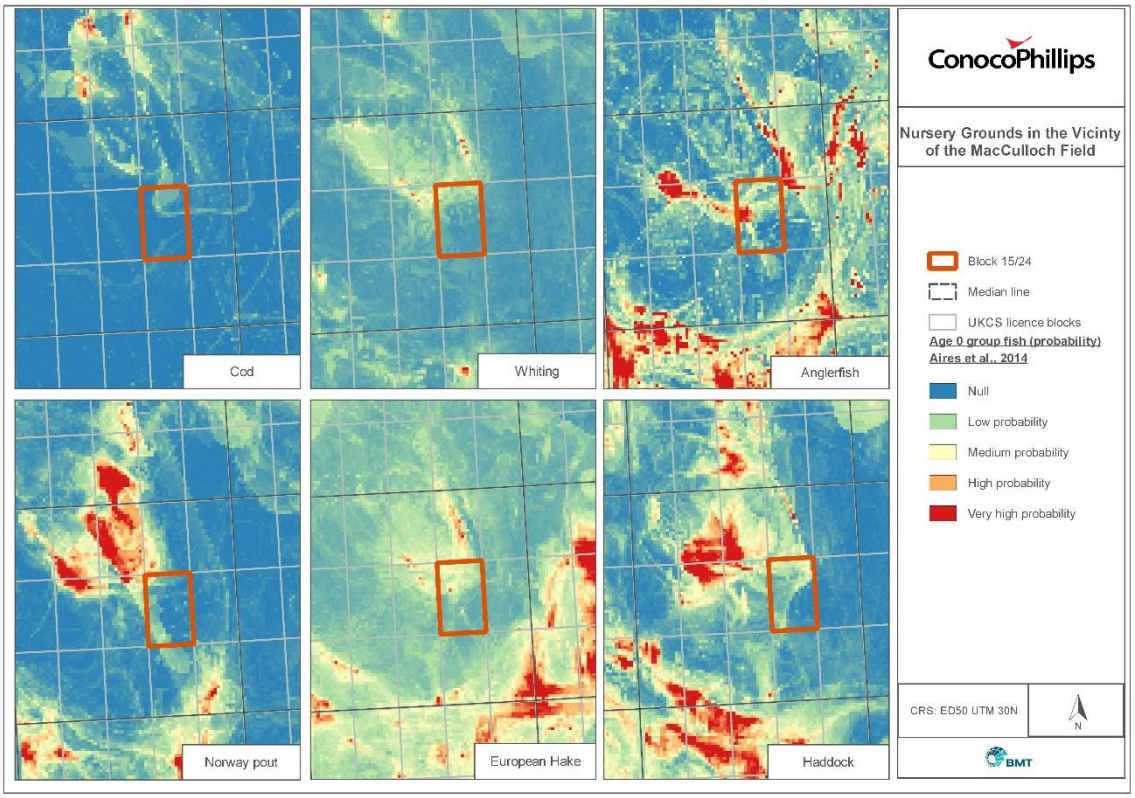


Figure 4.14: Nursery areas in the vicinity of the MacCulloch infrastructure

4.5 Socioeconomic Environment

4.5.1 Commercial fisheries

Demersal, pelagic and shellfish fisheries are active within ICES rectangle 45F0, of which the majority of 2017 catches were attributed to pelagic species. The primary fishing gear used were trawls. Commercial fisheries landings were 4,707 tonnes with a value of £5,426,970 for 2017 (Scottish Government, 2018). Table 4.7, presents the landings weight and value from ICES rectangle 45F0 over the last five years. Over the last five years the majority (99%) of the fishing effort has been associated with bottom trawling.

Table 4.7: Landings statistics for ICES rectangle 45F0 between 2012 and 2016

Year	Total effort (days)	Gear type	Effort (days	Total value (£)	Species type	Value (£)	Total quantity (tonnes)	Species type	Quantity (tonnes)
2017(p)	1,295	Seine nets	Disclosive data*	5,426,970	Demersal	2,168,180	4,707	Demersal	1,130
		Trawls	1,294		Pelagic	691,597		Pelagic	2,946
					Shellfish	2,567,193		Shellfish	632
2016	523	Seine nets	Disclosive data*	3,642,550	Demersal	946,707	4,155	Demersal	524
		Trawls	522		Pelagic	1,876,544		Pelagic	3,450
					Shellfish	819,300		Shellfish	181
2015	268	Seine nets	Disclosive data*	1,439,706	Demersal	304,200	2,526	Demersal	230
		Trawls	266		Pelagic	785,146		Pelagic	2,208
					Shellfish	350,360		Shellfish	88
2014	1,177	Seine nets	-	4,437,715	Demersal	850,247	4,204	Demersal	606
		Trawls	1,177		Pelagic	839,768		Pelagic	2,894
					Shellfish	2,747,700		Shellfish	704
2013	711	Seine nets	-	2,537,299	Demersal	565,519	3,389	Demersal	492
		Trawls	711		Pelagic	554,998		Pelagic	2,523
					Shellfish	1,416,712		Shellfish	374

Source: Scottish Government, 2018; p – provisional data; *Disclosive data due to low number of vessels accounting for this data entry;

4.5.2 Other users of the sea

Within 40 kilometres of the MacCulloch Field, there are eleven surface installations and seven major pipelines (Table 4.8).

Table 4.8: Oil and gas infrastructure within 40 km of the MacCulloch Field

Infrastructure type	Description	Block containing infrastructure	Distance (km) from MacCulloch FPSO location	Direction from MacCulloch FPSO location	Operator
Surface installations	Global Producer III FPSO	15/20	8.5	NE	Maersk
	Balmoral FPSO	16/16	25	SE	ENI
	Tiffany Platform	16/12	35	NE	CNRI
	Scott JD Platform	15/21	31	SW	Nexen
	Scott JU Platform	15/21	31	SW	Nexen
	Tartan A Platform	15/16	38	NW	Chevron
	Piper B Platform	15/17	32	NW	Repsol
	Saltire Platform	15/17	25	NW	Talisman
	Alba FPSO	16/26	36	SE	Chevron
	Alba North Platform	16/26	36	SE	Chevron
	Britannia Platform	16/26	39	SE	ConocoPhillips
Major pipelines	MacCulloch to Piper	-	0	N/A	ConocoPhillips
	Dumbarton DC2 control umbilical	-	0	N/A	Maersk
	Miller to St. Fergus	-	2	SE	BP (not in use)
	Beryl to St Fergus	-	7	W	Apache
	Galley SPS to Galley G6	-	14	SW	Repsol
	Nicol Gas Lift	-	11.5	SE	Premier
	Scott to Forties Unity	-	24	SW	Nexen

Source: NMPI, 2018

There are seven identified wrecks within 25 kilometres of the MacCulloch infrastructure. These have all been classified as non-dangerous wrecks by the UK Hydrographic Office, with the closest being a fishing vessel, *Westerled*, and a German submarine, *U-15*, located 9.5 and 15 km to the northeast of the MacCulloch Field, respectively.

Commercial shipping density in the area has been classified as low (BEIS, 2017).

With the exception of the Goldeneye CCS agreement for lease, situated approximately 65 km southwest of the MacCulloch Field, there are no other socioeconomic features within 100 km (Crown Estate, 2018).

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5.0 INITIAL IMPACT SCREENING

The environmental and societal criteria were assessed using a qualitative assessment of risk. This is based upon the assessment matrices within ConocoPhillips' HSE Risk Assessment Standard (Issue No. 4). The assessment uses a likelihood and consequence matrix (Table 5.1), to differentiate between four categories of risk; High, Significant, Medium and Low. Numeric scores were assigned to each risk score to help differentiate within each risk category. All assigned scoring was post-mitigation. Consequence descriptors are provided in Table 5.2. Table 5.3 presents the initial screening results for the proposed decommissioning activities.

The assessment standard provides descriptors of the management required for each category of risk, and these are presented below:

- High Risk
  - Manage risk using additional or improved risk-reducing measures **with priority**.
  - Inform appropriate management level with risk assessment detail and obtain appropriate approvals per the business unit's requirements.
- Significant Risk
  - Manage risk using additional or improved risk-reducing measures **with priority**.
  - Inform appropriate management level with risk management detail and obtain appropriate approvals per the business unit's requirements.
- Medium Risk
  - No additional risk-reducing measures required, where controls can be verified as functional.
  - Improvements based on lessons learned are encouraged.
- Low Risk
  - No additional risk-reducing measures required.
  - Improvements based on lessons learned are encouraged.

Table 5.1: Likelihood and consequence matrix

		Consequence Severity				
		Level 1	Level 2	Level 3	Level 4	Level 5
Likelihood	Frequent (5)	5	10	15	20	25
	Probable (4)	4	8	12	16	20
	Rare (3)	3	6	9	12	15
	Remote (2)	2	4	6	8	10
	Improbable (1)	1	2	3	4	5

Low Risk	Medium Risk	Significant Risk	High Risk

Assessing likelihood is a subjective process. Professional judgment should be used.

Frequent (5) - Occurs multiple times per year within ConocoPhillips business unit.
Probable (4) - Occurred within the ConocoPhillips business unit or more than once per year within ConocoPhillips.
Rare (3) - Occurred within ConocoPhillips or more than once per year within the oil and gas industry.
Remote (2) - Occurred or has been heard of within the oil and gas industry.
Improbable (1) - Virtually unrealistic, never heard of in the oil and gas industry.

Table 5.2: Consequence descriptors

Consequence Severity	Level 1	Level 2	Level 3	Level 4	Level 5
Environmental Impact	• Negligible environmental impact. • Immediate or instantaneous duration, no remediation required. • Small contained release that stays on site. • No exceedance or single exceedance of a permit or regulatory limit – regulatory enforcement unlikely (all media).	• Minor environmental impact, but with impacts being readily remediated or addressed by natural attenuation process. • Onshore release impact limited to facility and adjacent surrounding area. • Minor offshore release to sea mitigated through natural attenuation. • Single or multiple exceedances of a permit or regulatory limit – regulatory enforcement likely (all media).	• Moderate environmental impact, most likely requires emergency response but not always. • Uncontained release with off-site environmental impacts realised greater than the surrounding area of the facility with observable off-site impacts to flora/ fauna. • Multiple exceedances of regulatory limit during a prolonged incident or operational condition – regulatory enforcement likely (all media). • Off-site localised groundwater contamination.	• Major environmental impact, requires significant mitigation measures that address ecological systems or sensitive habitats. • Off-site impacts realised from one to several miles or more. • Release affecting public infrastructure or roads which result in public evacuation or closure of transportation routes such as roads or waterways. • Widespread surface water or groundwater contamination.	• High environmental impact very severe such as resulting from catastrophic release. • Long-term impacts to sensitive habitats and multiple ecosystems. • Impacts causing closure to drinking water supplies or fishing areas. • Significant offshore release with potential to impact shoreline.
Social Impact	• No restriction on access and no impact on operations. • Negligible impact to/ from key stakeholders. • Issue resolved quickly.	• Brief restriction on access (1 day to 1 month) and minor impact to operations or planned activities. • Minor impact to/ from key stakeholders. Likely addressed by prompt mitigation by stakeholder engagement professionals. • Issue resolved in a minimum amount of time.	• Temporary restriction on access (1 - 3 months) and moderate impact to operations or planned activities. • Moderate impact to/ from key stakeholders. Mitigation requires focused efforts with various business unit groups. • Issue resolved in a moderate amount of time.	• Permanent partial restriction on access (3 months to 2 years) and major impact to operations or planned activities. • Major impact to/ from key stakeholders. Mitigation requires senior level management involvement. • Issue will take a significant amount of time to resolve.	• Extended permanent loss of access (greater than 2 years) and loss of operation or planned activities. • Severe impact to/ from key stakeholders requiring executive level involvement. • Damage permanent.

Table 5.3: The risk assessment results associated with MacCulloch decommissioning activities

Activities/ Operations/ Unplanned Operations	Physical			Biological						Societal				Median risk value (R)	Justification for exclusion from further assessment/ Section reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)		
Planned Operations															
Physical presence of vessels (incl. mob/ demob/ transit and working on site)										4	2			**3**	Shipping/ fishing traffic can readily navigate round the individual vessels as they travel to and from the offshore site. Notifications of planned activities will be issued.
Underwater noise from associated vessels operations						2	4			2				**2**	Section 8 Although perceived to be a low impact a discussion section has been included in light of stakeholder concerns.
Operational discharges of treated oily bilge		2			2	2	2	2						**2**	Any discharge will be within permitted limits.
Sewage and grey water discharges		2			2	2	2							**2**	Sewage (organic material only) will be broken down and readily dispersed in the offshore environment. This will result in a localised transient impact with the discharge dissipating to background concentrations within a relatively short distance.

Activities/ Operations/ Unplanned Operations	Physical			Biological						Societal				Median risk value (R)	Justification for exclusion from further assessment/ Section reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)		
Macerated food waste discharge		2		2	2	2	2	2						**2**	Macerated food waste (organic material only) will be broken down and readily dispersed in the offshore environment. The particles of food waste will be <25 mm in diameter, and will be rapidly and widely dispersed in the water column.
Ballast water uptake and discharge from the vessels on site		2		2	4	2	2		2			2		**2**	The adherence by ConocoPhillips' contractor to the International Convention for the Control and Management of Ships' Ballast Water is expected to mitigate any potential transboundary, cumulative or global impact that may result from the transfer of organisms.
Atmospheric emissions from vessels			4											**4**	The emissions will be a small-scale contributor of greenhouse gases and other global gases. The atmospheric emissions will disperse in the exposed offshore environment. Section 7.
Reuse/ recycling of materials			1										3	**2**	Potential for pipelines and mooring chains to be recycled.
Waste management of hazardous materials												3	4	**4**	Potential for NORM associated with pipelines.
Waste management of non-hazardous materials													4	**4**	Suitably permitted waste contractor will be selected.

Activities/ Operations/ Unplanned Operations	Physical			Biological						Societal				Median risk value (R)	Justification for exclusion from further assessment/ Section reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)		
Overtrawlability surveys	6	4		6	4	4	4			4				**4**	Complete removal will require a single survey after decommissioning. Section 9.
Jetting to expose pipelines	6	4		6	2	4	2			1	1			**2**	Section 9
Structure separation and cutting.	2	2		2	2	2	1			1	1			**2**	Tool use tends intermittent and for short duration.
Underwater cutting of manifold piles, 3 m below seabed	6	4		6	4	6	4			2	2			**4**	Section 9. Intention is for internal cuts where possible, however, the worst-case scenario of an external cut was assessed.
Recovery of subsea material (mattresses, pipelines, etc.)	4	4		4	4	4	4			2	2			**4**	Section 9
Release of contaminated fluids/ materials		4		4	4	4				2				**4**	Pipelines are already flushed. Potential for small amounts of hydraulic fluid release during operations. Any release of fluids would be negligible and quickly dispersed. Any planned discharges will be suitably permitted. Removal of mattresses negates any legacy issues.
Dismantling structures/ recovery			2										2	**2**	Waste transport by road. Any cleaning required will be done by a specialist contractor and include use of bunded areas.

Activities/ Operations/ Unplanned Operations	Physical			Biological						Societal				Median risk value (R)	Justification for exclusion from further assessment/ Section reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)		
of materials onshore															
Unplanned operations															
Dropped objects	1													**1**	The area of impacted seabed will be small and localised. Any impacts will be temporary. Debris (including any dropped objects) will be recovered.
Vessel to vessel collision		8			8	6	6	8	5	6	6	6	6	**6**	Section 12

6.0 STAKEHOLDER CONSULTATION

Consultation with stakeholders is an important part of the EA process. It enables the issues and concerns of stakeholders to be recorded, addressed and communicated within the EA and, where applicable, acted upon during the planning stage.

6.1 Initial Consultation for MacCulloch

Communications have been held regarding the proposed MacCulloch decommissioning strategy with Department for Business, Energy and Industrial Strategy (BEIS), Scottish Fishermen's Federation (SFF), National Federation of Fishermen's Organisations (NFFO), Northern Ireland Fish Producers' Organisation (NIFPO) and Global Marine Systems Limited (GMS). Table 6.1 presents a summary of the issues raised during the consultation process.

6.2 Future consultation

The formal consultation process will begin with the submission of the consultation draft for the Decommissioning Programmes. The consultation process will include a public notice of the availability of the Decommissioning Programmes on the BEIS and ConocoPhillips websites and that a copy will be available at the ConocoPhillips Aberdeen office for inspection by members of the public. As well as making the Decommissioning Programme publicly available, copies will be sent to the following statutory consultees for comment:

- SFF;
- NFFO;
- NIFPO;
- GMS;
- BEIS; and
- Any other stakeholder as directed by BEIS.

The public consultation period will last approximately 30 days, at the end of which ConocoPhillips will be notified of the nature of any objections to the proposals.

Table 6.1: Summary of communications and key issues raised with regulatory agencies and stakeholders for MacCulloch

Stakeholder	Consultation Focus
Department of Energy and Climate Change (DECC) Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)	**2015 – 2018:** General OPRED/ ConocoPhillips MacCulloch Decommissioning Programme update meetings: **03.07.2014:** Purpose to commence the discussions on the MacCulloch Decommissioning Programme and removal of the FPSO from the field including the integrity and obsolescence of the infrastructure. **21.10.2014:** Proposed cessation of production for the MacCulloch field and the intent to utilise an exchange of correspondence for the removal of the FPSO from the field. **21.01.2015:** Pipeline Works Authorisation (PWA) status and commissioning of supporting studies (pipeline decommissioning methodology studies and environmental statement). **11.03.2015:** Plan to cease production 3rd May 2015 communicated. DECC advised that the FPSO may be permanently removed from the MacCulloch field on or after 1st April 2015. Presentation of permitting and activity schedule. **21.04.2015:** Progress update. Confirmation that DECC are content that the details of the removal of the PFSO are to be included within the draft decommissioning programme. Submission of the exchange of correspondence 14th April 2015. Proposed phases of decommissioning and the preliminary outputs of the commissioned studies communicated. **05.06.2015:** Pipeline Operatorship post cessation of production and management of PWA variations. **16.07.2015:** Progress update confirming that the gas export pipelines had been successfully cleaned and the cleaning of the oil export pipeline was ongoing. Mooring and riser disconnects were scheduled for 22nd and 27th July with vessel sail away anticipated end of July – early August. **18.11.2015:** Summary of successful campaign of removing the North Sea Producer FPSO on 13th August 2015. **15.11.2017:** ConocoPhillips Decommissioning Programme update including MacCulloch. Performance of the MacCulloch Light Well Intervention vessel (LWIV) campaign to suspend 11 previously disconnected wells ahead of full Well plug and abandonment.
Scottish Fishermen's Federation (SFF)	**Stakeholder Briefing/ Scoping Letter 3rd June 2015** Preliminary Consultation for the Preparation of the MacCulloch Field Decommissioning Environmental Statement

Stakeholder	Consultation Focus
	Comments raised with regard to the socio-economic baseline and observed steady decline in effort days in recent years (2009-13), without aligning this to the significant reductions to fishing quotas/days at sea during this timeframe. It is acknowledged that in 2013, there was a real scarcity of Nephrops across the central North Sea, which was very unexpected and uncommon for shellfish. **Stakeholder Meetings:** **24.06.2015:** Overview of the MacCulloch Decommissioning Programme. SFF communicated both the sensitivities and the importance of the area and stated concerns regards clay berms owing to soft sediment which has given rise to a number of incidents within the North Sea and fishing gear interactions. ConocoPhillips advised to consider the impact of clay berms during the removal of buried infrastructure. SFF confirmed that the starting position for all Decommissioning Programmes is a clean seabed.
The National Federation of Fishermen's Organisation (NFFO)	**Stakeholder Briefing/ Scoping Letter 3rd June 2015** Subject: Preliminary Consultation for the Preparation of the MacCulloch Field Decommissioning Environmental Statement No comments received. **Stakeholder Meetings:** **30.09.2015:** Decommissioning Programme overview (SNS & MacCulloch) **27.10.2015:** Update of ConocoPhillips Decommissioning Programmes (SNS & MacCulloch) NFFO confirmed that the starting position for all Decommissioning Programmes is a clean seabed.
Northern Irish Fish Producers Organisation (NIFPO)	**Stakeholder Briefing/ Scoping Letter 3rd June 2015** Subject: Preliminary Consultation for the Preparation of the MacCulloch Field Decommissioning Environmental Statement No comments received.
Global Marine Systems Limited (GMS)	**Stakeholder Briefing/ Scoping Letter 3rd June 2015** Subject: Preliminary Consultation for the Preparation of the MacCulloch Field Decommissioning Environmental Statement No comments received.

