Alligin Field Development

Environmental Statement

BEIS Reference: D/4211/2018

BPEOC Document Number: QD-BP-EV-REP-0043

June 2018

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Project Name	Alligin Field Development
Development Location	Block 204/19a and 204/20a
Licence No	P556
Project Reference No	D/4211/2018
Type of Project	New Tie-back Development
Undertaker	BP Exploration Operating Company Limited (BPEOC) Wellhead Road, Farburn Industrial Estate, Dyce, Aberdeen, UK, AB21 7PB
Licensees/Owners	**Co-venturers** / **% Holding** BPEOC – 50 Shell UK Limited – 50
Short Description	The Alligin Field will be developed as a two well subsea tie-back (one production well and one water injection well) to the existing Schiehallion and Loyal infrastructure, using the processing and export facilities of the Glen Lyon Floating Production Storage and Offloading (FPSO) further downstream. Note the Glen Lyon FPSO is located at the Schiehallion Field. The proposed development concept can be summarised as follows: • The drilling of one production well and one water injection well at the Alligin Field; • The installation and commissioning of three flowlines (production, water injection and gas lift) and an umbilical between the Alligin drill centre and the existing Schiehallion and Loyal infrastructure (lines will range in length from 5.5 km and 9 km) and the installation of associated subsea infrastructure; • Processing of the Alligin hydrocarbons at the Glen Lyon FPSO; and • First production in Q1 2020.
Key Dates	**Activities** / **Date** Drilling of wells – Q2 2019 – Q3 2019 Subsea installation – Q3 2019 Well tie-in and commissioning – Q3 2019 and Q4 2019 First production – Q1 2020
Significant Environmental Effects Identified	The Environmental Statement (ES) assesses the worst case impact of the project on the environment and is therefore very conservative. Even then applying the mitigations measures identified it is the conclusion of this ES that the current proposal for the Alligin Field Development can be completed without causing any significant long term environmental impacts or cumulative and transboundary effects.
Statement Prepared by	BP Exploration Operating Company Limited and Genesis Oil and Gas Consultants Ltd.

Company	**Job Title**	**Relevant Qualifications/Experience**
BP Exploration Operating Company Limited	Environmental Advisor, North Sea Projects	4 years in industry
	Environmental Lead, North Sea Projects	8 years in industry
Genesis Oil and Gas Consultants Ltd.	Consultant Environmental Engineer	20 years' working in environment/oil and gas
	Principal Environmental Consultant/GIS Specialist	13 years' working in environment/oil and gas

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NON-TECHNICAL SUMMARY

Background

The Alligin Field was discovered in 1995 and is located across Blocks 204/19a and 204/20a *c.* 140 km West of Shetland and *c.* 20 km from the UK/Faroe median line (Figure 1). The Field is part of the Greater Schiehallion Area which comprises the developed Schiehallion and Loyal Fields, the Alligin discovery and a number of other prospects.

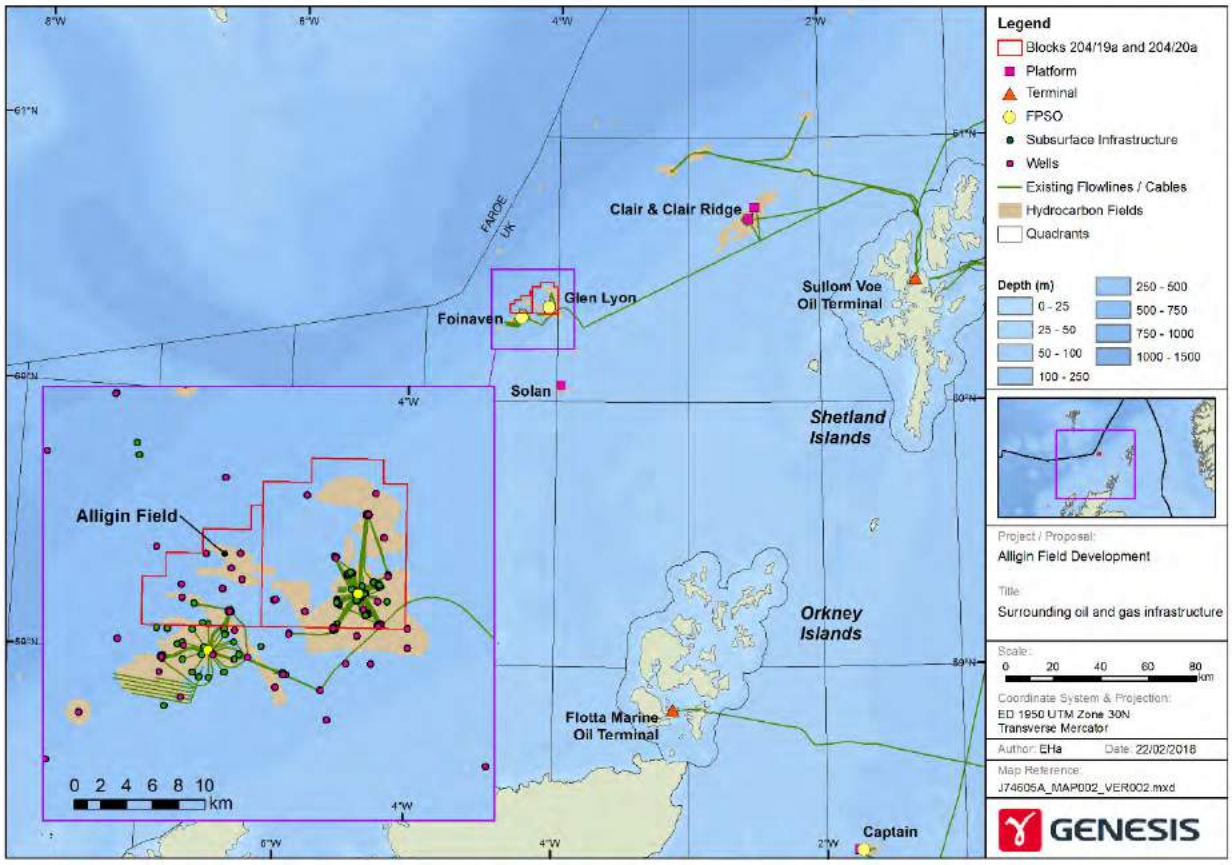

Figure 1: Location of the proposal Alligin Development.

BP Exploration Operating Company Limited (BPEOC) on behalf of itself and its Co-Venturer, Shell propose to develop the field as a two well subsea tie-back (one production well and one Water Injection (WI) well) to the existing Schiehallion and Loyal infrastructure, using the processing and export facilities of the Glen Lyon Floating Production Storage and Offloading (FPSO) further downstream. Note the Glen Lyon FPSO is located at the Schiehallion Field.

BPEOC have selected a tried and tested concept for the proposed Alligin Field Development which reflects current best practices and technologies and makes use of existing infrastructure where possible.

Environmental Statement Scope

The scope of the Environmental Impact Assessment (EIA) and resultant Environmental Statement (ES) includes all activities associated with the proposed Alligin Field Development Project and comprises:

- Drilling and completion of two subsea wells (one production well and one WI well);
- Installation of a new production flowline, gas-lift flowline, water injection flowline and control umbilical;
- Installation of subsea equipment (e.g. Xmas trees, flowline termination assembly, manifold etc.) on the seabed;
- Increased production at the Glen Lyon FPSO; and
- Decommissioning.

This document provides details of the EIA that has been undertaken to support BPEOC and their Co-Venturer's application for consent to undertake the proposed project. This process includes a public consultation followed by a comprehensive review by various bodies including the Department for Business, Energy and Industrial Strategy (BEIS).

The ES presents the results of the EIA conducted to evaluate the environmental impacts of the proposed project. These include: the physical presence of vessels and infrastructure, atmospheric emissions, discharges to sea, impacts on the seabed, the effects of underwater noise, the production of waste and an evaluation of the potential impacts from accidental events, as well as vulnerability of the proposed activities to natural disasters. In addition, potential impacts on designated protected sites, sensitive habitats, and cumulative and transboundary impacts are assessed.