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7.0 ENERGY AND EMISSIONS

This section provides quantitative estimates of the energy use and the atmospheric emissions from the proposed MacCulloch decommissioning activities. The potential for environmental impact and mitigation measures to minimise emissions and optimise energy use are also assessed.

7.1 Regulatory Context

Atmospheric emissions generated from the decommissioning of the MacCulloch facilities will be managed in accordance with current legislation and standards as detailed within Appendix A.

7.2 Approach

This assessment is based on the Institute of Petroleum (IoP) Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures (IoP, 2000) and BEIS Guidance Notes on Decommissioning of Offshore Oil and Gas Installations and Pipelines (BEIS, 2018a). The assessment includes:

- Establishment of a materials inventory for each structure to be decommissioned;
- Identification of all operations associated with the selected decommissioning options;
- Identification of all end points associated with decommissioning each structure (end points are defined as the final states of the materials at the cessation of the decommissioning operations); and
- Selection of conversion factors and subsequent calculation of energy use and atmospheric emissions.

The calculations predominantly use the energy use and atmospheric emission factors provided within the IoP (2000) guidelines (Appendix B). In accordance with these guidelines, alternative factors may be used where specific equipment is considered to have a significantly different fuel use from that presented in the IoP database. Appendix B details the factors used for the energy and emissions calculations associated with the manufacture of new materials, recycling of materials, general fuel consumption and vessel fuel use.

The following sources were considered to have an associated impact on the energy and emissions at each stage of the MacCulloch facilities decommissioning:

- Helicopters for transportation of personnel;
- Vessels for transportation and offshore operations;
- Onshore dismantling and/ or processing materials;
- Onshore transportation to processing, recycling and landfill sites;
- Recycling; and
- New manufacture to replace recyclable materials decommissioned in situ or disposed of in landfill.

7.3 Assumptions and Calculation Factors

The general assumptions for the calculation of the energy use and atmospheric emissions relevant to the MacCulloch facilities decommissioning activities include:

- Vessel fuel consumption rates, energy usage factors and CO_2 emissions for all vessels have been taken from the IoP (2000) and Defra (2013) guidelines and Defra (2015) greenhouse gas factors repository.
- The use of a guard vessel has not been factored into the calculations.
- Determination of Wait on Weather (WoW) time excludes mobilisation, demobilisation and transit.
- Cutting, dredging and trenching operations are only considered as part of the overall fuel consumption for vessels.
- Rock-placement will be sourced in Norway. It has been assumed that this has been allowed for in the transit times of the rock-placement vessels.
- Any option which involved decommissioning in situ had a future survey programme of two, five and ten years factored into the assessment with relevant impacts considered.
- One helicopter return trip of 426 km form Aberdeen to the site has been allowed for crew change every 14 days.

The following sub-sections outline the assumptions specific to particular components of the infrastructure.

7.3.1 Flowline and umbilical assumptions

The following assumptions apply to pipeline decommissioning:

- All flowlines and umbilicals will be completely removed.
- There will be two return helicopter flights during the vessel scope.
- A WoW contingency is applied to all vessels involved with the pipeline removal.
- In pipeline calculations, all steel is assumed to be recycled. In reality, some of this may be reused or sent to landfill.

7.3.2 Mattress assumptions

- All mattresses will be completely removed.
- There will be two return helicopter flights during the vessel scope.
- A WoW contingency is applied to all vessels involved with the mattress removal.
- In mattress calculations, all concrete is assumed to be landfilled.

7.3.3 Mooring system assumptions

- The mooring system will be completely removed.
- There will be one return helicopter flight during the vessel scope.
- A WoW contingency is applied to all vessels involved with the mooring system removal.
- In mooring system calculations, all steel is assumed to be recycled. In reality, some of this may be reused or sent to landfill.

7.4 Estimated Energy Use and Emissions

A summary of the anticipated energy use and atmospheric emissions for the MacCulloch decommissioning activities are provided in Table 7.1 and Table 7.2, respectively. The values for these tables were sourced from the Comparative Assessment Report for Pipelines/ Flowlines, Mattresses & Mooring System (RPS, 2015b).

The total annual CO_2 emissions from offshore oil and gas UKCS operations during 2016 were 13.1 million tonnes. The estimated CO_2 emissions released during the decommissioning of the MacCulloch infrastructure and flushing operations represent less than 0.1% of this total (Oil and Gas UK, 2017).

Table 7.1: Total energy use for the MacCulloch decommissioning

Decommissioning aspect	Energy use (GJ)	Approximate contribution (%)
Flowlines and umbilicals		
Vessel and helicopter use	27,752.80	70.66
Onshore transportation	381.22	0.97
Recycling	11,142.00	28.37
Stabilisation materials		
Vessel and helicopter use	22,794.15	28.46
Onshore transportation	1,464.67	5.04
New manufacture to replace recyclable materials landfilled	4,794.00	16.50
Mooring system		
Vessel and helicopter use	6,747.23	32.65
Onshore transportation	461.47	2.23
New manufacture to replace recyclable materials landfilled	13,455.00	65.11

Table 7.2: Total atmospheric emissions for the MacCulloch decommissioning

Decommissioning aspect	CO_2 emissions (Te)	Approximate CO_2 contribution (%)
Flowlines and umbilicals		
Vessel and helicopter use	2,059.58	62.87
Onshore transportation	27.72	0.85
Recycling	1,188.48	36.28
Stabilisation materials		
Vessel and helicopter use	1,691.42	28.11
Onshore transportation	106.52	1.77
New manufacture to replace recyclable materials landfilled	4,218.72	70.12
Mooring system		
Vessel and helicopter use	500.48	25.41
Onshore transportation	33.56	1.70
New manufacture to replace recyclable materials landfilled	1,435.20	72.88

Note: Steel anchors are the only infrastructure decommissioned in situ.

7.5 Summary

Table 7.3 provides a summary of the energy and emissions for decommissioning all components and associated activities of the MacCulloch decommissioning project.

The operations for decommissioning the MacCulloch facilities are predicted to use a total of 88,992.54 GJ of energy. Approximately 64% of this total can be attributed to vessel and helicopter use offshore.

A total of 11,261.68 tonnes of CO_2 is expected to arise from the decommissioning of the MacCulloch facilities. Vessel and helicopter use offshore represents approximately 38% of total emissions.

The highest contributor to CO_2 emissions is represented by the new manufacture to replace recyclable materials decommissioned in situ or taken to landfill, which represents approximately 50% of total emissions and represents approximately 21% of the total energy use.

Table 7.3: Total energy use (GJ) and CO_2 atmospheric emissions (tonnes) for the MacCulloch decommissioning activities.

Decommissioning aspect	Energy (GJ)	CO_2 emissions (tonnes)
Vessel and helicopter use	57,294.18	4,251.48
Onshore transportation	2,307.36	167.8
Recycling	11,142.00	1,188.48
New manufacture to replace recyclable materials decommissioned in situ or taken to landfill	18,249.00	5,653.92
Total	**88,992.54**	**11,261.68**

7.6 Impacts on Sensitive Receptors

There are no specific significant impacts perceived to result directly from the energy consumed nor the emissions produced from these decommissioning operations. These activities will contribute to global emissions but are less than 0.1% of the total UKCS CO_2 emissions (Oil and Gas UK, 2017).

7.7 Proposed Mitigation Measures

Mitigation measures to minimise energy use and atmospheric emissions during the MacCulloch decommissioning operations are detailed within Table 7.4.

Table 7.4: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Vessels and helicopters for onshore and offshore transportation and operations Onshore and offshore operations	• Vessels will be audited as part of selection and pre-mobilisation. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Vessels will use ultra-low sulphur fuel in line with MARPOL requirements. • Work programmes will be planned to optimise vessel time in the field. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.

8.0 UNDERWATER NOISE

Sound is important to many marine organisms, with marine mammals, fish and certain species of invertebrates having a range of complex mechanisms for both the emission and detection of sound (Richardson et al., 1995). Underwater noise may activities/ behaviours such as feeding, mating, socialising, resting and migration. Noise disturbance may have consequential impacts upon the body condition and the reproductive success of individuals or populations (Southall et al., 2007; Richardson et al., 1995). Indirect impacts may also result, should the noise disturb prey species, making feeding more difficult (Southall et al., 2007; Richardson et al., 1995).

During the proposed decommissioning of the MacCulloch Field noise may be generated by a number of sources including:

- DSV;
- CSV;
- Trawl;
- AHV;
- Guard vessel;
- Survey vessel;
- Helicopters;
- Pipeline cutting (assumed mechanical);
- Lifting and removing the pipelines.

These sources will emit low frequency noise both into the air and water column. The introduction of additional anthropogenic sounds into the environment has the potential to affect the behaviour of and, in extreme cases, even injure local wildlife.

This section will consider the noise and potential impact generated during the MacCulloch decommissioning activities.

8.1 Regulatory Context

The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) set down the obligations for the assessment of the impact of offshore oil and gas activities on habitats and species protected under Council Directive 92/43/EEC (the Habitats Directive). This aims to halt any decline, but also to ensure that the qualifying species and habitats recover sufficiently to enable them to flourish over the long-term. Regulation 5 requires that an appropriate assessment (a Habitats Regulation Assessment) of the implications of a proposed activity on the site in view of the site's conservation objectives must be made.

The Conservation of Offshore Marine Habitats and Species Regulations 2017 are the governing legislation for implementation of a number of the other requirements contained in the Directive. Part 5 provides powers to issue licences for specific activities that could result in the injury or disturbance of European Protected Species (EPS injury or disturbance licences).

It is an offence to deliberately:

- Capture, injure or kill any wild animal of a European Protected Species (EPS); or
- Disturb wild animals of any such species.

Disturbance of animals is defined under the Regulations and includes, in particular, any disturbance which is likely to impair their ability to:

- Survive, breed, rear or nurture their young; or
- Hibernate or migrate (where applicable); or

- Significantly affect the local distribution or abundance of the species to which they belong.

In a marine setting, EPS include all the species of cetaceans (whales, dolphins and porpoises) (JNCC, 2017). As underwater noise has potential to cause injury and disturbance to cetaceans, an assessment of underwater noise generated by the subsea installation operations is required in line with guidance provided by the JNCC (JNCC, 2017).

8.2 Approach

The impact of underwater noise on any sensitive receptors is assessed here using a modelling approach, which includes the identification of potential noise sources, an evaluation of their levels and frequencies, an introduction to relevant underwater noise propagation pathways and the appropriate assessment model, followed by an impact assessment. The assessment results are then compared against relevant values from the literature, addressing both behavioural impacts to and injury of the target species. Any identified potential issues are then evaluated with respect to transboundary and cumulative impacts.

8.3 Sources of Potential Impacts

The quantification of noise impacts from MacCulloch decommissioning activities has been evaluated based on relevant scientific literature. In addition, potential noise impacts resulting from associated vessels activities were further investigated using the Marsh-Schulkin propagation model (Schulkin and Mercer, 1985). The Marsh-Schulkin model applies to acoustic transmission in relatively shallow water (up to, approximately, 185 m) and represents sound propagation loss in terms of sea state, substrate type, water depth, frequency and the depth of the mixed layer. In order to model the worst-case scenario, it was assumed that all sources will be in operation at all times during each activity. In reality, this is unlikely, and the source level is likely to be lower than predicted within this assessment.

8.3.1 Assumptions

For all vessel operations, the worst-case conservative assumption is that a maximum of five vessels will be on site at any given time. Sensitivity studies were undertaken to determine the worst case in relation to the number of vessels and water depth present within the decommissioning area.

8.3.2 MacCulloch decommissioning operations

All of the potential noise sources associated with the MacCulloch decommissioning operations are classed as continuous sounds and, as such, do not fall into the target Marine Safety Framework Directive (MSFD) descriptor for loud, low-frequency impulsive sounds. The vessel noise, dominant sound source, is classed as a non-pulse noise source. Of note here is that the use of explosives is not currently anticipated by ConocoPhillips during MacCulloch decommissioning activities.

Vessels

Broadband source levels for vessels rarely exceed 190 dB re 1 µPa m and are typically much lower (Hannay and MacGillivray, 2005; Genesis, 2011). The level and frequency of sound produced by vessels is related to vessel size and speed, with larger vessels typically producing lower frequency sounds (Richardson et al., 1995). Noise levels

depend on a vessel's operating status and can vary considerably with time. In general, vessels produce noise over the range 100 Hz to 10 kHz, with strongest energy over the range 200 Hz to 2 kHz.

The modelling undertaken used data from Hallett (2004) to represent five vessels in the chosen scenario. Hallett (2004) investigated underwater radiated noise measurements of ten merchant ships (lengths 89 to 320 m, average 194 m) during port entry or exit. Whilst not directly representative of the vessels movements anticipated for MacCulloch decommissioning operations, it is considered that the use of Hallett (2004) data provides a more conservative measure of vessel noise than many of the published examples for specific construction and support vessels. Hence, the resultant noise spectrum has been used to represent each vessel modelled with the overall cumulative effect being calculated.

For continuous sound such as shipping noise, it is usual to use a measure of the total root mean squared (rms) sound intensity of a signal. However, the larger zero-to-peak values have been used in the modelling to illustrate the worst-case scenario.

Pipeline cutting and lifting

Pipelines, as a worst-case scenario, would be exposed using jetting methods and is assumed that it would be removed by mechanical cutting with an underwater pipe cutter and lifting the cut pipeline sections onto a vessel for transportation to shore. Underwater noise from pipeline cutting is expected to be temporary and short-term. Pangerac et al. (2016) found that the sound radiated from the diamond wire cutting of a conductor was not easily discernible above the background noise, which was present in the area during the cutting operation. Consequently, target species could be temporarily disturbed.

Helicopters

Helicopter activities related to MacCulloch decommissioning will occur throughout operations. Helicopter noise originates from both the sea surface disturbance by the downwash from the rotor blades and the transmission of engine and blade noise directly into the sea. The downwash noise is very similar to wind noise in its frequency characteristics and is greatest in the 2 to 20 kHz region. Additional strong tonals in the 10 to 100 kHz range are associated with rotors and turbine operation, respectively (Harland et al., 2005).

When sound travels from air to water, the energy is largely reflected back from the water surface and only a small fraction of the sound produced by the helicopter is actually transmitted into the sea. Although helicopter sound is fairly broadband (0 to 20 kHz), the lower frequency sound, up to 200 Hz, is much more pronounced (Berrow et al., 2002). The dominant tones in the noise spectra from helicopters are generally below 500 Hz (Richardson et al., 1995). The angle at which sound from the aircraft intersects the water's surface is also important. At angles greater than 13° from the vertical, much of the incident sound is reflected and does not penetrate into the water (Richardson et al., 1995).

Levels and durations of sounds received underwater from a passing aircraft depend on its altitude and aspect, receiver depth and water depth. In general, the peak received sound level in the water from the aircraft directly overhead decreases with increasing aircraft altitude (Richardson et al., 1995).

8.4 Impacts on Sensitive Receptors

Underwater noise can affect the behaviour of or may cause injury to several different marine taxa, in particular fish and marine mammals such as pinnipeds and cetaceans.

8.4.1 Fish and Shellfish

Many fish species use sound for prey location, predator avoidance and for social interactions. The inner ear of fish, including elasmobranchs (sharks, skates and rays), is very similar to that of terrestrial vertebrates and hearing is understood to be present among virtually all fish (NRC, 2003).

The majority of fish species detect sounds from below 50 Hz and within the range 500 to 1500 Hz. A small number of species can detect sounds to over 3 kHz, with very few species able to detect sounds over 100 kHz. Fish with the narrower bandwidth of hearing are often referred to as “hearing generalists” or hearing “non-specialists” whilst fish with the broader range are often called “hearing specialists”. The difference between hearing generalists and specialists is that the latter usually have specialised anatomical structures that enhance hearing sensitivity and bandwidth (Popper and Hastings, 2009).

Hearing generalists include salmonids, cichlids, tunas and other numerous species. Hearing specialists include all the Otophysi and Clupeiformes, and some representatives in a wide range of other fish groups including a few holocentrids and sciaenids. The fish known to have the widest hearing frequency bandwidth are limited to the members of the clupeiform genus Alosa (Popper and Hastings, 2009).

The fish species found in the MacCulloch locality are mainly hearing generalists (cod, Norway pout, anglerfish, blue whiting, ling, mackerel, spotted ray, spurdog, European hake, haddock and whiting), with the exception of herring, which is considered as specialist.

The MacCulloch decommissioning area (ICES rectangle 45F0) is located within spawning grounds for cod, *Nephrops* and Norway pout. The MacCulloch decommissioning area also lies within the nursery grounds throughout the year for anglerfish, blue whiting, cod, European hake, haddock, herring, ling, mackerel, *Nephrops*, Norway pout, sandeel, spotted ray, sprat, spurdog and whiting.

Fish exhibit avoidance reactions to vessels and it is likely that radiated underwater noise is the cue. For example, noise from research vessels has the potential to bias fish abundance surveys by causing fish to move away (De Robertis and Handegard, 2013; Mitson and Knudsen, 2003). Reactions include diving, horizontal movement and changes in tilt angle (De Robertis and Handegard, 2013).

A comprehensive review by Popper and Hastings (2009) on the effects of anthropogenic sound on fish concluded that there are substantial gaps in the knowledge that need to be filled before meaningful noise exposure criteria can be developed. De Robertis and Handegard (2013) mentioned that further research is needed, to identify the stimuli fish perceive from approaching vessels and to what extent fish perceiving these stimuli will react, before further recommendations to reduce vessel-avoidance reactions can be made.

8.4.2 Pinnipeds

Pinnipeds (seals) produce a diversity of sounds within a bandwidth from 100 Hz to several tens of kHz. Their sounds are used primarily in critical social and reproductive interactions (Southall et al., 2007). Available data suggest that most pinniped species

have peak sensitivities between 1 and 20 kHz (NRC, 2003). However, the data available on the effects of anthropogenic noise on pinniped behaviour are limited. The grey seal and the harbour or common seal, are both resident in UK waters and occur regularly over large parts of the North Sea (SCOS, 2017). Seals have been reported in very low numbers in Block 15/24 and surrounding blocks of the MacCulloch area. Furthermore, due to distance from shore (170 km) seals are unlikely to be present in the area.

8.4.3 Cetaceans

Cetaceans use sound for navigation, communication and prey detection. Anthropogenic underwater noise has the potential to impact on marine mammals (JNCC, 2017; Southall et al., 2007; Richardson et al., 1995), including cetaceans.

The main cetacean species occurring in the MacCulloch area (Quadrant 15 and surrounding quadrants) are minke whale (sightings in May, July and August), killer whale (sightings in November), common dolphin (sightings in August), white-beaked dolphin (sightings throughout the year except January and April), white-sided dolphin (sightings July to September), Risso's dolphin (sightings in July) and harbour porpoise (sightings throughout the year except March and November).

There are major differences in the hearing capabilities of the different marine mammal species and, consequently, vulnerability to impact from underwater noise differs between species. Southall et al. (2007) established a classification based upon the hearing types of different marine mammal species (Table 8.1).

Table 8.1: Cetacean functional hearing groups

Frequency range	Estimated auditory bandwidth	Species sighted in MacCulloch area for the planned period of activities
Low-frequency (LF) cetaceans	7 Hz – 35 kHz	Minke whale
Mid-frequency (MF) cetaceans	150 Hz – 160 kHz	Killer whale White-beaked dolphin White-sided dolphin Common dolphin Risso's dolphin
High-frequency (HF) cetaceans	275 Hz – 160 kHz	Harbour porpoise

Source: UKDMAP, 1998; NMFS, 2018

8.5 Prediction of Injury and Behavioural Avoidance Zones

The Marsh-Schulkin model (Schulkin and Mercer, 1985) was used to predict the distance from the activities beyond which the sound level would be too low for injury under NOAA thresholds (NMFS, 2018). In addition, the Southall (Southall et al., 2007) and Nedwell dB_{ht} (species) criteria were then applied to determine avoidance zones for specific species.

In September 2016, the National Marine Fisheries Service (NMFS), part of the NOAA published a document 'Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts' (NMFS, 2016), which includes an amended set of injury thresholds and an amended set of frequency 'weightings' to compensate for the different sensitivities of groups of mammals (referred to as NOAA Guidelines hereafter). This has since been widely adopted as preferable to the use of the Southall et al. (2007) thresholds for injury and it is noted that the document includes work by many

of the same team contributing to the Southall et al. paper. The NOAA guidelines do not amend the thresholds or approach to the assessment of disturbance, only injury, using the metrics of peak sound pressure level (SPL) and cumulative sound exposure level (SELcum). These were supplemented in 2018 by an update ('Version 2.0' of NOAA Guidelines; NMFS, 2018), which does not change the thresholds, but which gives further interpretation on their use.

To compare the Southall criteria to predicted vessel operation noise levels, the non-pulse injury threshold was applied. The threshold for injury to cetaceans of 230 dB re 1 µPa m is higher than the model output Sound Pressure Level (SPL) of 195 dB re 1 µPa m. Therefore, the threshold for cetacean injury is not predicted to be exceeded for any of the decommissioning operations. Southall et al., (2007) does not provide non-pulse threshold recommendations for disturbance and therefore this method cannot be applied to determine disturbance zones.

For continuous sound such as shipping noise, it is usual to use a measure of the total sound intensity of a signal (rms). However, the larger zero-to-peak values have been used in this comparison to illustrate the worst case scenario.

8.5.1 The $dB_{ht\ (species)}$ Alternative Approach

The work of Southall et al. (2007) gives a broad indication of suitable sound thresholds for behavioural responses and injury, these can be further clarified by consideration of the alternative approach of Nedwell *et al.* (2007).

Nedwell et al. (2007) suggest that all species with well-developed hearing are likely to avoid sound when the level exceeds 50 to 90 dB above their hearing threshold and receive damage to hearing organs at 130 dB above their hearing threshold. Species-specific audiograms are used to filter received noise levels according to the hearing ability of a species, giving sound levels in $dB_{ht\ (species)}$ (loudness of the sound perceived by that species). The distance from the centre of operations to the points at which 130 $dB_{ht\ (species)}$ and 90 $dB_{ht\ (species)}$ are exceeded represents an estimate of the limits within which injury (PTS) and likely strong avoidance might be expected, respectively.

According to Nedwell et al. (2007), the sound propagation model results (Table 8.2) indicate that the noise threshold for a likely injury reaction (130 dB_{ht} (species)) is unlikely to occur for any of the cetacean species within the vicinity of the vessel operations.

The size of the strong avoidance zones will vary by species and range from 5 (grey seal) to 83 m (killer whale) (Table 8.2). The disturbance radius area is calculated based on the distance it takes for the noise level to decrease to levels below the avoidance threshold. Modelling results predicted that the noise threshold for an avoidance reaction may be exceeded for killer whale (83 m), harbour porpoise (37 m), Risso's dolphin (22 m), white-sided dolphin (17 m), harbour seal (15 m), minke whale (9 m), white-beaked dolphin (7 m) and grey seal (5 m).

Table 8.2: Predicted frequencies causing greatest effect and radii within which likely strong avoidance and injury may occur for each species for the noise generated by the MacCulloch decommissioning operations

Species[1]	Hearing threshold in range (dB)	Source level max (dB)[2]	Source level (dB_{ht} (species))[2]	Frequencies causing greatest effect (kHz)[2]	Maximum radii of injury zone (m)[2]	Maximum radii of strong avoidance zone (m)[2]
Harbour porpoise	52	177	118	8	<1	37
Killer whale	52	177	125	8	<1	83
Risso's dolphin	63	177	113	8	<1	22
White-beaked dolphin*	69	177	104	8	<1	7
White-sided dolphin	66	177	111	8	<1	17
Minke whale	90	193	103	0.1	<1	9
Grey seals	73	174	101	10	<1	5
Harbour seals	67	177	110	8	<1	15

*Audiogram for white-beaked dolphin is not available for frequency range overlapping with source. Striped dolphin audiogram was used as a proxy to obtain data, as patterns for both species are overlapping for available frequencies.

(1) No audiograms are available for common dolphin. Cetacean species presence data is given in Section 4.
(2) Propagation model outputs.

At low frequencies where the only noise source is from vessels, it is outside of the hearing range of all species except the minke whale. However; at low frequencies the vessel noise level is less than the 90 dB_{ht} (species) limit (90 dB above the hearing threshold of the minke whale), which is thought to be related to the onset of severe avoidance behaviour in the minke whale and so any contribution from the vessels need not be considered further.

8.6 Transboundary and Cumulative Impacts

The MacCulloch decommissioning area is located approximately 51 km west of the UK/ Netherlands median line. At this distance noise levels from vessels, the greatest source of sound associated with the decommissioning of the MacCulloch, would attenuate to a level lower than that likely to cause injury or temporary displacement to any cetacean species. Therefore, there is unlikely to be a transboundary impact from the noise generated by the proposed decommissioning operations at the MacCulloch area.

Within 10 km of the pipeline there are two platforms, Global Producer III (8 km southwest) and Donan (10 km northeast), both Maersk operated. There are also 31 wells within Block 15/24, and 23 pipelines that intersect the block (Oil and Gas UK, 2018).

Given the location of the proposed work, and the limited impact of MacCulloch noise related decommissioning activities, no cumulative impacts (resulting from cumulative sound sources) are anticipated with other oil and gas installations or fields.

The MacCulloch Field is not located near areas of lease by the Crown Estate or renewables (Section 4).

Source levels at frequencies below 500 Hz from dredger vessels are generally in line with those expected for a cargo ship travelling at modest speed (MALSF, 2011). It is worth mentioning that the elevated broadband noise is dependent on the aggregate type being extracted (gravel generating higher noise levels than sand) (MALSF, 2011). In addition, due to the limited impact of vessel noise highlighted by the noise modelling assessment, no cumulative impacts from aggregate extraction activity would be expected.

8.7 Proposed Mitigation Measures

Appropriate mitigation measures, in accordance with the relevant JNCC guidelines (2017), should be implemented during the proposed decommissioning operations (Table 8.3). Noise generated from vessel activities are generally not considered by JNCC to pose a high risk of injury (JNCC, 2017). The noise impact assessment undertaken supports this view, showing that it is unlikely there would be significant impact on any marine species. Consequently, it is considered unlikely that mitigation measures will be required beyond those listed in Table 8.3.

Table 8.3: Planned mitigation measures for underwater noise impacts

Potential source of impact	Planned mitigation measures
Underwater noise from decommissioning activities	Machinery and equipment will be in good working order and well-maintained. Helicopter maintenance will be undertaken by contractors in line with manufacturers and regulatory requirements. The number of vessels utilising dynamic positioning would be minimised where possible, taking into account mitigation proposed for other receptors.

8.8 Conclusions

Sound levels associated with the MacCulloch decommissioning would attenuate to ambient levels within a few kilometres of the sound source. As such, it is unlikely that sound produced by the decommissioning activities would have an effect on fish behaviour that would be noticeable at a population level when considering the limited spatial extent of the sound generated and the generally fluid, mobile nature of fish populations.

Records indicate previous sightings of up to seven cetacean species in the vicinity of MacCulloch area across the year. The listed species are all subject to regulatory protection from injury and disturbance.

A worst case scenario for the modelling of underwater vessel noise has been undertaken for the MacCulloch decommissioning considering one point source location and five vessels and is applicable for the MacCulloch decommissioning operations. This represents the maximum vessel number that may be at MacCulloch at any one time. The subsea noise levels generated by surface vessels used during the decommissioning operations are unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by vessel noise in the immediate vicinity or by any other continuous noise source during the offshore decommissioning activities at the MacCulloch area. The individual and cumulative impacts from decommissioning activities at MacCulloch are not considered significant.

9.0 SEABED FOOTPRINT

This section discusses the potential short and long-term environmental impacts associated with seabed disturbance resulting from the proposed MacCulloch decommissioning activities. The MacCulloch decommissioning activities that will impact the seabed will be confined to the decommissioning of offshore infrastructure (flowlines, umbilicals, stabilisation materials and mooring system).

9.1 Regulatory Context

Seabed disturbance resulting from the proposed MacCulloch decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

9.2 Approach

The proposed MacCulloch activities include the decommissioning of:

- Two drill centres (EDC and WDC), comprising:
  - 13 wellheads;
  - Four manifolds (PLEM (including 2 SSIVs), WDCC1, WDC2, WDC3); and
  - 16 manifold piles.
- Two mid-water arch bases;
- Mooring system
  - Nine anchors connecting wires and chains;
- Fourteen flowlines;
- Five chemical/ control umbilicals;
- 510 concrete mattresses; and
- 98 tonnes of grout bags.

These activities will require work below, at, or near the seabed which may result in disturbance to seabed sediments and background sediment concentrations. Table 9.1 summarises the short and long-term environmental impacts associated with seabed disturbance during the proposed MacCulloch decommissioning activities.

Table 9.1: Summary of potential sources of seabed disturbance and resultant environmental impacts during the MacCulloch decommissioning activities

Decommissioning activity outcome	Seabed sediment environmental impact		
	Release of contaminants	Burial, smothering and seabed scars	Change in habitat
Full removal of pipelines and mattresses	-	Short-term	-
Removal of manifolds	-	Short-term	-
Removal of mooring systems (excluding buried anchors)	-	Short-term	-
Overtrawlability surveys	-	Short-term	-
Anchoring activities	-	Short-term	-

9.3 Sources of Potential Impacts

The following represent worst-case scenarios for the MacCulloch operations and will require work at, below or near the seabed:

- Cutting operations below the seabed for the 16 manifold piles to allow full removal, including potential excavation activities to enable access for a Remotely Operated Vehicle (ROV) and/ or cutting tool (short-term impact);
- Excavation of the flowlines and umbilicals (short-term impact);
- Removal of the mooring systems, excluding buried anchors (short-term impact); and
- Overtrawlability surveys to cover anchors and 500 m safety zone area around previous FPSO location.

As discussed in Section 3 all subsea structures will undergo complete removal as part of the decommissioning activities. The only infrastructure to remain will be the remains of the manifold piles which will be cut 3 m below the seabed, and buried anchors. The structures will be lifted onto a DSV or AHV. Removal of the subsea structures will result in a short-term impact to a seabed area of approximately, 9.49 km^2 (Table 9.2).

Structures and materials to be removed as part of the MacCulloch decommissioning activities, and the approximate seabed area of disturbance are presented in Table 9.2

The following assumptions were made during the calculation of the MacCulloch seabed disturbance area:

- The maximum flowline diameter of 10”, and 50 m margins for the overtrawlability surveys were used for the calculation of flowlines and umbilical disturbance areas;
- The disturbance resulting from the removal of the jumpers, mattresses and grout bags would be covered by the overtrawl surveys of the pipelines, umbilicals and within the 500 m safety zone;
- The disturbance resulting from the removal of the mid-water arch bases will be covered by the overtrawl surveys of the 500 m safety zone; and
- To cover the disturbance resulting from the removal of the mooring system (3 x 3 mooring chains) and overtrawl surveys, the anchor pattern radius was increased to 1.5 km.

Anchors

There are nine steel plough anchors, measuring 7.1 by 6.6 m each. Anchors are buried too deep to allow survey using normal survey equipment. Based on the design criteria and discussions with the ConocoPhillips’ Subsea Department they are expected to be buried in excess of 20 m deep. Figures 9.1 to 9.3 present anchor placement pattern and design. Potential seabed impact of the anchors would be 0.0004 km^2 (9 x 7.1 m x 6.6 m), however, it is excluded from the calculations due to the depth of burial and intention to decommission anchors in situ.

Table 9.2: Structures and materials with the potential to impact on the seabed as part of the MacCulloch decommissioning activities

Structure	Dimensions of structure	Dimensions of disturbance	Seabed impact (km^2)
Flowlines x 14 and umbilicals* x 5	10 inch x 22.9 km 2 x 50 m x 22.9 km	0.10025 km x 22.9 km	2.30
Manifold system x 1	0.0115 km x 0.0092 km	0.0205 km x 0.0182 km	0.00037
Manifold system x 1	0.011 km x 0.009 km	0.02 m x 0.018 m	0.00036
Manifold system x 1	0.0160 km x 0.0125 km	0.025 m x 0.0215 m	0.00054
Manifold system (PLEM) x 1	0.0112 km x 0.0102 km	0.0202 m x 0.0192 m	0.00039
Mooring system x 3	1.035 km anchor pattern radius	1.5 km radius	7.07
Subsea structure removal total			**9.37**

*The worst-case scenario of seabed disturbance from removal of flowlines is calculated including overtrawl survey disturbance 50 m either side of the pipeline which would result in the worst seabed impact. As umbilicals run along the pipelines their length is not added to overall length of impact.

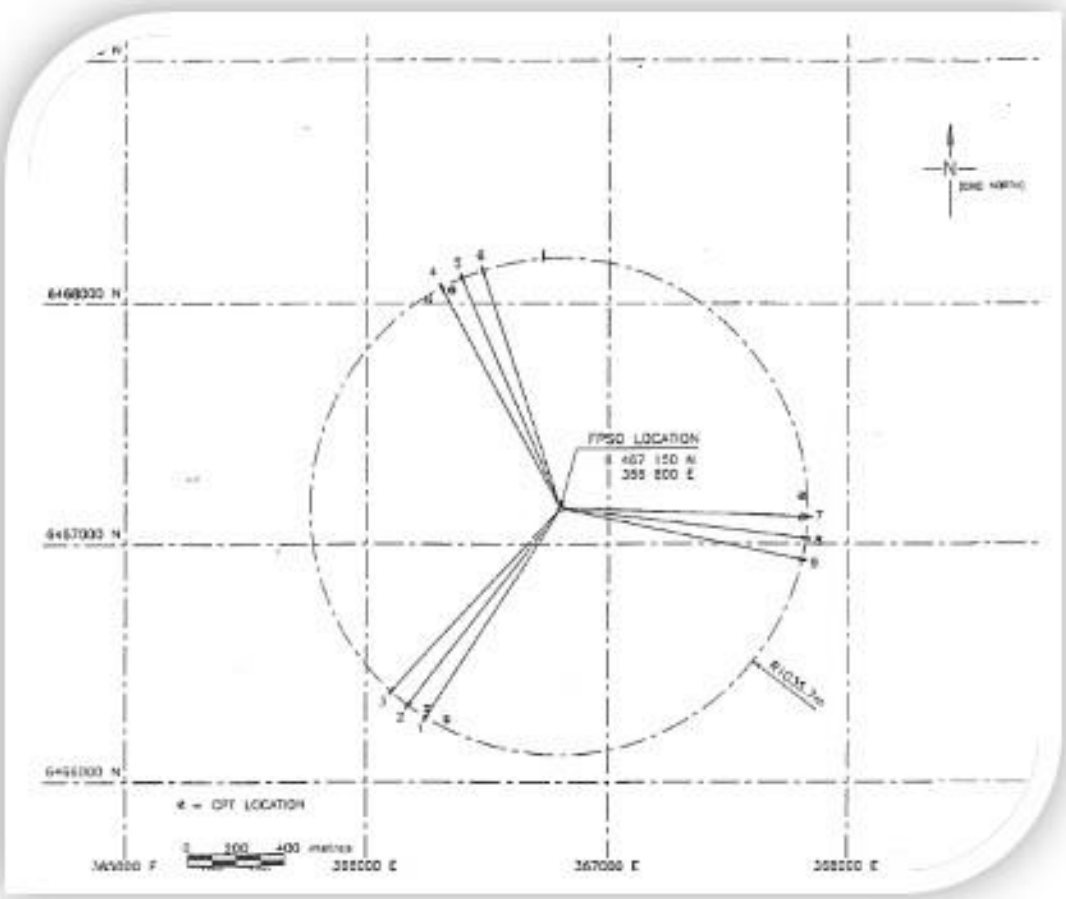

Figure 9.1: Anchor pattern at the MacCulloch Field

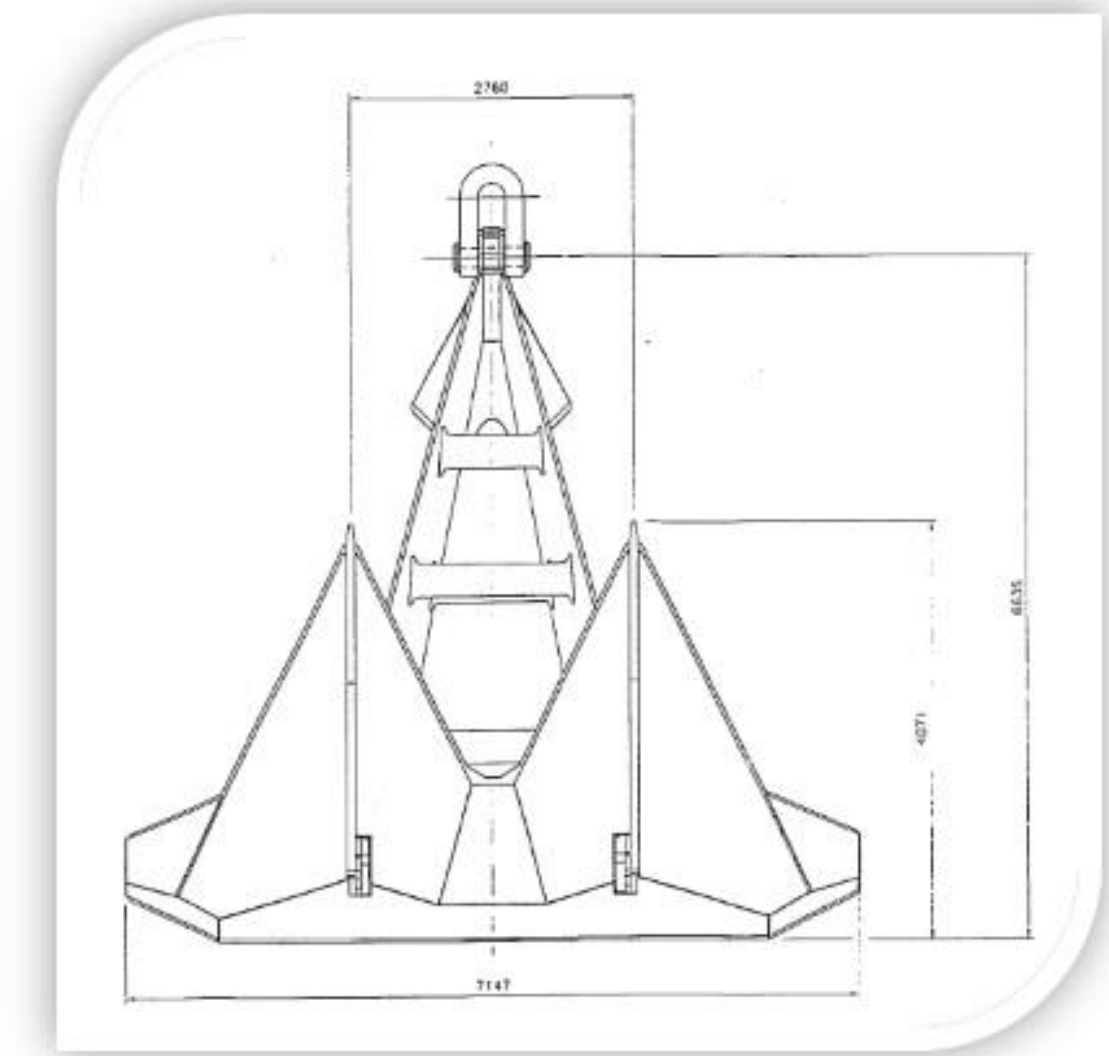

Figure 9.2: Front view of the plough anchor

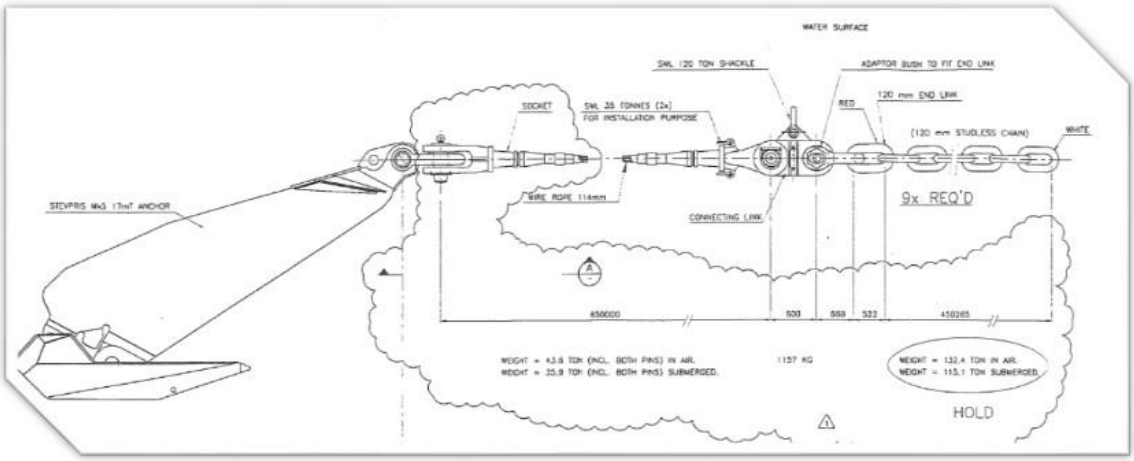

Figure 9.3: Side view of the plough anchor and connection to mooring chain

9.4 Short and Long-Term Impacts

The seabed impacts resulting from the MacCulloch decommissioning activities can be classified as short-term. The complete removal of all structures on the seabed mitigates against long-term impacts. Short-term impacts can be defined as those which have transient impacts lasting a few days to a few years. Long-term impacts are those which will continue to have an impact for decades to centuries following decommissioning.

9.4.1 Short-term impacts

Cutting, excavation and anchoring activities will be transient and will have a non-permanent impact on the local benthic environment in the MacCulloch area. The likely impacts arising from these activities can be summarised as:

- Sediment disturbance (Section 9.5.1); and
- Fauna disturbance (Section 9.5.2).

9.5 Short-Term Impacts on Sensitive Receptors

The following sections provide an overview of the spatial and temporal extent of the short-term impacts based on the current understanding of the seabed environment in the MacCulloch area. Decommissioning environmental surveys undertaken around the MacCulloch facilities provide an indication of the seabed sediments and sediment chemistry in the area (Section 4).

9.5.1 Sediment disturbance

The seabed environment of the MacCulloch area is characterised by generally weak tidal currents, readily influenced by other factors such as winds and density driven circulation. The sediments present in the vicinity of the MacCulloch infrastructure comprise course silt, medium silt or very fine sand. There are several pockmarks present in the vicinity, varying in size between <10 m and 190 m across, with depths of up to 5.5 m below the surrounding seabed and gradients of up to 13° (Gardline, 2016) (Section 4).

Excavation around and removal of the manifolds, pipelines and mooring systems from the seabed will physically disturb the sediment in the offshore MacCulloch area and could result in formation of clay berms, as evidenced by formation of seabed scars with little natural restoration observed during debris clearance survey (Gardline, 2016).

Sediments that are re-suspended during excavation activities will drift with the seabed currents before settling out over adjacent areas. The lateral spread of the re-suspended sediments is expected to be limited due to the weak subsea currents in the MacCulloch area and at worst-case, this could have a minor impact on the local community. In extreme cases, re-suspended sediments might smother surrounding benthic communities, but otherwise this impact area will be limited to the immediate vicinity of the disturbance.

Following completion of the lifting activities, due to the weak currents in the area (Section 4) the natural physical processes of sediment transportation and biological settlement may not be sufficient to restore the seabed habitat to its original condition. To minimise the adverse effects of removal activities, careful planning must be undertaken, followed by post decommissioning assessment of excavated sites and mitigation measures as required.

Overtrawlability surveys will be undertaken following completion of the decommissioning operations, to identify snagging risks and, in some cases, recover debris. The processes

of overtrawlability surveys will have a physical impact on the seabed of the area. The overall area of seabed impacted by overtrawlability surveys is estimated to be 9.37 km^2 this is summarised in Table 9.2.

The aim of debris clearance trawl sweep operations is to remove and recover all potential snagging hazards and declare the area safe for normal fishing to resume. Excavation and removal activities can result in the formation of clay berms/ seabed scars on the seabed, which have proven dangerous for trawling and have a potential to damage the catch. Purpose designed chain mats (Figure 9.4) are used to reduce the size of the clay berms/ seabed scars. ConocoPhillips will ensure that debris clearance (overtrawlability) trawl sweeps are undertaken following removal of the anchor chains and other subsea infrastructure.

Source: Scottish Fishermen's Federation Services Limited, 2018

Figure 9.4: Chain matts for removal of clay berms

9.5.2 Faunal disturbance

Fauna living on and around the seabed sediments are typical for this area of the central North Sea and moderate to high numbers of taxa and individuals have been recorded within the area (Fugro, 2013). Communities in the area are comprised of annelids, arthropods, molluscs, echinoderms and other phyla (e.g. nemerteans, phoronids and cnidarians) (Fugro, 2013) (Section 4).

The MacCulloch infrastructure lies within spawning grounds for cod, *Nephrops*, and Norway Pout as well as nursery grounds for anglerfish, blue whiting, herring, ling, mackerel, sandeel, spotted ray, spurdog, spiny dogfish, *Nephrops*, cod, European hake haddock, Norway pout and whiting (Aires et al, 2014; Ellis et al., 2010; Coull, *et al*., 1998) (Section 4).

Removal of the subsea structures from the seabed will physically disturb the benthic fauna living on or in the sediment. The disturbance to the benthic fauna will be relatively short-term, localised and confined to an estimated area of impact of 9.49 km^2 (Table 9.2). The Scanner Pockmark Special Area of Conservation (SAC) and Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA) lie within ~10 km and ~50 km, respectively, of the MacCulloch Field. Due to the weak currents in the area is unlikely that any sediments suspended as a result of the decommissioning activities will be transported to, and have an effect on, these sites.

The proposed activities will cause some direct impact to fauna living on and in the sediments within the MacCulloch area. Mortality is more likely in non-mobile benthic organisms whereas mobile benthic organisms may be able to move away from the area of disturbance and so be able to return once operations have ceased. Upon completion

of the subsea decommissioning activities, it is expected that the resettled sediment will be recolonised by benthic fauna typical of the area. This will occur as a result of natural settlement by larvae and plankton and through the migration of animals from adjacent undisturbed benthic communities (Dernie *et al*., 2003). In a series of large scale field experiments, Dernie *et al*., (2003) investigated the response to physical disturbance (sediment removal down to 10 cm) of marine benthic communities within a variety of sediment types (clean sand, silty sand, muddy sand and mud). Of the four sediment types investigated, the communities from muddy sand habitats (such as those prevalent in the MacCulloch area) had the slowest recovery rate following disturbance.

9.6 Cumulative and Transboundary Impacts

Following completion of the MacCulloch decommissioning activities, the total maximum seabed impact is expected to be approximately 9.37 km^2 (Table 9.2) with no structures left behind on the seabed.

Within 40 kilometres of the MacCulloch field there are eleven surface installations and seven major pipelines (Section 4). There are no cumulative impacts predicted to result from the decommissioning activities.

The MacCulloch field is located 51 km east of the UK/ Netherlands median line. Decommissioning activities are not anticipated to create any transboundary impacts.

9.7 Proposed Mitigation Measures

Mitigation measures to minimise seabed impacts within the MacCulloch areas are detailed within Table 9.3.

Table 9.3. Planned mitigation measures

Potential sources of impact	Planned mitigation measures
Subsea equipment cutting, excavation and lifting	• Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. • The requirements for further excavation will be assessed on a case-by-case basis and will be minimised to provide access only where necessary. Internal cutting will be used preferentially where access is available. • Post decommissioning assessment and remediation of excavated sites and clay berms.

9.8 Conclusions

The removal of the subsea infrastructure will create some temporary, medium-term disturbance of the seabed sediments, over an estimated area of 9.37 km^2. This disturbance will be largely limited to the area of decommissioning and occur due to the excavation of the seabed (where required), the manoeuvring of the ROV, the use of cutting equipment and subsequent overtrawl surveys. These activities will be controlled to minimise excavation activity and to ensure accurate placement of cutting and lifting thereby minimising the risk of sediment disturbance.

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10.0 SOCIETAL IMPACTS

This section discusses the potential short and long-term societal impacts associated with the decommissioning the MacCulloch infrastructure. The measures taken or planned by ConocoPhillips to minimise these impacts are detailed in Section 10.6.

10.1 Regulatory Context

Societal impacts generated from the proposed decommissioning activities will be managed in accordance with current legislation, guidelines and standards, as detailed in Appendix A.

10.2 Approach

During the comparative assessment for the selected decommissioning options the following issues were noted as having a societal impact:

- An increase in vessel collision risk between the decommissioning vessels and other users of the sea; and
- Foul smell resulting from marine growth on recovered inventory brought to shore.

10.3 Sources of Potential Impacts

The following provides a description of the two issues identified as having a societal impact as a result of the proposed decommissioning operations.

10.3.1 Decommissioning vessel presence

There may be the potential for short-term impacts resulting from disruption to previously established shipping operations in the area, while decommissioning vessels carry out surveys, remove infrastructure and undertake overtrawlability surveys. For the duration of the proposed activities, the physical presence of the decommissioning vessels will increase the current vessel activity in the vicinity of the MacCulloch infrastructure.

A maximum of four vessels may be present at any one time within the decommissioning area to undertake structure removal and overtrawlability trials. The type of vessels present could include:

- AHV;
- CSV;
- DSV;
- Trawler;
- Supply vessel;
- Guard vessels; and
- Survey vessels.

10.3.2 Potential snagging hazards

The majority of the infrastructure will be removed under the proposed decommissioning activities, however the mooring system anchors are being assess as decommissioned in situ due to the current depth of burial and the fact that in order to remove these a large area of sediment would need to be excavated, resulting in unnecessary additional disturbance. In their current state of burial (in excess of 20 m below the seabed), they are well within the clean seabed parameters (<0.6 m) set out by BEIS. In addition, there

are some sections of the pipework buried by rock protection as part of a crossing matrix which may pose difficult to remove and some mattresses may not be feasible to move if significantly degraded or buried. These pieces of infrastructure may pose a risk to other users of the sea, however at the point of decommissioning an as left survey will be conducted to accurately document the infrastructure location and burial state. Following this, ConocoPhillips will undertake a post decommissioning monitoring programme, the frequency and duration of which will be agreed with BEIS once the extent of any infrastructure requiring to be decommissioned in situ has been determined.

10.4 Impacts on Sensitive Receptors

Receptors potentially impacted by the proposed decommissioning activities may include:

- Commercial shipping (cargo, oil and gas related, windfarm support/ construction, etc); and
- Commercial fishing.

10.4.1 Commercial shipping

Commercial shipping traffic density within the UKCS block associated with the MacCulloch infrastructure (Block 15/24) is low (Section 4).

Vessel activity within the MacCulloch decommissioning area will be associated with:

- Decommissioning activities;
- Site specific surveys conducted before decommissioning operations commence;
- Post-decommissioning survey work; and
- Debris cleaning/ overtrawl activities.

These activities will be short in duration and accompanied by the required permitting and notifications to mariners, therefore mitigating potential impact to a negligible level of significance.

Following industry standards and notifications to mariners of planned transit routes, movement of decommissioned infrastructure to the decommissioning port(s) will not pose a significant risk to commercial shipping.

The decommissioning activities will result in a number of seabed depressions and scars resulting from the removal of the MacCulloch subsea infrastructure and excavation of pipelines and piles.

The natural recovery of anchor scars and similar depressions was observed at between 1 and 5 years, depending on the environmental conditions present (Loe, 2010; Hill et al., 2011; Thompson et al., 2011). Overtrawlability trials would be undertaken to ensure there are no berms or snagging issues associated with these depressions at the point of decommissioning.

The majority of MacCulloch vessel activities will be concentrated around pipelines and manifolds. It is assumed that these vessels will remain in place until the structures are removed. With this and the proposed mitigation measures (Section 10.6), no significant impacts to shipping are anticipated as a result of the proposed decommissioning activities.

10.4.2 Commercial fishing

With respect to commercial fishing, there is limited potential for snagging hazards (Section 10.3.2) from seabed obstructions as majority of subsea infrastructure is planned for complete removal. There is the potential for increased collision potential based on increased vessel numbers operating in the vicinity of the decommissioning area (Section 10.4.1). However, the risk posed by this will be minimised by utilising suitable mechanisms to notify mariners and other key stakeholders.

Further potential impacts may include the limited loss of access to fishing grounds during decommissioning activities. However, as discussed in Section 10.4.1, historic vessel density in the area is low. This may be due to the presence of the FPSO. As a result, once all the infrastructure is removed and decommissioning operation shave ceased, this may open the area to fishing activity.

10.5 Cumulative and Transboundary Impacts

Given the location of the MacCulloch infrastructure, approximately, 51 km to the west of the UK/ Netherlands median line, there are no transboundary impacts anticipated.

There are a number of oil and gas infrastructure in the North Sea which could potentially undergo decommissioning at the same time as the MacCulloch subsea infrastructure. Given the predominately localised and limited nature of the activities associated with the MacCulloch decommissioning programme, it is unlikely that there will be any cumulative societal impacts.

10.6 Proposed Mitigation Measures

Proposed mitigation measures to minimise societal impacts are detailed in Table 10.1.

Table 10.1: Planned mitigation measures

Potential sources of impact	Planned mitigation measures
Physical presence of decommissioning vessels causing potential interference to other users of the sea.	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Use of designated transit routes for all decommissioning vessels. • 24 hour manned bridge policy.
Damage to or loss of gear as a result of subsea obstructions.	• Majority of subsea infrastructure is planned for complete removal. • Post-decommissioning seabed clearance and an overtrawlability survey will be conducted on areas of potential snagging risk.

10.7 Conclusions

There will be a minor impact to fishing activities during the decommissioning operations in the MacCulloch area and transient loss of access for vessels during the decommissioning operations. These impacts will be reduced by minimising the number of vessels travelling to, or standing by, the MacCulloch subsea infrastructure and by notifying users of decommissioning activities via relevant Notices to Mariners. Post decommissioning any infrastructure remaining in situ will be documented and distributed to relevant authorities and a monitoring programme will be executed in agreement with BEIS's requirements.

All structural material recovered from the MacCulloch Field will be transported to shore for dismantling, and recycling or disposal as appropriate. Licensed contractors at

licensed sites will undertake dismantlement, segregation, decontamination and disposal (recycling, re-use or disposal) in accordance with site permit conditions.

11.0 DISCHARGES TO SEA

This section discusses the potential planned discharges to sea resulting from the MacCulloch decommissioning operations. Potential impacts to seabed sediments, including the associated benthic fauna are reviewed in Section 9. Any unplanned discharges during accidental events are not included, but presented in Section 12.

11.1 Regulatory Context

Discharges to sea generated from the decommissioning of the MacCulloch facilities will be managed in accordance with current legislation and standards as detailed within Appendix A.

11.2 Approach

During the decommissioning of the MacCulloch infrastructure and the associated vessel operations, the following activities or decommissioning strategies may lead to contaminated fluids and/ or solids entering the marine environment via instantaneous discharge of residual contaminants during pipeline cutting and removal operations.

This section assesses the type of potential contaminant, the magnitude of impacts to sensitive receptors and outlines the mitigation measures that ConocoPhillips will put in place.

ConocoPhillips will ensure that every effort is made to achieve an acceptable level of cleanliness to meet the intent of current Health and Safety Executive (HSE) and BEIS guidance. The decommissioning guidelines (BEIS, 2018a) encourage operators to utilise the Offshore Petroleum Activities (Oil Pollution Prevention and Control (OPPC)) Regulations 2005 Guidance Notes, in the first instance when assessing the potential for discharges to sea during operations (DECC, 2014).

During production, OSPAR Recommendation 2001/1 requires all installations to achieve a 30 mg/l performance standard for entrained oil in water intentionally discharged or unavoidably released to sea; compliance is achieved through Oil Discharge Permits as described in the OPPC guidance. The concentration of dispersed oil in water as averaged over a monthly period must not exceed 30 mg/l, whereas the maximum permitted concentration must not exceed 100 mg/l at any time.

Releases of entrained hydrocarbons or contaminated material are most likely to occur during pipeline cutting. It will be difficult to accurately monitor concentrations that escape during this process. However, during the decommissioning operations for the FPSO, the pipelines were flushed and made hydrocarbon free (<30 mg/l). Therefore, any residual volumes are thought to be low.

11.3 Sources of Potential Impacts

The following section provides an overview of the main subsurface discharge stream (excluding accidental), that may have an environmental impact, namely the cutting and removal of the pipelines.

11.3.1 Potential residual contaminants in pipelines

During the initial decommissioning phase in 2015, all pipelines, including flowlines and umbilicals, were flushed. The contents of the gas and production lines are now restricted to residual amounts of gas/ production fluids and untreated seawater, with <30 mg/l hydrocarbons. The contents of the umbilicals are restricted to seawater.

During pipeline cutting, there is the opportunity for small quantities of entrained fluids contaminated with hydrocarbons to enter the marine environment. Contaminants include residual hydrocarbons, along with dissolved organic and inorganic compounds that were present in the geological formation. The impact of discharging this fluid to the environment is dependent on several physical, chemical and biological processes including: the volume and density of discharge, dilution, volatilisation or low molecular weight hydrocarbons and biodegradation of organic compounds. Hydrocarbons do not affect all components of marine ecosystems equally (OSPAR, 2009b).

Compounds in residual fluids lost to the marine environment undergo weathering, reducing their concentration in the receiving environment and decreasing the potential toxicity to marine organisms (Neff, 1987). The dilution of residual fluids is dependent on the rate of introduction and local hydrographic conditions. Dilution rates of 30 to 100-fold occur within the first few tens of metres of the discharge point, and at distances 50 to 1,000 metres of this point, rates of 1,000 to 100,000 times are typical (OGP, 2005).

During the first hours after release, dilution is the predominant mechanism in concentration reduction. Similar entrained waste streams such as produced water present a 100-fold dilution factor within 50 m of the discharge point (Somerville et al., 1987). After it is discharged, a contaminated fluid will be first diluted by the turbulence close to the discharge point, and then widely dispersed by marine currents. Due to the low volumes of contaminants discharged from pre-flushed pipelines and the rapid dispersion in the environment, long-term or chronic effects are therefore unlikely.

11.4 Impacts on Sensitive Receptors

The potential for short-term and long-term impacts are assessed for the major taxonomic groups relevant to the central North Sea marine environment, to determine the potential scale of interaction within the vicinity of the discharge.

11.4.1 Plankton

Some localised toxicity to planktonic organisms may result from the release of fluids contaminated with entrained hydrocarbons during the proposed decommissioning operations. The localised release of such fluids is likely to become rapidly diluted within the water column to levels below concentrations known to cause lethal or sub-lethal effects to the planktonic community (Lee and Neff, 2011; Neff, 2002).

Consequently, a short-term release of any remaining contaminated fluid does not present a risk to the planktonic community. The long-term impacts of released contaminants are negligible due to the dilution factor, the low concentrations released and the time frame involved.

11.4.2 Benthic environment

It is anticipated that any contaminated fluids released during and after the proposed decommissioning activities will dilute to levels that are too low to cause significant harm to benthic organisms. Therefore, it is unlikely that benthic organisms will be impacted.

The release of solid contaminants and their impacts on the benthic fauna was discussed in Section 9.

11.4.3 Fish and shellfish

There is a low probability of fish, shellfish or other epibenthic organisms in the water column and on seabed being impacted by residual fluid or solid contaminants due to the

expected low concentrations of hydrocarbons or chemical contaminants in the seawater. There is the possibility that fish and shellfish may be exposed to chemical and/ or metal contaminants through their feeding on benthic organisms that have been exposed to low levels of contaminants. However, this food web exposure would be of a low concentration and localised, and would only impact individual organisms with little or no impact to the species' populations in the area. It is anticipated that any contaminated fluids released during and after the proposed decommissioning activities will dilute to levels that are too low to cause significant harm to benthic organisms. Therefore, it is unlikely that benthic organisms will be impacted.

11.4.4 Protected habitats and species

The MacCulloch decommissioning area is located 10.5 km from the Scanner Pockmark SAC and 52 km from the Norwegian Boundary Sediment Plain NCMPA. The short-term release of contaminated fluids or solids is unlikely to affect any of the Annex I habitats in these areas.

Annex II species sighted within the MacCulloch decommissioning area include harbour porpoise, bottlenose dolphins, grey and harbour seals. The short-term release of contaminated fluids or solids is unlikely to have a significant affect any of the Annex II species noted. Except for the harbour porpoise, all species have been observed in low numbers/ abundances. The high mobility of all these species suggests that no discernible impact on individuals or populations should be observed.

11.5 Cumulative and Transboundary Impacts

The predicted small release of contaminated fluids during cutting operations is the only potential short term or immediate impact during the decommissioning process. The discharges of oil in flush fluids are estimated to be less than 30 mg/l following the Phase I cleaning and flushing regime, the impact to the local environment will be negligible and temporary. Therefore, the potential for cumulative impacts is greatly reduced.

Previous monitoring programmes in regions with high densities of offshore installations and significant volumes of entrained water discharges, have confirmed the presence of constituent compounds around the offshore installations They have not however identified any negative environmental effects (Bakke et.al, 2013). In the North Sea, surveys of contaminants in fish tissue have not revealed elevated levels of contaminants from entrained fluids (OSPAR, 2009b). Similar results have been found for the Gulf of Mexico (OGP, 2005).

The MacCulloch subsea infrastructure are located, approximately, 45 km west of the UK/ Netherlands median line and since all identified impacts would be localised and within UK waters, no transboundary impacts are anticipated for either short term or long-term impacts.

11.6 Proposed Mitigation Measures

The key mitigation strategies proposed for potential discharges as highlighted in Section 11.3 are presented in Table 11.1 below.

Table 11.1: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Residual hydrocarbons or solids in pipelines and subsea pipework	• All pipelines were cleaned during the Phase I decommissioning process. • There will be no long-term release of residual contaminants as all pipelines will be removed.

11.7 Conclusions

For the short-term/ immediate impacts during decommissioning operations, the release of residual fluids and chemical contaminants will result in localised effects which are not expected to be significant. These are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities. There will be no long-term release of contaminants resulting from the degradation of the pipelines as they will be removed during the decommissioning process.

12.0 ACCIDENTAL EVENTS

This section evaluates the potential impacts of accidental events and the proposed mitigation measures ConocoPhillips will implement to; reduce the probability of occurrence, and ensure that the impact to the environment is reduced as low as reasonably practicable.

Regarding offshore decommissioning operations, three types of accidental event present the most likely worst-case impacts to the environment:

- Hydrocarbon release;
- Chemical spill; and
- Dropped objects.

12.1 Regulatory Context

The consequences of potential oil or chemical releases from the proposed MacCulloch decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

12.2 Hydrocarbon Releases - Approach

This sub-section examines the potential impacts of an accidental hydrocarbon release occurring during the proposed decommissioning activities.

12.2.1 Sources of potential impacts

All offshore activities carry the potential risk of a hydrocarbon loss to the marine environment. During the period from 2011 to 2017, a total of 990 tonnes of oil was discharged from 1995 individual spill events in the UKCS (BEIS, 2018b). Analysis of spill data between 2011 to 2017 identified that:

- 42% of spill records related to condensates;
- 36% to crude oil;
- 8% to diesel; and
- The remaining 14% to hydraulic oils, lubricants and other materials (BEIS, 2018b).

During 2017 on the UKCS, a total of 262 oil spills were reported to BEIS, of which 17% were greater than 1 tonne (BEIS, 2018b).

The potential sources of hydrocarbon spillages from the MacCulloch infrastructure have been identified through knowledge and experience developed from ConocoPhillips oil and gas operations in the North Sea. Based on this knowledge the following scenarios have been identified for the proposed activities[1]:

- Worst-case sinking of a vessel due to collision, releasing diesel to the sea;
- Diesel spill from a vessel;
- Loss of residual fluids from subsea structures or pipelines;
- Accidental bunkering fuel (diesel or aviation) spillage during refuelling; and

[1] Well P&A is subject to OSD assessment of well notifications by the joint competent authority but out of scope of the DP and this EA. P&A has larger potential risks with regard to reservoir hydrocarbon spill.

- Diesel storage tank loss.

Despite the small probability of a vessel collision occurring, and considering that the subsea infrastructure are expected not to contain hydrocarbon fluids, the possibility of hydrocarbon spillages and the impacts on sensitive receptors have been investigated in detail in the following sections.

Oil behaviour at sea

When oil is released to the marine environment, it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation.

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important early on in a spill whilst oxidation, sedimentation and biodegradation are more important in later stages. The behaviour of crude oil released at depth will depend on the immediate physical characteristics of the release, on subsequent plume dispersion processes, and metocean conditions (DTI, 2001).

12.2.2 Hydrocarbon properties

Hydrocarbons used in, or produced by the MacCulloch field include diesel, aviation fuel and condensate.

The MacCulloch crude has a specific gravity of 0.865 and have API of 32. Consequently, this oil is classified as ITOPF Group 3. Group 3 oils can lose up to 40% by volume through evaporation, however, due to a tendency for forming viscous emulsions during high energy conditions, the initial volume of spill may increase and natural dispersion may be reduced (ITOPF, 2012).

Diesel and aviation fuel have very high levels of volatile components, evaporating quickly on release. The low asphaltene content in these fuels prevent emulsification, reducing persistence of them in the marine environment. Whilst diesel oil is a more persistent hydrocarbon than the condensate, its characteristics and subsequent behaviour when released means that it may not represent a significant threat to the environment when compared to a crude oil spill.

12.2.3 Impact assessment and oil spill modelling

An accidental hydrocarbon release can result in a complex and dynamic pattern of pollution distribution and impacts in the marine environment. As there are a variety of natural and anthropogenic factors that can influence an oil spill, each one is unique. The extent of an oil spills environmental impact depends on variables including:

- Location and time of the spill;
- Spill volume;
- Hydrocarbon properties;
- Prevailing weather/ metocean conditions;
- Environmental sensitivities; and
- Efficacy of the contingency plans.

12.2.4 Overview of the modelling undertaken

Oil spill modelling has previously been undertaken for the MacCulloch area and is included within the Onshore Oil Pollution Emergency Plan (OPEP) and Offshore Central North Sea Field OPEP (ConocoPhillips, 2016a and 2016b). This document has been approved by the regulator. All spill scenarios undertaken for the MacCulloch area (Table 12.1) were modelled using the Oil Spill Contingency and Response (OSCAR) model Version 7.

Table 12.1: Oil spill modelling summary

Scenario*	Modelling group	Type	Release rate/ quantity	Description
S8	Group 3 - MacCulloch	Well blowout	1,463 m^3/ day (mean daily rate)	MacCulloch W12 (highest flowing well in the MacCulloch modelling group) blowout through casing
S9	Group 3 - MacCulloch	Vessel/ MODU diesel inventory loss	2,128 m^3 (instantenous)	Semi-sub MODU at MacCulloch, diesel inventory loss

*Only scenarios relevant to MacCulloch are presented in the table

12.2.5 Impacts on sensitive receptors

The potential for short-term and long-term impacts are assessed for the major taxonomic groups relevant to the central North Sea marine environment, to determine the potential scale of interaction within the vicinity of an accidental spill. Socioeconomic and shoreline impacts are also described below.

Biological receptors

Although there is only a small likelihood of a hydrocarbon spill from MacCulloch, there is a potential risk to organisms in the immediate marine environment if a spill were to occur. Table 12.2 summarises the potential effects of an oil spill to marine life during the MacCulloch decommissioning operations.

As most spills are likely to be on the surface, both planktonic and benthic communities are less likely to be influenced by an accidental spill. Other communities including fish, birds and marine mammals may incur more significant impacts. For a detailed description of the environmental sensitivities in MacCulloch area, please refer to Section 4.

Shoreline impact

Spill modelling undertaken for the OPEPs (ConocoPhillips, 2016a and 2016b) that are relevant for MacCulloch, predict that following well blowout oil may reach the UK coastline with a probability of 2.7%, while diesel will not beach (Table 12.3).

The actual hydrocarbon volume remaining in the pipelines following cleaning activities in 2015 will be residual; therefore, it is unlikely that the low volume will result in a coastline impact. In addition, the actual characteristics of condensate will result in a lesser impact than the marine diesel modelled.

Table 12.2: Summary of potential impacts to main biological receptors in the MacCulloch decommissioning area

Biological receptor	Impacts to biological receptors at risk in the MacCulloch area
Plankton	Localised effects to plankton community due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation.
Benthos	The impact from the condensate or diesel to benthic species or the seabed would be localised. Benthic communities may be affected by gross contamination, with recovery taking several years. Mortality would be dependent on oil sensitivity, potentially leading to structural change in the community. The subsurface release of condensate or the surface release of diesel is unlikely to impact benthic communities and therefore the risk is considered minimal.
Fish, spawning and nursery grounds	Three species of fish and shellfish spawn in the decommissioning area (Ellis *et al*., 2010; Coull, *et al.,* 1998). The MacCulloch infrastructure also coincide with nursery grounds for 14 species of fish and shellfish (Aires *et al.*, 2014; Ellis *et al.,* 2010; Coull, *et al.,* 1998). These species are present throughout the year. Adult fish are expected to avoid the affected area, but if affected, hydrocarbons may result in tainting of the fish, and hence in a reduction of commercial value. Eggs and larvae may be affected, but such effects are generally not considered to be ecologically important because eggs and larvae are distributed over large sea areas. Demersal species may be influenced by habitat pollution.
Seabirds	Seabird sensitivity to surface pollution has been recorded as medium to low between January and October in the UKCS block 15/24. Very high sensitivity was recorded in January and December in neighbouring Block 15/28. No data were available for November and December for most blocks (Webb et al., 2016).
Marine mammals	The main cetacean species occurring in the decommissioning area are Harbour porpoise, White-beaked dolphin and White-sided dolphin, with sightings occurring throughout the year. Further species observed in the surrounding areas include Minke whale, Common dolphin, Killer whale and Risso's dolphin (UKDMAP, 1998, Reid et al., 2003 and NMPi, 2018; Section 4). Harbour and grey seals have been observed in varying densities throughout the decommissioning area (NMPI 2018; Section 4) Potential effects may include inhalation of toxic vapours, eye/ skin irritation and bioaccumulation. Ingestion of oil can damage the digestive system or affect liver and kidney function. Loss of insulation through fouling of the fur of young seals and otters increases the risk of hypothermia. Oil contamination can impact food resources directly through prey loss or indirectly through bioaccumulation. However, it is expected that marine mammals would avoid the area if a spill were to occur.
Offshore protected habitats and species	The decommissioning area is located 10.5 km northwest of the Scanner Pockmark SAC and 52 km northwest of the Norwegian Boundary Sediment Plain NCMPA. Annex II species sighted within the decommissioning area include Harbour porpoise, Bottlenose dolphins, Grey seals and Harbour seals.
Inshore protected habitats and species	Based on oil spill modelling, there is very low probability that coastal habitats will be affected by a potential oil spill from the MacCulloch area.

Table 12.3: Oil spill modelling output summary

Scenario*	Scenario type	Description	Probability of crossing median line	Maximum probability of beaching
S8	Well blowout	W12 blowout through casing	Norway, 100%	UK, 2.7%
S9	Vessel/ MODU diesel inventory loss	Decommissioning MODU at MacCulloch	Norway, 6%	Does not beach

*Only scenarios relevant to MacCulloch are presented in the table

Socioeconomic receptors

Several socioeconomic receptors may be impacted by a potential spill from the proposed decommissioning activities and are described in Table 12.4.

Table 12.4 Summary of main socioeconomic receptors

Socioeconomic receptor	Impacts to socioeconomic receptors at risk in the MacCulloch area
Fisheries	Fishing is one of the primary economic activities in the EU and it supports other shore-based activities including fish processing and boat construction. The impacts to offshore fishing are limited to the period that oil remains on the surface as access to fishing grounds would be limited. There is the potential for fish that come into contact with oil to become tainted, precluding commercial sale. There is no UKCS evidence of any long-term effects of oil spills on offshore fisheries. The UK landings within the decommissioning area are moderate, with the exception of the pelagic which were low (Section 4).
Tourism	Due to the offshore location of the MacCulloch infrastructure (>200 km) suggests that there is unlikely to be any impact on coastal tourism.
Shipping	Shipping density in the decommissioning area is low (BEIS, 2017). Shipping lanes are used by shuttle tankers, supply and standby vessels serving the offshore oil installations in the area. Although all may potentially be impacted by an oil spill, the impacts likely last only while oil is on the sea surface, as this may restrict access. However, it is unlikely that there will be any long-term impacts on this industry.
Oil and gas	The oil and gas industry is well established in the North Sea. Although the receptors may potentially be impacted by an oil spill, the impacts would likely last only whilst there is oil on the sea surface, as this may restrict access to installations for instance However, it is unlikely that there will be any long-term impacts on this industry.

12.2.6 Cumulative and transboundary impacts

Residual, cumulative and transboundary impacts expected as a result of an accidental oil spill event are summarised in the following sub-sections.

Cumulative impacts

Cumulative effects arising from the proposed decommissioning activities have the potential to act additively in combination with other oil and gas activity. This includes both existing activities and new activities, and may act additively with those of other human activities (e.g., fishing and marine transport of crude oil and refined products) (DTI, 2004).

Any hydrocarbon discharge resulting from the proposed decommissioning activities would be expected to disperse rapidly in the immediate environment, without the potential to combine with other discharges from concurrent incidents. It is difficult to

predict whether the impacts from an oil spill, to the marine ecology of the affected area, would be cumulative. This would depend on previous disturbances or releases at specific locations. Cumulative effects of overlapping "footprints" for detectable contamination or biological effects are considered to be unlikely. No significant synergistic effects are currently identified (DTI, 2004).

Transboundary impacts

There is a probability that a hydrocarbon spill would cross into Norwegian sector. Modelling predicts that following well blowout there is a 100% of probability of oil crossing into Norwegian sector, while a diesel spill will only cross the median line in extreme conditions, i.e., continuous 30 knot wind blowing in the direction of the median line, with a probability of 6% (Table 12.3). It should be noted that the modelling was undertaken for the well at its full capacity, which is currently largely depleted.

In the event of any oil slick crossing it the Maritime and Coastguard Agency (MCA) Counter Pollution and Response Branch has agreements with equivalent organisations in other North Sea coastal states, under the Bonn Agreement 1983. Applicable international arrangements are further described in Appendix A.

12.2.7 Proposed mitigation measures

Mitigation and management primarily focus on preventing or minimising the probability of an accidental spill and secondly, reducing the consequences of the event through optimum and efficient containment and release response. During decommissioning, minor non-routine and emergency events such as minor leaks, drips and spills from machinery and hoses on the platform, from vessels or at onshore sites, could cause a localised impact. The accidental release of small quantities of oil would be minimised as far as possible through appropriate management procedures and mitigation measures. The effects of such releases could be rectified quickly on site and they would be managed through vigilance, operational, inspection and emergency procedures, and specific safeguards such as on-site clean-up equipment and containment measures. For these reasons, such minor events have been excluded from this assessment as they will be managed under normal operational procedures and controls.

The response to all spills is detailed in the OPEPs (ConocoPhillips, 2016a and 2016b). Table 12.5 lists the planned measures to prevent or reduce the likelihood of a spill occurring during the proposed decommissioning activities. Based on the estimated volumes of diesel and condensate, the ConocoPhillips response capability for both counter pollution and containment can provide an appropriate level of response to a spill. The mitigation measures and contingency plans in place would consider all foreseeable spill risks and would ensure that the spill risk is reduced to as low as reasonably practicable.

Table 12.5: Oil spill preventative measures for likely spill scenarios occurring during decommissioning activities

Potential source of impact	Planned mitigation measures
All oil spills	The OPEPs (ConocoPhillips 2016a and 2016b) have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The OPEPs detail responsibilities for initial response and longer-term management, and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the size of the spill: • Tier 1 - standby vessel equipped with dispersants and spraying equipment; • Tier 2 - air surveillance and dispersant spraying through Oil Spill Response Ltd. (OSRL); and • Tier 3 - clean-up equipment and specialist staff available through OSRL. In addition, ConocoPhillips have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability Fund (OPOL).
Vessel collision	Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	In the event of an accidental spill to sea, vessels will implement their SOPEP.

12.2.8 Conclusions

The conclusions from the impact assessment for an accidental hydrocarbon release are that the:

- Worst-case scenario at the decommissioning area would result from a loss of diesel from on-site vessels or collision;
- Condensate and diesel spills will disperse and dilute quickly, with no significant impact to coastlines;
- Probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area; and,
- Response in the OPEPs will provide the direction to effectively manage the spill in case of an accidental event.

12.3 Chemical Releases - Approach

An accidental chemical release can result in a complex and dynamic pattern of pollution distribution and impact to the marine environment. The number of factors that could influence an accidental chemical spill, both natural and anthropogenic, renders each spill unique. Potential sources of impact are presented in the following sub-sections, and include a review of the sensitive receptors that may be influenced. In many cases, both impacts and receptors have been detailed in the hydrocarbon release section (Section 12.2). Where the chemical release impacts differ from those described in the hydrocarbon release section, they will be discussed in further detail.

12.3.1 Methodology

As part of the decommissioning process it is important to consider the magnitude of a potential chemical spill and assess the effects of such an unplanned event on key sensitive receptors.

12.3.2 Sources of potential impact

Technical failure remains the leading cause of chemical spills in the North Sea. The primary sources of loss to the environment are from spills of hydraulic fluids or chemicals. From the proposed decommissioning activities, the most likely incident would be the accidental loss of fluids during subsea or topsides removal.

12.3.3 Impacts on sensitive receptors

Chemical release into the marine environment may impact sensitive receptors in different ways, depending on the following factors:

- Spill volume;
- Depth of release;
- Chemical toxicity;
- Chemical solubility;
- Persistence in the environment;
- Biodegradability of the compound;
- Potential for bioaccumulation in the food chain; and
- Partitioning of individual components.

Biological receptors

Section 4 and Table 12.3 provide a comprehensive description of the biological receptors in the decommissioning area sensitive to potential chemical spills. Due to the rapid dispersion and dilution of chemicals upon discharge or release, few biological receptors are noticeably impacted. The most sensitive receptors are the planktonic communities.

Plankton (phytoplankton, zooplankton and fish larvae) are likely to come into direct contact with discharged chemicals, with zooplankton appearing to be the most vulnerable particularly at the early stages of development. However, the impact of a chemical spill is not likely to impact beyond the immediate vicinity of the discharge point because:

- The likely credible maximum volume of chemicals that may be subject to a spill event would be very low;
- Discharge is likely to be dispersed and diluted rapidly by the receiving environment;
- Many of the compounds are volatile or soluble and are removed from the water by evaporation and dilution; and,
- Biological Oxygen Demand (BOD) is likely to be within the capacity of ambient oxygen levels.

Socioeconomic receptors

The main socioeconomic receptors relevant to a hydrocarbon spill are presented in Table 12.4 and in most cases; this information is also pertinent to chemical spills. Dispersion, dilution and potentially very small volumes spilt will result in localised impact areas. No significant socioeconomic impacts are foreseen for fisheries, tourism, oil and gas, or shipping.

12.3.4 Cumulative and transboundary impacts

The majority of chemical spills are unlikely to result in an environmental impact, due to a combination of rapid dispersion and dilution of the chemicals and the depth and distance from shore (>200 km) of the MacCulloch infrastructure. The potentially spilt volumes are unlikely to pose any noticeable risk to residual, cumulative or transboundary impacts.

12.3.5 Proposed mitigation measures

The impacts of all the chemicals that may be used or discharged offshore during decommissioning will be assessed and reported to BEIS in a relevant permit application.

The proposed mitigation measures to reduce the likelihood of chemical spills to the environment are presented in Table 13.6.

Table 12.6: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Chemical spills from the decommissioning activities	• ConocoPhillips will conduct all operations in a controlled manner with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. • Phase I activities, including pipeline flushing, removed chemical inventories.

12.3.6 Conclusions

The conclusions from the impact assessment for a chemical release are:

- Chemical spills will disperse and dilute quickly, with only localised effects to planktonic communities;
- Probability of a chemical spill occurring is low and will not significantly add to the overall spill risk in the area.

12.4 Dropped Objects - Approach

There is the potential for the loss of objects during the decommissioning process. Depending on the size of the objects, they may present a hazard to shipping and subsea infrastructure and to fishing activities such as trawling. Dropped objects may also impact on the seabed community within the drop zone. Dropped objects can vary in size from tools to large sections of subsea infrastructure or the loss of a vessel.

12.4.1 Sources of potential impact

The likely worst-case scenario which imposes the greatest environmental and socioeconomic impact for a dropped object would be the loss of a large section of subsea infrastructure from the removal phase of the project. As a result of an accident, a section of the infrastructure could fall to the seabed whilst being transferred to a vessel. This type of event may cause localised effects in the water column, on the seabed or to the benthos. The extent and severity of these effects would depend on the object lost and the amount of seabed and sediment disturbed. Any impacts would be short term as all dropped objects would be recovered where physically possible.

12.4.2 Impacts on sensitive receptors

Potential impacts on biological and socioeconomic receptors from of an accidental dropped object are described in the following paragraphs.

Biological receptors

In the event of a dropped object, the dominant receptors are the infaunal and epibenthic communities within the drop zone. Section 4 presents a summary of the project specific surveys undertaken.

Whilst the impact of a dropped object on the immediate drop zone may be significant, the effect is likely to be localised. The benthic community beyond 500 m from MacCulloch infrastructure is indicative of and comparable in diversity and composition with surrounding areas of the North Sea (as detailed in Section 4). Therefore, the impact of a dropped object would have no significant impact on the wider community. No other biological receptors would be impacted by a dropped object.

Socioeconomic receptors

Any dropped objects will be recovered during decommissioning operations and an independent seabed debris clearance survey conducted once decommissioning operations have been completed to verify that a clean seabed has been left. No impacts relating to other socioeconomic receptors have been identified from dropped objects.

12.4.3 Cumulative and transboundary impacts

In case of a potential loss of objects during the decommissioning process, the impacts will be temporary and will only cause disturbance to a localised area of seabed and the associated water column. They will not have any residual effects and will not contribute to cumulative or transboundary impacts.

12.4.4 Proposed mitigation measures

Appropriate mitigation measures in the event of a dropped object should be implemented during the proposed decommissioning operations (Table 12.7).

Table 12.7: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Dropped object event from the decommissioning activities	• All efforts will be made by ConocoPhillips to minimise the number of dropped objects. During the preparation for removals programme, items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects the MacCulloch infrastructure wherever practicable. The recovery of such debris will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea wherever possible.

12.4.5 Conclusions

The conclusions from the impact assessment for a dropped object include:

- Worst case scenario would be the loss of a major portion of the subsea infrastructure during lifting operations;
- Depending on the size of the item, dropped objects may present a hazard to shipping and subsea infrastructure and fishing activities such as trawling; and,
- Post decommissioning surveys will provide locations of dropped objects and assist in their removal where practicable.

13.0 WASTE MANAGEMENT

Decommissioning activities will generate quantities of controlled waste, defined in Section 75(4) of the Environmental Protection Act 1990 as household, industrial and commercial waste or any such waste. The sequence and quantities of controlled waste generated at any one time will depend on the processes used for dismantling and the subsequent treatment and disposal methods.

Three key challenges are associated with waste management for the MacCulloch infrastructure:

- Generation of large quantities of controlled waste within short timeframes. This will require detailed planning to manage the logistics associated with the transport to shore, temporary storage and onward treatment/ disposal of materials.
- Potential for “problematic” materials, generated due to cross–contamination of non-hazardous waste with substances that have hazardous properties, which results in the material being classified as hazardous waste. Hazardous waste is defined as material that has one, or more, properties that are described in the Hazardous Waste Directive (91/689/EEC) as amended by Council Directive 94/31/EC.
- Problems associated with materials with unknown properties at the point of generation. These quantities of ‘unidentified waste’ require careful storage and laboratory analysis to determine whether they are hazardous or non-hazardous waste.

In accordance with the BEIS Guidance Notes under the Petroleum Act 1998 (BEIS, 2018a), the disposal of such installations should be governed by the precautionary principle. ConocoPhillips will assume the worst-case, especially when dealing with hazardous and unidentified wastes, and choose waste treatment options which would result in the lowest environmental impact.

13.1 Waste Generation

ConocoPhillips will follow the principles of the waste hierarchy as described in Section 13.3. Typical non-hazardous waste will include scrap metals (steel, aluminium and copper), concrete and plastics that are not cross-contaminated with hazardous waste and can therefore be removed and recovered for reuse, recycling or landfill. Hazardous waste will include oil contaminated materials and chemicals. Many types of hazardous waste generated during decommissioning are routinely generated during production and maintenance of offshore installations. However, the decommissioning process may generate significantly greater quantities of both non-hazardous and hazardous waste when compared to routine operations and as such requires appropriate management.

An estimate of the different types of materials and quantities in the MacCulloch infrastructure to be decommissioned, are detailed in Section 3.

13.1.1 Radioactive waste

Radioactive wastes such as NORM associated with pipework will be managed in line with current legislative requirements (Appendix A). On 1 September 2018, the Environmental Authorisations (Scotland) Regulations 2018 (EA(S)R) came into force for radioactive substances activities in Scotland and replaced the Radioactive Substances

Act 1993 associated Exemption Order and the High-Activity Sealed Sources and Orphan Sources Regulations 2005.

13.2 Regulatory Context

There is no waste related legislation that specifically covers decommissioning activities, however some aspects of existing waste legislation are relevant (Appendix A).

Whether a material or substance is 'waste' is determined by EU law. The EU Waste Framework Directive (WFD) (2008/98/EC) defines 'waste' as "any substance or object which the holder discards or intends or is required to discard". The Directive provides a list of definitions.

The responsibility for waste management lies with the producer or waste holder. The action of removal and transfer of redundant installations and infrastructures to shore falls within the legal definition of waste. The responsibility for determining whether a substance or object is waste lies with the Operator.

Having determined the substance or object is waste, subsequent storage, handling, transfer and treatment of the waste generated is then governed by several regulations. An overview of the legislation is available in Appendix A.

If the selected disposal yard is in a country outside of the UK, the waste will be dealt with in line with the receiving countries waste legislation.

13.3 Waste Management

The waste hierarchy is a conceptual framework which ranks the options for dealing with waste in terms of their sustainability (Figure 13.1). For the onshore treatment and disposal of MacCulloch material, ConocoPhillips will follow the principles of the waste hierarchy to minimise waste production.

The waste hierarchy is a key element in OSPAR Decision 98/3 and BEIS Guidance Notes (BEIS, 2018a) and requires that the decommissioning decisions are consistent with the waste hierarchy. ConocoPhillips recognises that, in line with the waste hierarchy, the reuse of an installation or its components is first in the order of preferred decommissioning options for waste. However, as the majority of the MacCulloch infrastructure are obsolete and/ or in a degraded condition, they are not considered suitable for safe re-use. The majority of the pipelines and moorings chains will be recycled. All mattresses removed to shore are assumed to be placed in landfill in absence of identifying suitable reuse options.

Source: http://www.sepa.org.uk/waste/moving_towards_zero_waste/waste_hierarchy.aspx

Figure 13.1 The waste hierarchy

Non-hazardous materials, such as scrap metal, concrete, and plastics not contaminated with hazardous waste, will be removed and, where possible, be reused or recycled. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Steel accounts for the greatest proportion of the materials inventory.

Where necessary, hazardous waste resulting from the dismantling of the MacCulloch facilities will be pre-treated to reduce hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling. Under the Landfill Directive, pre-treatment will be necessary for most hazardous wastes which are destined to be disposed of to landfill site.

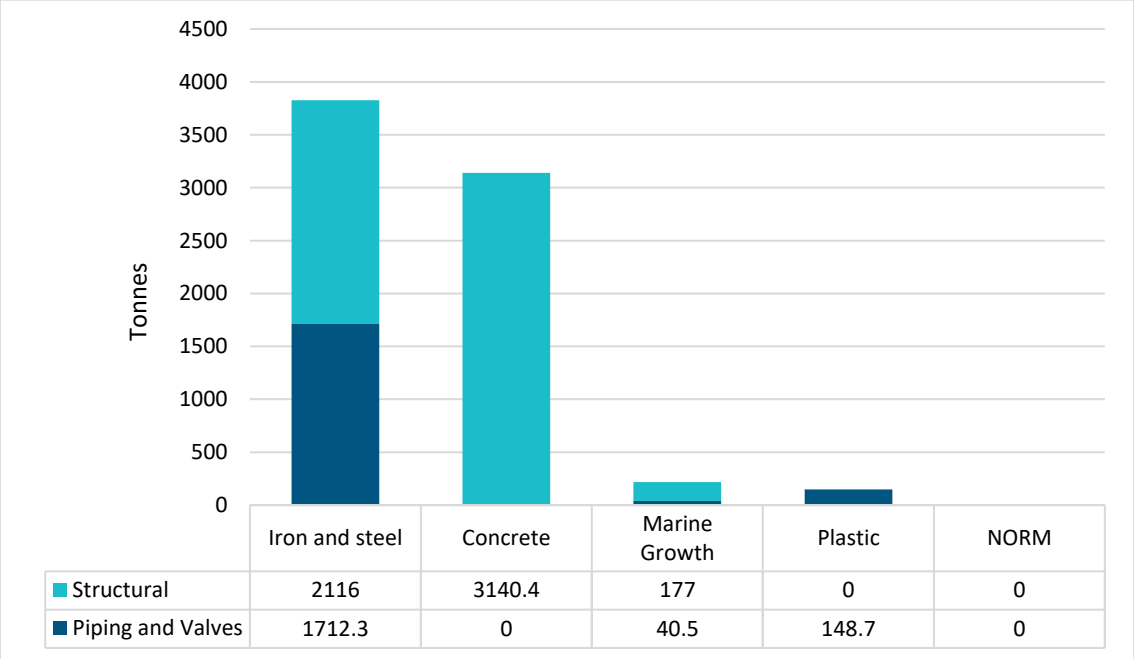
Tables 13.1 outlines the fate of decommissioned material, whilst Figure 13.2 provides a comparative breakdown of materials across the infrastructure. Figure 13.3 provides a breakdown of eth final fate of the inventory listed in Table 13.1.

Table 13.1: Proposed fate of materials

Infrastructure	Inventory	Recommended decommissioning option	Destination
Grout bags	• 98 Te (estimated)	• Full removal.	• Reuse or recycling.
Jumpers	• x 54	• Full removal.	• Planned for recycling.
Manifolds	• x 4	• Full removal. • Piles cut to 3 m below seabed surface.	• Planned for recycling.
Mattresses	• x 510 (estimated)	• Full removal.	• Disposal via landfill*.
Midwater Arch bases	• 2 x MWA bases	• Full removal.	• Planned for recycling.
Mooring system	• 9 x Mooring chains and wire	• Full removal. Cut and lift.	• Potential for entire inventory to be recycled. • Disposal method still to be confirmed.

Pipelines	• 14 x flowlines •	• Full removal. Cut and lift.	• Treatment for NORM. • Planned for recycling.
Umbilicals	• 5 x umbilicals •	• Full removal. Cut and lift.	• Treatment for NORM. • Disposal via landfill.
Control modules	• x 10	• Full removal	• Planned for recycling

*This is assumed in the absence of identifying reuse options.



	Iron and steel	Concrete	Marine Growth	Plastic	NORM
Structural	2116	3140.4	177	0	0
Piping and Valves	1712.3	0	40.5	148.7	0

* Other constitutes mixed construction and demolition wastes other than those mentioned in codes 170901, 170902 and 170903.

Figure 13.2 Materials inventory by functional category

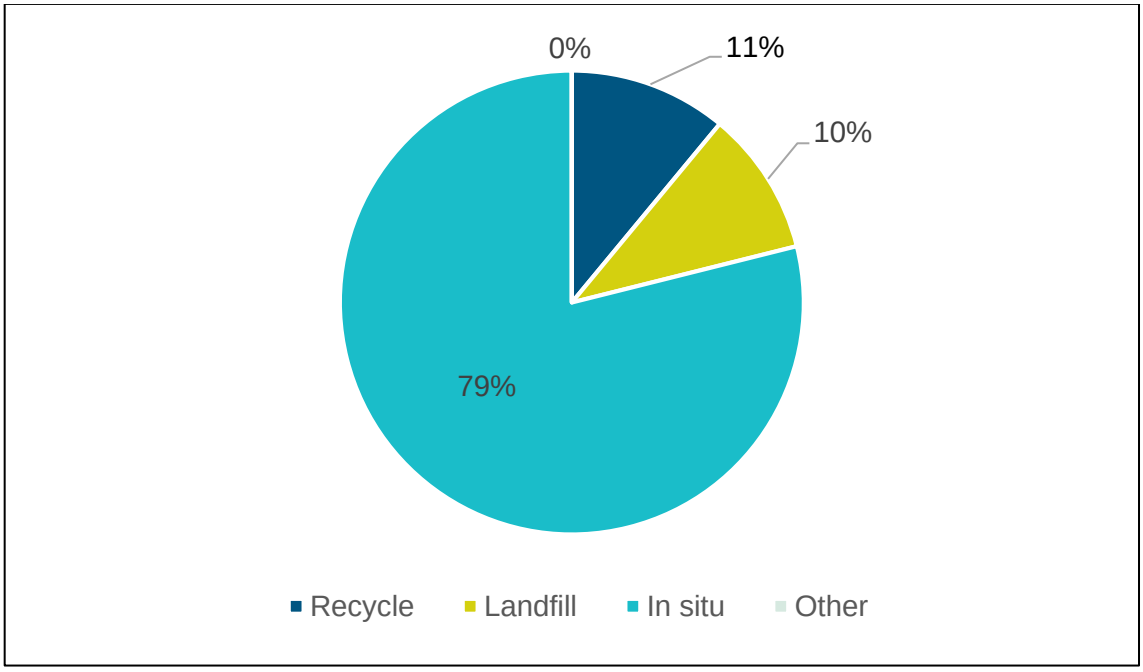


Figure 13.3: Pie chart of estimated material disposal route percentages for the MacCulloch infrastructure

ConocoPhillips aim to recycle 97% of the removed material. The management of waste generated from operations and drilling activities has been addressed by ConocoPhillips through an ISO14001 certified Environmental Management System (EMS) (as presented in Section 14). The EMS includes a documented procedure for waste management which is designed to ensure that all waste generated during the ConocoPhillips offshore activities are managed according to the Company's Health, Safety and Environment (HSE) policy and relevant legislation.

Specifications to manage the waste generated during decommissioning will conform to the requirements of the ConocoPhillips EMS (ConocoPhillips, 2018d) as follows:

- Undertake a review of the EMS and update it to ensure that significant environmental impacts and legislative requirements, as a result of waste generation and treatment during decommissioning, are adequately recorded and assessed, and any requirements for operational controls or other management actions are identified.
- Prepare an Active Decommissioning Waste Management Plan.

13.3.1 Environmental management system

Sustainable Development is a key consideration when conducting business. For ConocoPhillips this is about conducting business while promoting economic growth, a healthy environment and vibrant communities, now and into the future. The ConocoPhillips world-wide and UK Health Safety and Environmental Polices are implemented in the UK through an independently verified EMS which covers all activities carried out by ConocoPhillips both onshore and offshore. The underlying policies, processes and EMS are described in more detail in Section 14.

13.3.2 Contractor management

Waste management activities include the handling, storage and treatment of waste offshore, the transfer of waste to a waste treatment or dismantling yard for further storage, handling and treatment as appropriate, and then further transfer to the final disposal or treatment point. These activities will be conducted by contractors and sub-contractors on behalf of ConocoPhillips using their own waste management systems. The waste contractors/ sub-contractors will also undertake all necessary paperwork including the tracking of wastes, accounting and identification of wastes, wastes generated per asset and waste segregation. Although ConocoPhillips will not be undertaking the actual physical work, the legal liability, i.e. Duty of Care, for all waste generated from decommissioning remains with ConocoPhillips for the duration of the programme.

The selection and management of contractors by ConocoPhillips is managed through the contractor control processes and procedures. Specific targets to maximise re-use and recycling, minimisation of waste to landfill, and the use of innovative solutions with contractors/ sub-contractors would be agreed at this stage and included in the disposal yards contract. Specific actions to support the management and minimisation of waste generated by contractors during decommissioning will include:

- Ensuring that waste management issues are covered within the contractor interface documents; and
- Engaging with contractors to identify effective technical solutions that support waste minimisation with the reuse and recycling of waste, if possible.

The procedures and processes for waste and contractor management will be embedded in the EMS, detailing actions, roles and responsibilities of personnel from within ConocoPhillips and the various contractors working on an individual decommissioning project. Specific audit/ monitoring schedules will be set up as part of the disposal yard contract award and will comply with the ConocoPhillips Corporate Waste Disposition Standard.

13.3.3 Measuring and monitoring performance

Measuring and monitoring performance is an important element of an EMS and ConocoPhillips already has a number of mechanisms in place to do this (ConocoPhillips, 2015). With respect to the management and minimisation of waste during the decommissioning of the MacCulloch infrastructure, the key areas for action:

- Monitoring legislative compliance; and
- Measuring performance against stated targets.

A range of methods will be used to ensure effective monitoring of waste management activities including, for example, auditing of contractors and disposal sites, monthly waste statistic summaries and the use of disposable yards materials tracking tools.

14.0 ENVIRONMENTAL MANAGEMENT

This section introduces relevant ConocoPhillips corporate policies and details by which ConocoPhillips will manage the environmental aspects of the MacCulloch decommissioning activities. This section also catalogues the commitments made in support of the decommissioning proposals and provides a delivery mechanism for these commitments.

14.1 Health, Safety and Environmental Policy

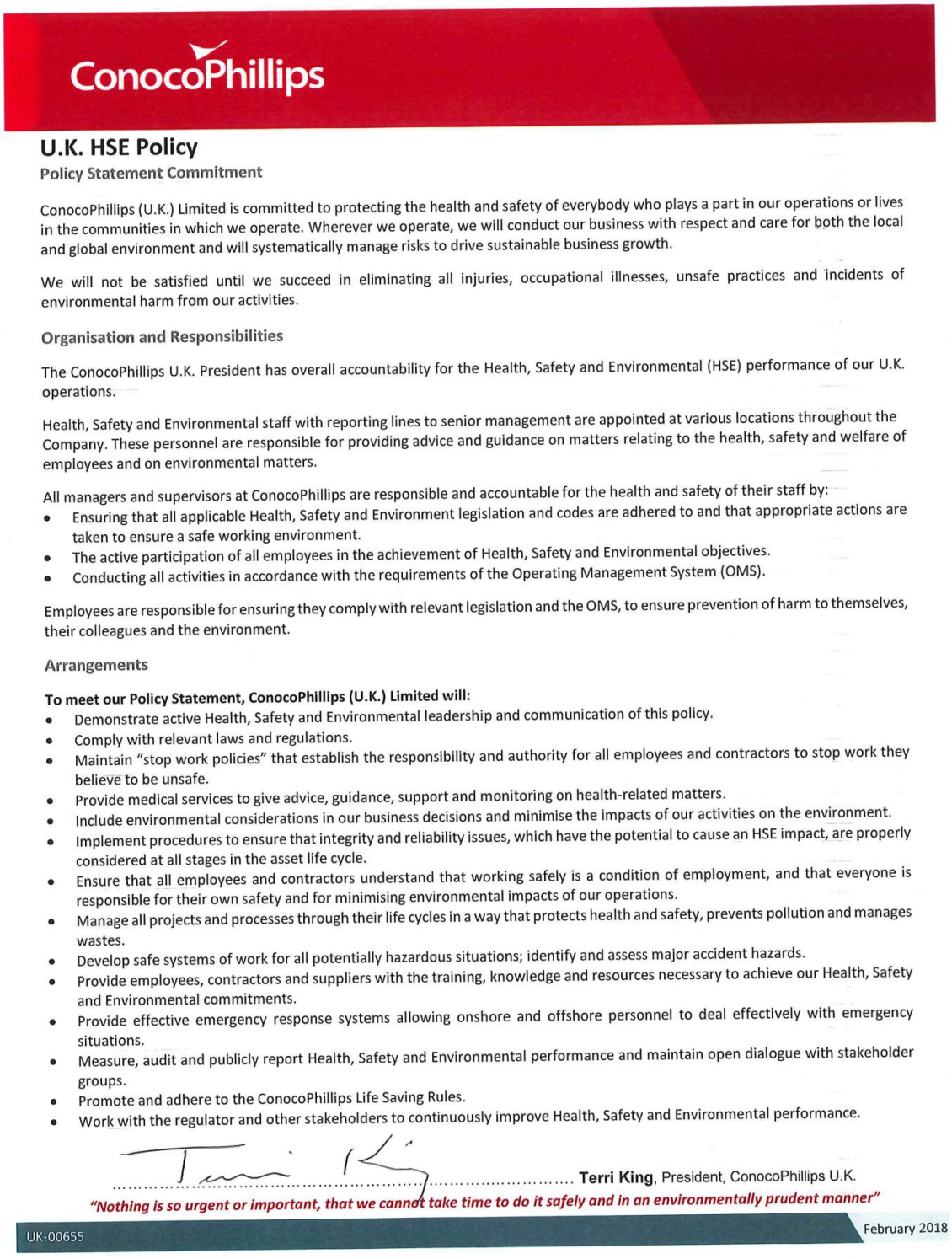
ConocoPhillips takes all reasonable precautions to achieve the goal of harm-free operations. The ConocoPhillips (U.K.) HSE Policy (Figure 14.1) presents the company's public commitment to conducting business in a manner that protects the health and safety of people and preserves the integrity of the environment within which it operates. It is endorsed by top management who are responsible for ensuring its implementation. Line managers have primary responsibility for ensuring compliance with the Policy and for effective communication of the policy commitments and requirements to their staff.

The HSE Management System Standard provides corporate expectations for the business' HSE Management System which is the primary tool used to execute the commitments made in the HSE Policy. The HSE Management System adheres to a continuous improvement lifecycle and includes key elements such as risk assessment, incident and near miss reporting and investigation, HSE training, audits and annual review and goal setting.

14.2 ConocoPhillips HSE Management System

ConocoPhillips' environmental policies have the underlying principle of conducting business with respect and care for the environment in which the company operates.

The ConocoPhillips (U.K.) HSE Policy provides a framework for the integrated management of environmental issues related to the company's U.K. business activities. It commits the company to comply with environmental legislation and strive for continuous improvement in environmental performance.



ConocoPhillips

U.K. HSE Policy

Policy Statement Commitment

ConocoPhillips (U.K.) Limited is committed to protecting the health and safety of everybody who plays a part in our operations or lives in the communities in which we operate. Wherever we operate, we will conduct our business with respect and care for both the local and global environment and will systematically manage risks to drive sustainable business growth.

We will not be satisfied until we succeed in eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from our activities.

Organisation and Responsibilities

The ConocoPhillips U.K. President has overall accountability for the Health, Safety and Environmental (HSE) performance of our U.K. operations.

Health, Safety and Environmental staff with reporting lines to senior management are appointed at various locations throughout the Company. These personnel are responsible for providing advice and guidance on matters relating to the health, safety and welfare of employees and on environmental matters.

All managers and supervisors at ConocoPhillips are responsible and accountable for the health and safety of their staff by:

- Ensuring that all applicable Health, Safety and Environment legislation and codes are adhered to and that appropriate actions are taken to ensure a safe working environment.
- The active participation of all employees in the achievement of Health, Safety and Environmental objectives.
- Conducting all activities in accordance with the requirements of the Operating Management System (OMS).

Employees are responsible for ensuring they comply with relevant legislation and the OMS, to ensure prevention of harm to themselves, their colleagues and the environment.

Arrangements

To meet our Policy Statement, ConocoPhillips (U.K.) Limited will:

- Demonstrate active Health, Safety and Environmental leadership and communication of this policy.
- Comply with relevant laws and regulations.
- Maintain "stop work policies" that establish the responsibility and authority for all employees and contractors to stop work they believe to be unsafe.
- Provide medical services to give advice, guidance, support and monitoring on health-related matters.
- Include environmental considerations in our business decisions and minimise the impacts of our activities on the environment.
- Implement procedures to ensure that integrity and reliability issues, which have the potential to cause an HSE impact, are properly considered at all stages in the asset life cycle.
- Ensure that all employees and contractors understand that working safely is a condition of employment, and that everyone is responsible for their own safety and for minimising environmental impacts of our operations.
- Manage all projects and processes through their life cycles in a way that protects health and safety, prevents pollution and manages wastes.
- Develop safe systems of work for all potentially hazardous situations; identify and assess major accident hazards.
- Provide employees, contractors and suppliers with the training, knowledge and resources necessary to achieve our Health, Safety and Environmental commitments.
- Provide effective emergency response systems allowing onshore and offshore personnel to deal effectively with emergency situations.
- Measure, audit and publicly report Health, Safety and Environmental performance and maintain open dialogue with stakeholder groups.
- Promote and adhere to the ConocoPhillips Life Saving Rules.
- Work with the regulator and other stakeholders to continuously improve Health, Safety and Environmental performance.

..... **Terri King**, President, ConocoPhillips U.K.

"Nothing is so urgent or important, that we cannot take time to do it safely and in an environmentally prudent manner"

UK-00655 February 2018

Figure 14.1: ConocoPhillips (U.K.) HSE Policy Statement

ConocoPhillips (U.K.) has implemented a dedicated environmental management process that is fully integrated within its Deming Cycle-based Operating Management System (OMS) (Figure 14.2).

The OMS provides the governance by which the company's HSE Policy is implemented throughout our operations.

ConocoPhillips and its contractors will operate according to ConocoPhillips procedures and best industry practices. ConocoPhillips operates an Environmental Management System (EMS) accredited to the ISO14001:2015 standard. Certification was received on the 17th August 2018 and is valid until May 2019.

Figure 14.2: Deming Cycle-based Operating Management System (OMS)

14.3 Environmental Aspects

The Environmental Aspects Register is a comprehensive listing of environmental aspects and their associated impacts arising or likely to arise, from company activities, products and services (existing and planned), including:

- Emissions to atmosphere (controlled and uncontrolled);
- Discharges to sea and surface water and sewers (controlled and uncontrolled);
- Seabed disturbance (impacts in protected habitats);
- Offshore underwater noise (seismic survey and piling noise and the potential impacts on marine mammals and fish species);

- Impacts to land (waste disposal and other waste with potential for contamination);
- Resource consumption (use of land, water, fuel/ energy, raw materials);
- Social and socioeconomic;
- Community issues (onshore) (noise, vibration, dust, odour, and visual impact); and
- Non-routine events (spills and emissions).

The Register and significance scores can be viewed by ConocoPhillips U.K. personnel at all U.K. locations via the company intranet. Areas requiring improvement are subject to annual environmental goals, which are cascaded down through the organisation from company level, through the Business Unit down to specific asset, workgroup and individual employee level. Provision is made within the system to allow goals and programmes to be generated at the operating asset level also. Improvement programmes allow the company to assign resources to meet any environmental targets set and to operate in an environmentally responsible way.

Environmental aspects related to the MacCulloch decommissioning will be integrated into the existing ConocoPhillips Environmental Aspects Register.

14.4 Register of Commitments

ConocoPhillips is committed to minimising the environmental impact of its activities. Continuous improvement in environmental performance is sought through effective project planning and implementation, emission reduction, waste minimisation, waste management and energy conservation.

A register of commitments has been developed to address the overall activities of the MacCulloch decommissioning activities (Table 14.1) and are in addition to the mitigation measures identified during the EA process. This register, along with the proposed mitigation measures, will form part of the decommissioning project planning process, and will be integrated into the relevant phases.

Table 14.1: Register of commitments

Issue	Commitment
Delivery of commitments	The commitments made within this EA will be incorporated into operational work programmes, plans and procedures. Programmes will be tracked to ensure that commitments and mitigation measures are implemented throughout the project.
Management responsibilities	Key environmental responsibilities, duties, communication, reporting and interface management arrangements of ConocoPhillips and the main contractors involved in the decommissioning activities will be agreed, documented and communicated at the appropriate stages of the project.
Commitment to the environment	ConocoPhillips will work to minimise short and long-term impacts from their decommissioning operations.
Post-decommissioning	ConocoPhillips will undertake post-decommissioning surveys (scope and frequency to be discussed and agreed with BEIS).
Legacy issues	In consultation with BEIS, ConocoPhillips will endeavour to address any material environmental issues identified as requiring positive action regarding man-made infrastructure decommissioned in situ.

The mitigation measures and commitments will also be embedded into the following documents to ensure appropriate execution and management:

- Detailed engineering specifications;

- Contracts; and
- Execution plans.

14.5 Roles and Responsibilities

The roles and responsibilities of ConocoPhillips, contractors and subcontractors will be clearly identified and the interrelationship between these entities defined. As contracts are awarded the organisational chart will be updated and evolve to incorporate amendments to the project phases, then managed accordingly.

14.6 Contractor Interface

Contractor management is an integral part of ConocoPhillips (U.K.) HSE Policy and contractors are expected to demonstrate a high level of HSE commitment and have systems in place for managing Health, Safety and Environmental issues.

The ConocoPhillips (U.K.) HSE Policy requires contractors to attend periodic Health, Safety and Environmental meetings and ensure an understanding that working safely is a condition of employment, and that everyone is responsible for their own safety and for minimising environmental impacts. The necessary training, knowledge and resources are supplied to contractors by ConocoPhillips to meet company HSE commitments.

At the project level, all offshore contractors involved in the decommissioning of facilities must produce procedures for all aspects of the decommissioning activities; these procedures are subject to Hazard Identifications (HAZIDs) and procedural Hazard and Operability (HAZOP) assessment. Appropriate measures are introduced where necessary to ensure acceptable levels of safety and environmental protection. All Contractors are responsible for all aspects of national and international regulatory compliance with regard to their activities and equipment, including international pollution prevention measures.

Contractor interface documents will be developed to manage environmental commitments during decommissioning. The interface document will detail the management organisation, the communication and reporting lines and the division of responsibilities during operational and emergency situations.

14.7 Staff Training and Awareness

Environmental training is undertaken by all ConocoPhillips staff involved in activities that have the capacity to create a significant environmental impact. The training ensures competency to perform work in compliance with ConocoPhillips Environmental Policy and individual responsibilities.

Training and competency are managed through individual contracts and ConocoPhillips stipulating minimum standards of training and competency that are required for personnel to undertake work on ConocoPhillips' behalf. These comprise industry standard training/ awareness and technical standards. Compliance with this is demonstrated at regular performance reviews. Contractors are also regularly independently audited with training and competency forming a key part of these audits.

14.8 Environmental Monitoring

Decommissioning operations will be conducted under the relevant licences and permits applied for by ConocoPhillips. Monitoring and reporting to the regulator and internally will

be conducted in accordance with relevant legislation and these licences. For example, discharges to sea from chemicals and residual hydrocarbons will be permitted appropriately and any accidental discharges to sea will be reported and investigated through ConocoPhillips's incident investigation process.

ConocoPhillips have arrangements in place for monitoring environmental performance and compliance with legislation, company policy, standards and procedures. Two approaches to monitoring are applied: active (providing feedback on performance) and reactive (providing information on incidents, accidents and near misses). Appropriate performance measures will be established for monitoring progress towards the achievement of defined goals and targets, and appropriate arrangements will be in place to ensure the effective collation and reporting of this performance data.

Through the execution of the HSE Management System Standard, a variety of deliverables are generated by ConocoPhillips. These include investigation reports of "high and significant risk" incidents, audit findings and HSE Compliance Verification Reports. A monthly report highlighting HSE performance is communicated electronically via the company intranet, which is accessible to all employees. Both the ConocoPhillips Management Committee and Public Policy Committee of the company's Board of Directors receive updates of HSE issues, events and performance from the HSE Vice President.

14.9 Performance Monitoring (Inspection, Audit and Corrective Actions)

Monitoring will be performed by internal and external parties. The scope and frequency of internal monitoring depends on an assessment of risks performed by line managers, process owners and corporate staff functions. Internal monitoring consists of three main categories: follow-up, verification and internal audit.

ConocoPhillips maintains a multi-tiered risk-based HSE audit programme encompassing regulatory and management system compliance audits at both the corporate and business unit levels. The programme also includes external insurance risk assessments. Independent, limited assurance audits of ConocoPhillips' corporate level processes for collating and reporting aggregated HSE data presented in ConocoPhillips' Sustainable Development report are also commissioned. Auditing associated with decommissioning will be identified and scheduled in the ConocoPhillips Audit Programme prior to and during ongoing decommissioning operations.

15.0 CONCLUSIONS

An EA forms an integral part of the ConocoPhillips Environmental Management process, ensuring that adequate environmental and social considerations are incorporated into the MacCulloch decommissioning strategy. This EA presents the findings for the recommended options for the decommissioning of the MacCulloch infrastructure, providing sufficient information to enable a robust evaluation of the potential environmental consequences of the proposed decommissioning activities.

The MacCulloch infrastructure is located in a marine environment that is typical of this part of the central North Sea. ConocoPhillips has considered that there are potentially certain times of the year when populations of seabirds, life stages of fish, marine mammal presence and commercial fishing interests may be more susceptible to potential impact. However, the area is not considered particularly sensitive to the proposed decommissioning activities (Sections 4 and 5).

Infrastructure covered under MacCulloch is located within ~50 km of one SAC and one NCMPA:

- The Scanner Pockmark SAC; and
- The Norwegian Boundary Sediment Plain NCMPA.

The SAC is designated for the Annex I habitat; Submarine structures made by leaking gases. The NCMPA is designated for the conservation of aggregations of the OSPAR threatened and/or declining species, Ocean quahog (*Arctica islandica*). There is no expectation of any adverse impact on either the SAC or the NCMPA as a result of the MacCulloch decommissioning activities.

The Annex II species recorded within and around the MacCulloch infrastructure include harbour porpoise, bottlenose dolphin, harbour seal and grey seal. Harbour porpoises have been sighted in very high numbers in May and December (UKDMAP, 1998; Reid *et al.,* 2003). Bottlenose dolphins have been recorded in the area but abundances are not available (Reid *et al.*, 2003; UKDMAP, 1998). Harbour and grey seals have been observed throughout the decommissioning area in very low densities (NMPI, 2018).

Following the identification of the interactions between the proposed decommissioning activities and the local environment, the assessment of potentially significant environmental impacts, stakeholder consideration, the key environmental concerns identified as requiring consideration for impact assessment were:

- Effects of energy use and atmospheric emissions (Section 7).
- Effects of underwater noise generated during the decommissioning activities (Section 8).
- Effects of seabed disturbance during decommissioning activities – removal of subsea structures, overtrawl survey, etc. (Section 9).
- Physical presence of vessels causing interference/ displacement of other users of the sea (Section 10).
- Potential release of residual contaminants during routine decommissioning activities (Section 11).
- Non-routine events, such as the spillage of hydrocarbons or other fluids during the decommissioning activities or through accidental events such as vessel collisions (Section 12).

Mitigation to avoid and/ or reduce the environmental concerns highlighted above is in line with industry best practice. ConocoPhillips will ensure that proposed mitigation measures are implemented and monitored to achieve the outcome presented in this EA.

ConocoPhillips are aware that a number of oil and gas fields/ installations in the central North Sea are currently being decommissioned or are reaching the end of their operational life. Consequently, the potential for additive or cumulative impacts within the central North Sea will be increased in the short-term. Decommissioning activities may contribute to overall gaseous emissions in the central North Sea but the impact of this is estimated to be minor in context with total UKCS emissions associated with the oil and gas industry (Section 7). Underwater noise will also be increased during decommissioning mainly due to the presence of vessels, but will be transient and is not expected to have a cumulative impact (Section 8).

Activities resulting from the decommissioning of the MacCulloch infrastructure are expected to create a maximum seabed impact of 9.49 km^2 (Section 9). There is the possibility that minor releases of materials may occur during cutting and removal of pipelines. It is expected that these discharges will result in negligible localised effects and are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities (Section 11).

The decommissioning approach for the majority of the MacCulloch infrastructure will be full removal. However, the mooring anchors are significantly buried (in excess of 20 m) and pose negligible risk to other users in their current state where as removal of this infrastructure would pose a large are of disturbance to the seabed in order to excavate the anchors sufficiently to permit removal. At present the proposed strategy is to fully remove all mattresses which can be accessed, however should technical issues arise which would prevent the safe removal of these then an application may be made to decommission in situ. Any material decommissioned in situ will be accurately mapped and a monitoring programme designed and agreed with BEIS at the point of decommissioning.

Other than a minor contribution to overall emissions, decommissioning activities are not anticipated to cause any transboundary impacts.

The transient loss of access for vessels during the decommissioning operations is unlikely to have a significant impact on other sea users (i.e. commercial shipping and fishing). The 500-meter exclusion zones remain at the drill centres and the area of the FPSO is marked as an area of Oil and Gas Field Decommissioning: Please see Figure 15.1.

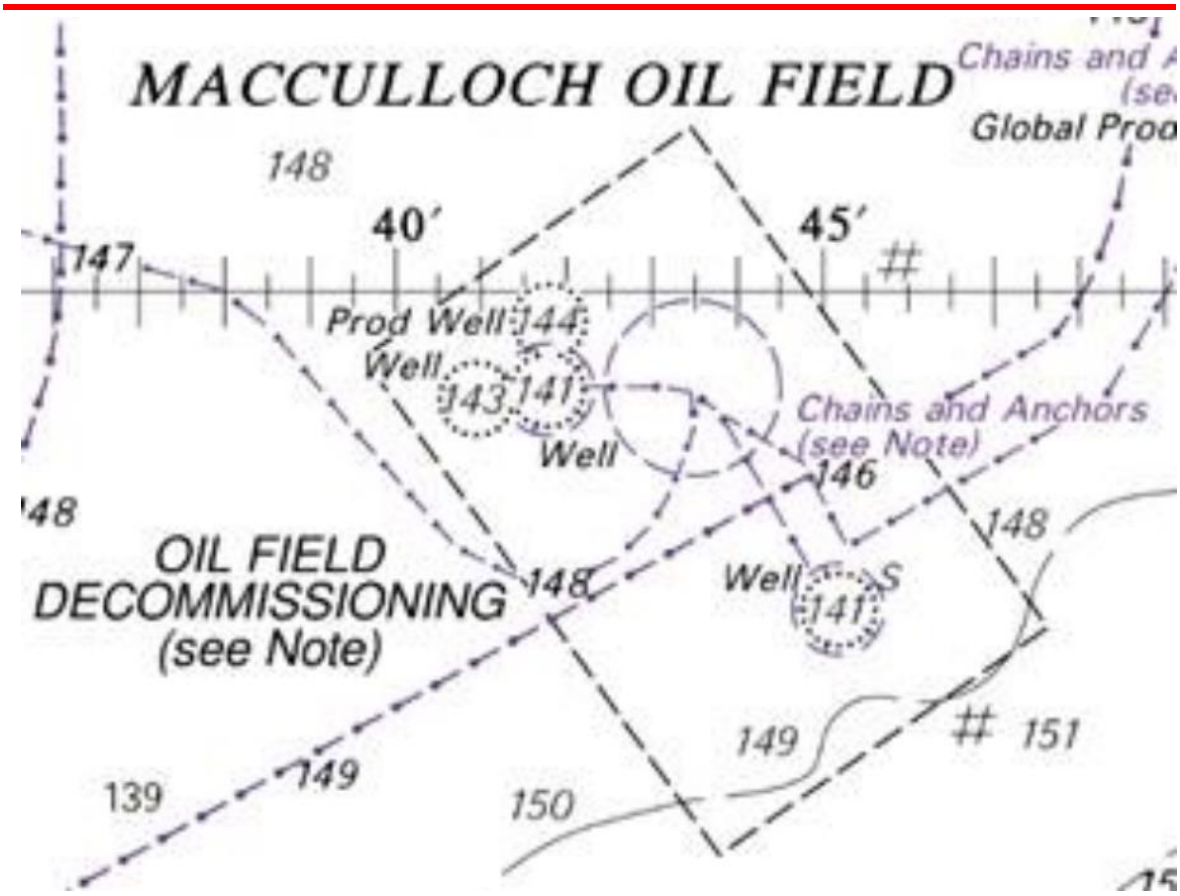


Figure 15.1: MacCulloch Field decommissioning area

In addition, the EA has highlighted the positive impact that the decommissioning of the MacCulloch infrastructure will have on commercial fisheries with the opening of areas of the sea which have previously been excluded for safety reasons.

Therefore, it is the conclusion of this EA that the recommended options presented for the decommissioning of the MacCulloch infrastructure can be completed without causing significant adverse impact to the environment.

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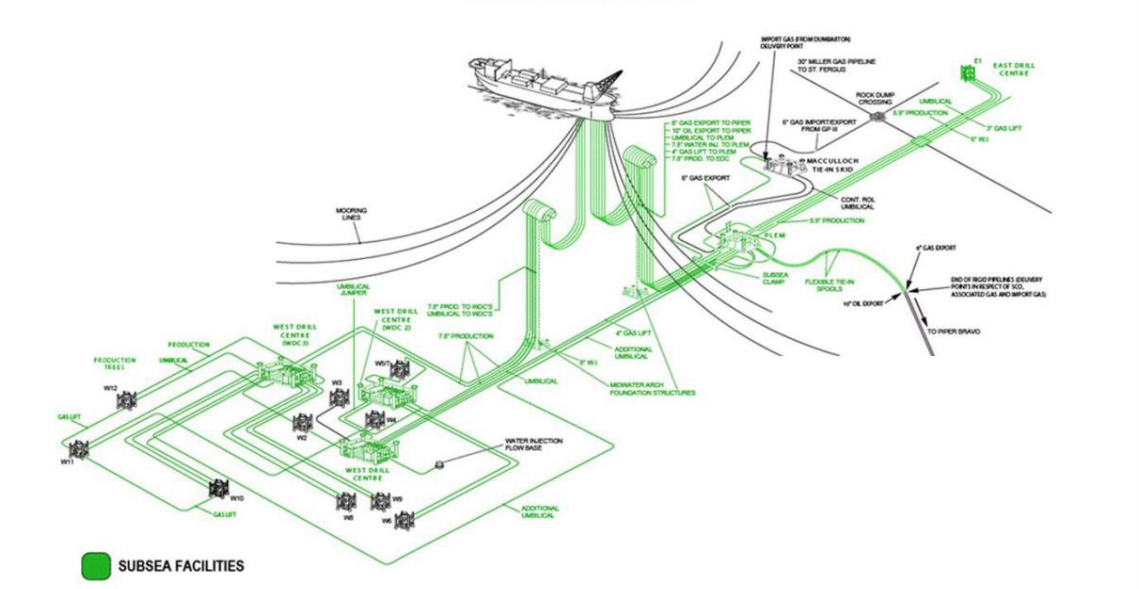
ConocoPhillips

MACCULLOCH FIELD DECOMMISSIONING PROJECT:

SUBSEA INFRASTRUCTURE AND ASSOCIATED INFIELD PIPELINES

APPENDICES FOR THE MACCULLOCH FIELD DECOMMISSIONING PROGRAMMES EA:



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APPENDIX A

SUMMARY OF ENVIRONMENTAL REGULATORY REQUIREMENTS

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This appendix presents a summary of key international, UK and EU regulations and legislation applicable to the MacCulloch Field decommissioning project. It summarises the policy, legal, and regulatory framework within which this EA has been undertaken.

Table A.1: Relevant Regulations and Guidance

Relevance	Legislation	Summary of requirements
Legislative Framework for Decommissioning	OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations	Mandates that offshore facilities are re-used, recycled or finally disposed of on land. Derogations from this decision can be sought, particularly with regard to large steel jackets weighing more than 10,000 tonnes and concrete gravity base structures, but all topsides, steel substructure jackets weighting 10,000 tonnes or less and subsea structures must be removed and returned to shore.
	International Maritime Organisation (IMO) Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone 1989	These Guidelines and Standards represent the "generally accepted international standards" as mentioned in the United Nations Convention on the Law of the Sea (UNCLOS), Article 60, which prescribes that any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation and to prevent any potential effect on the marine environment.
	Petroleum Act 1998	The Petroleum Act 1998 sets out requirements for undertaking decommissioning of offshore installations and pipelines including preparation and submission of a Decommissioning Programme.
	Energy Act 2008	Part III of the Energy Act 2008 amends Part IV of the Petroleum Act 1998 and strengthens the powers of the of the Secretary of State in relation to financial assurances.
	The Energy Act 2016	The introduction of the Energy Act 2016 formally establishes the Oil and Gas Authority (OGA) as an independent regulator, with a specific decommissioning remit.
	Marine (Scotland) Act 2010	The Marine (Scotland) Act controls marine activities in Scottish territorial waters and provides a legal mechanism to ensure clean, healthy, safe, productive and biologically diverse seas. It comprises a strategic marine planning system, a streamlined marine licensing system, improved marine nature conservation measures, improved measures for the protection of seals and improved enforcement measures. The Act enables the designation of Marine Protected Areas (MPAs) – equivalent to Marine Conservation Zones (MCZs) in English and Welsh waters.
	Scotland's National Marine Plan	The National Marine Plan (Scottish Government 2015) provides an overview framework for marine activity in Scottish waters out to 200 nautical miles, with the aim of enabling sustainable development and the use of the marine area in a way that protects and enhances the marine environment, while promoting existing and

Relevance	Legislation	Summary of requirements
		emerging industries. A core set of general policies underpin this objective. Consideration should be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.
	BEIS: Guidance Note for Operators – Offshore Oil and Gas Sector: Update on Marine Planning in the UK (2018)	Guidance note for the oil and gas sector, updating stakeholders on the UK marine planning process with a focus on environmental impact assessments (EIAs) associated with decommissioning activities within a marine plan area.
	CDA: Guidance - Retention of Information and Samples after Asset Decommissioning (2017)	Guidance considering the legal framework to determine how long associated data, documents, and samples must be retained after an offshore asset in the UKCS is decommissioned.
	BEIS: Guidance Notes - Decommissioning of Offshore Oil and Gas Installations and Pipelines (2018)	Guidance for operators, licensees and contractors on the regulatory requirements for decommissioning offshore oil and gas installations and pipelines in accordance with international obligations and those set out in the Petroleum Act (updated from 2009 version).
	OGA: Guidance on requirements for the planning for Cessation of Production (2018)	This guidance is intended to assist field operators and licensees involved in the planning for Cessation of Production from a field, a group of fields, an asset within a field (e.g. a platform) or a field acting as a hub.
	MCA: MIN 553 (M) Offshore Structure Decommissioning (2017)	This Marine Information Note provides guidance for moving fixed offshore installations during decommissioning
	OPRED: Standard Decommissioning Programme(s) Template (2018)	A streamlined, standard decommissioning programme template for non-derogation cases.
	European Commission, Best Available Techniques Guidance Document on upstream hydrocarbon exploration and production 2019	Non-binding reference document for the permitting of installations for the exploration and production of hydrocarbons, refers to decommissioning in Section 3.5.15 and Section 25.
Environmental Impact Assessment	The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended), (including by the Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and Other Miscellaneous Provisions (Amendment) Regulations 2017)	These Regulations implement the requirements of **The EIA Directive**, EC Directive *85/337/EEC*, now codified by *2011/92/EU (amended by Directive 2014/52/EU)*. The Regulations require an EIA and the associated public consultation document (ES) to be submitted for projects seeking consent to extract 500 tonnes or more oil per day and/ or 500,000 cubic meters of gas per day. These regulations ensure that the Secretary of State for Business, Energy and Industrial Strategy takes environmental information into consideration before deciding whether to consent certain offshore activities.
Protected Sites and Species	The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended 2007, 2010, 2017)	These Regulations make provision for implementing **The Birds Directive** (2009/147/EC) and **The Habitats Directive** (92/43/EEC) in relation to offshore oil and gas activities. The Regulations set down the obligations for the assessment of the impact of offshore oil and gas activities (including gas and carbon dioxide

Relevance	Legislation	Summary of requirements
		unloading and storage activities) on habitats and species protected under the Birds Directive and the Habitats Directive. The Regulations make provision for the selection, registration and notification of sites in the offshore marine area (European Offshore Marine Sites) and for the management of these sites. Competent authorities are required to ensure that steps are taken to avoid the disturbance of species and deterioration of habitat in respect of the offshore marine sites and that any significant effects are considered before authorisation of certain plans or projects.
	Conservation of Offshore Marine Habitats and Species Regulations 2017	These Regulations are the governing legislation for implementation of a number of the other requirements contained in the Directives. The Regulations apply to the "offshore area" outside UK territorial waters and are commonly referred to as the Defra Offshore Habitats Regulations. The Regulations consolidate the provisions contained in the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 and subsequent amending instruments, and make minor modifications reflecting changes to related legislation. They include provisions for the designation and protection of areas that host important habitats and species in the offshore marine area. They also implement assessment obligations for marine industry activities other than offshore oil and gas; introduce a licensing system for any marine activities that could kill or injure protected species, or could deliberately disturb protected species in such a way as to be likely to impair their ability to survive, breed, or rear or nurture their young, to hibernate or migrate; or could significantly affect the local distribution or abundance of that species. The most important provisions of the regulations in relation to environmental submissions to the Department are contained in Part 5, which provides powers to issue licences for specific activities that could result in the injury or disturbance of European Protected Species (EPS injury or disturbance licences).
Discharges to Water	OSPAR Recommendation 2012/5 for a Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations	This recommendation aims to produce a method for prioritising mitigation for discharges and substances that pose the greatest environmental risk. It is intended that all offshore installations in the OSPAR area with produced water discharges will have been assessed to determine the risk level, allowing appropriate measures to be taken to reduce the risk posed by the most hazardous substances by 2020.
	OSPAR Recommendation 2006/5 on a management regime for offshore cuttings piles	This recommendation outlines the approach for the management of cuttings piles offshore with the purpose of reducing the impacts of pollution by oil and other substances to a level that is not considered significant. Cuttings pile management is divided into two stages:

Relevance	Legislation	Summary of requirements
		• Stage 1: required the initial screening of all cuttings piles to be carried out within two years of the Recommendation coming into effect (30th June 2006) • Stage 2: required a Best Available Technique (BAT) and/or Best Environmental Practice (BEP) assessment, to be completed within the timeframe laid out in Stage 1.
	The Offshore Chemical Regulations 2002 (as amended 2011)	The Offshore Chemicals Regulations 2002 (as amended 2011) implement the OSPAR Decision (2000/2) and OSPAR Recommendations (2000/4 and 2000/5) introducing a Harmonised Mandatory Control System for the use and reduction of the discharge of offshore chemicals. Under the Offshore Chemical Regulations 2002 (as amended) a chemical permit is required for the use and discharge of chemicals used offshore (with some exemptions). All offshore activities, including production, drilling, discharges through pipelines and decommissioning are covered by the Regulations. A risk assessment of chemical discharges is required as part of the permit application.
	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011)	Under these Regulations, it is an offence to make an unlawful release of oil, i.e. a release of oil other than in accordance with the permit granted for oily discharges (e.g. produced water etc.). Operators will be required to make provision for the removal and recycling of oil recovered during decommissioning. Permits must include Best Available Techniques (BAT) assessments in order to justify the treatment and discharge options that have been selected.
Atmospheric Emissions	The Offshore Combustion Installations (Pollution, Prevention and Control) Regulations 2013	The Offshore (PPC) Regulations 2013 transpose the relevant provisions of *The Industrial Emissions Directive 2010/75/EU* in respect to specific atmospheric pollutants from combustion installations with a thermal capacity rating ≥50MW on offshore platforms undertaking activities involving oil and gas production. These regulations mirror those of the Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001 (as amended). Permitting under these regulations include emission allowances for carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulphur (SO_x), methane (CH_4) and volatile organic compounds (VOCs) including, as with the OPPC Regulations, demonstration of BAT.
	Greenhouse Gases Emission Trading Scheme (ETS) Regulations 2005	These regulations implement the EU Emissions Trading Scheme (EUETS) in the UK. Operators are required to apply for a permit covering emission of CO_2 for an installation with combustion equipment with an aggregated thermal capacity exceeding 20 MW, issued prior to decommissioning.
	The Fluorinated Greenhouse Gases Regulations 2015	The Regulations implement the EU Parliament Regulation 517/2014 and cover certification of equipment such as refrigeration, fire protection and that which contains fluorinated gas (f-gas) based solvents.

Relevance	Legislation	Summary of requirements
	The Ozone-Depleting Substances Regulations 2015	These Regulations make provision in the UK for EC Regulation 1005/2009 which controls the production, impact, export, placing on the market, recovery, recycling, reclamation and destruction of substances that deplete the ozone layer.
Accidental Events	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015	These Regulations amend the existing requirements in the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 for certain facilities in the UKCS to have an Oil Pollution Emergency Plan (OPEP). The amendments extend the requirement to have an OPEP to non-production installations in the territorial sea and the continental shelf and apply further requirements to installations and their connected infrastructure which are carrying out offshore oil and gas operations, including decommissioning operations.
	The Offshore Installations (Emergency Pollution Control) Regulations 2002	The Regulations give the Representative of the Secretary of State for Energy and Climate Change (SOSREP) powers to intervene in the event of an incident involving an offshore installation where there is, or may be, a risk of significant pollution, or where an operator is failing or has failed to implement effective control and preventative operations.
Waste	The Environmental Protection (Duty of Care) (Scotland) Regulations 2014	These Regulations came into force on the 1 March 2014. The Environmental Protection Act 1990 imposes a duty on any person who imports, produces, keeps or manages controlled waste to take appropriate measures in ensuring there is written description of a waste product when it is transferred. This Statutory Instrument (Scotland only) provides personnel transferring and receiving waste must, at the same time as the written description of waste is transferred, complete and sign a transfer note in respect of the waste.
	The Waste (Scotland) Regulations 2012	The 2012 Scotland Regulations make a number of amendments to a variety of Scottish waste legislation to transpose aspects of Directive 2008/98/EC on waste into Scottish law: • Environmental Protection Act 1990 • Pollution Prevention and Control (Scotland) Regulations 2000 • Landfill (Scotland) Regulations 2003 • Waste Management Licensing (Scotland) Regulations 2011
	The Waste Electrical and Electronic Equipment Regulations 2006 (as amended 2013)	These Regulations transpose the requirements of the Waste Electrical and Electronic Equipment Directive (WEEE Directive 2002/96/EC) which came into force in January 2007. The Regulations define new responsibilities for users and producers of Electrical and Electronic Equipment depending on whether the equipment was purchased before or after 13/08/05.

Relevance	Legislation	Summary of requirements
		The 2013 regulations transpose the main provisions of Directive 2012/19/EU ("the Directive") on waste electrical and electronic equipment (WEEE) which recasts Directive 2002/96/EC.
	Environment Protection Act 1990 Part II; The Controlled Waste Regulations 1992; The Special Waste Regulations 1996; The Special Waste Amendment (Scotland) Regulations 2004	This legislation covers the management, handling and disposal or recycling of materials onshore. The Environment Protection Act 1990 Part II sets out management and disposal requirements. Scotland implements **The Hazardous Waste Directive**, EC Directive *91/689/EEC* via The Controlled Waste Regulations 1992, The Special Waste Regulations 1996 and The Special Waste Amendment (Scotland) Regulations 2004. Should disposal of radioactive waste be required, the Radioactive Substances Act 1993 may apply.
	Dangerous Substances in Harbour Areas Regulations 1987	The carriage, loading, unloading and storage of all classes of dangerous substances in port areas are controlled under the Dangerous Substances in Harbour Areas Regulations 1987 (and amendments).
Shipping	International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 Annex V	Annex V (Prevention of pollution by garbage from ships (entered into force December 1998)) deals with the different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The Annex also designates Special Areas (including the North Sea) where the disposal of any garbage is prohibited except food wastes. The dumping of plastics at sea is also prohibited by this Annex.
	The Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009	These Regulations implement Directive 2005/35/EC of the European Parliament and of the Council of 7th September 2005 on ship-source pollution and on the introduction of penalties for infringements. The Directive aims to achieve better enforcement of the requirements of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73), as modified by the Protocol of 1978 (MARPOL 73/78).
	The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 (as amended 2010)	These Regulations implement the requirements of MARPOL 73/78 Annex IV in the UK and apply to vessels including fixed or floating platforms which operate in the marine environment and came into force on 1st February 2009. They lay out the requirements for sewage system surveys and certification and the requirements of sewage systems with an exception for fixed installations at a distance of more than 12 nautical miles from the nearest land. They also identify the requirements for a garbage management plan, garbage record books and prohibit the disposal of various types of garbage into the marine environment.
Safety	The Offshore Installations (Offshore Safety Directive) Regulations 2015	This regulation implements the requirements of Directive 2013/30/EU of the European Parliament and of the Council on safety of offshore oil and gas operations and amending Directive 2004/35/EC (**The Offshore Safety Directive**), which

Relevance	Legislation	Summary of requirements
		intends to reduce as far as possible the occurrence of major accidents related to offshore oil and gas operations (such as the 2010 Deepwater Horizon incident in the Gulf of Mexico) and to limit their consequences. The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 supersedes the Offshore Installations (Safety Case) Regulations 2005. Operators must prepare a Safety Case for offshore installations and the notification of specified activities to the competent authority (the Health and Safety Executive and the Secretary of State acting jointly). This incorporates operations through production and including decommissioning.

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APPENDIX B

ENERGY AND EMISSIONS FACTORS

APPENDIX B: ENERGY AND EMISSIONS FACTORS

The method employed for the calculation of energy use and associated gaseous emissions is based on the IoP guidelines (IoP, 2000). These are drawn from a wide variety of sources and have been selected to represent the breadth of current industry practice; therefore, where possible and appropriate, these factors are used in preference to other data sources (IoP, 2000). In this way, a comparison is possible between the different components of the current study and other studies that have been undertaken using this methodology.

An alternative data source should only be used when it is considered by the operator that new or special equipment is likely to have a significantly different fuel consumption rate from that presented in the IoP database. The tables below present the factors applied to each element of the energy and emissions calculations: recycling of materials (Table B1); manufacture of new materials (Table B2); general fuel consumption (Table B3) and vessel fuel use (Table B5). Only conversion factors for carbon dioxide (CO_2) were considered.

Table B1: Energy consumption and gaseous emissions factors used in the calculations of the recycling of materials

Materials	Energy (GJ/tonne)	CO_2 Emissions (kg/ tonnes)	Source
Recycled Standard steel	9	960	IoP (2000)

Table B2: Energy consumption and gaseous emissions factors used in the calculations of the manufacture of new materials

Materials	Energy (GJ/tonne)	CO_2 Emissions (kg/ tonnes)	Source
New Standard steel	25.0	1,889	IoP (2000)
New Concrete	1.0	880	IoP (2000)

Table B3: Energy consumption and gaseous emissions factors used in the calculations for fuel use

Fuel type	Energy (GJ/tonne)	CO_2 Emissions (kg/ (tonnes)	Source
Marine diesel	43.1	3,200	IoP (2000)
Aviation fuel	46.1	3,200	IoP (2000)
Diesel fuel	44.0	3,180	IoP (2000)

Table B4: Rates of fuel consumption for vessels involved in decommissioning activities.

Vessel	Rate of fuel consumption (tonnes/day)				Source/ Comments
	In port	In transit	Working	Waiting on weather	
AHV	2	50	5	30	IoP (2000)
DSV	3	22	18	10	IoP (2000)
CSV	2	26	18	9	IoP (2000) values for Multi-Support Vessel
Trawler	0	1	1	1	Estimated
	Tonnes/ 1000 km				Source/ Comments
Helicopter	5				IoP (2000)

References

Institute of Petroleum (IOP), 2000. Guidelines for the calculation of estimates of energy use and emissions in the decommissioning of offshore structures.

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