Option Selection

A number of development options were considered for the Alligin Field Development, with the aim of optimising the value of the field and the surrounding infrastructure, through a safe and environmentally responsible development, incorporating justified opportunities and accounting for risks and capital exposure. Early on in Option Selection it was determined due to the size, and proximity of the Alligin field to existing infrastructure, a standalone development was not economically feasible and therefore this option was ruled out at this stage.

Development of the field via

- One production well and one WI well;
- One production well and two vertical WI wells; and
- Two production wells and two WI wells

was considered. During well optimisation it was determined that the proposed development option, comprising one production and one WI well, provided the most efficient method for optimised reservoir recovery.

Consideration was given to a number of different subsea tie-ins to the four different drill centres associated with the Schiehallion Field (the West drill centre, the North West drill centre, the Central drill centre and the North drill centre) and to the Loyal drill centre. Provision of injection water and lift gas from the North West drill centre was selected due to available capacity. In addition, this drill centre is the closest one to the proposed Alligin drill centre hence minimising the length of lift gas and injection water flowlines to be installed. Tie-in of the production line to the North West drill centre was not selected as it is possible it would result in future constraints on production, hence a tie-back to the Loyal drill centre was selected for the production line.

Trenched and backfilled, and surface lay options were evaluated for the installation of the Alligin pipelines and umbilical. The option to surface lay was selected for a number of reasons:

- Surface lay results in a significantly smaller corridor of seabed disturbance and turbidity during installation, with subsequent impact to protected benthic species being limited to the immediate footprint of the pipeline;
- Based on the results of preliminary analysis, the surface laid solution for the Alligin production flowline is feasible without specific engineered buckle mitigation scheme (reducing requirements for rock dumping);
- Clay berms created by trenching may result in an additional serious snagging hazard whilst the use of a chain mat to break up these berms would further impact on the designated deep-sea sponge aggregations associated with the area;
- Alligin flowlines have been designed to meet the required load and impact cases determined by design standards;
- Surface laid flowlines are potentially recoverable at the time of decommissioning;
- Surface lay aligns with the existing Greater Schiehallion Area pipe lay philosophy; and
- Surface lay flowlines can easily be visually inspected.

The Alligin production flowline will be conservatively designed to meet the requirements for potential impact loads (such as interference with trawl gear) in line with design standards. With regards to the smaller diameter flexible flowlines and umbilical it is expected that the reduced diameter and relatively low submerged weight means that snagged fishing gear will displace the flowline, both laterally and vertically, enough to increase the likelihood of the fishing gear releasing and thus not causing serious damage to the flowlines or the fishing gear.

Alligin Field Development Project

The Alligin Field is part of the Greater Schiehallion Area and will tie back to infrastructure at the Schiehallion and Loyal Fields. The Schiehallion Field has been developed via four drill centres: North, West, Central, and North West whilst Loyal Field has been developed vial the Loyal drill centre. Alligin production fluids will be transported to the Glen Lyon FPSO via the Loyal drill centre whilst water injection and lift gas will be provided to the Alligin wells via the North West drill centre (Figure 2).

The proposed Alligin Field Development can be summarised as follows:

- The drilling of one production well and one WI well;
- The installation of:
  - a *c*. 9 km production flowline to the existing Loyal drill centre;
  - a *c*. 5.5 km injection water flowline and a *c*. 5.5 km lift gas flowline from the existing Schiehallion North West drill centre; and
  - a *c*. 5.7 km subsea control umbilical for power, communications and chemical supply tied back to an existing Dynamical Umbilical Termination Assembly (a structure which allows a number of subsea control modules to be connected to the same communications, electrical and hydraulic supply lines and allows multiple wells to be controlled via one umbilical).
- Increased production at the Glen Lyon FPSO (relative to operation without Alligin); and
- Decommissioning at End of Field Life (EoFL).

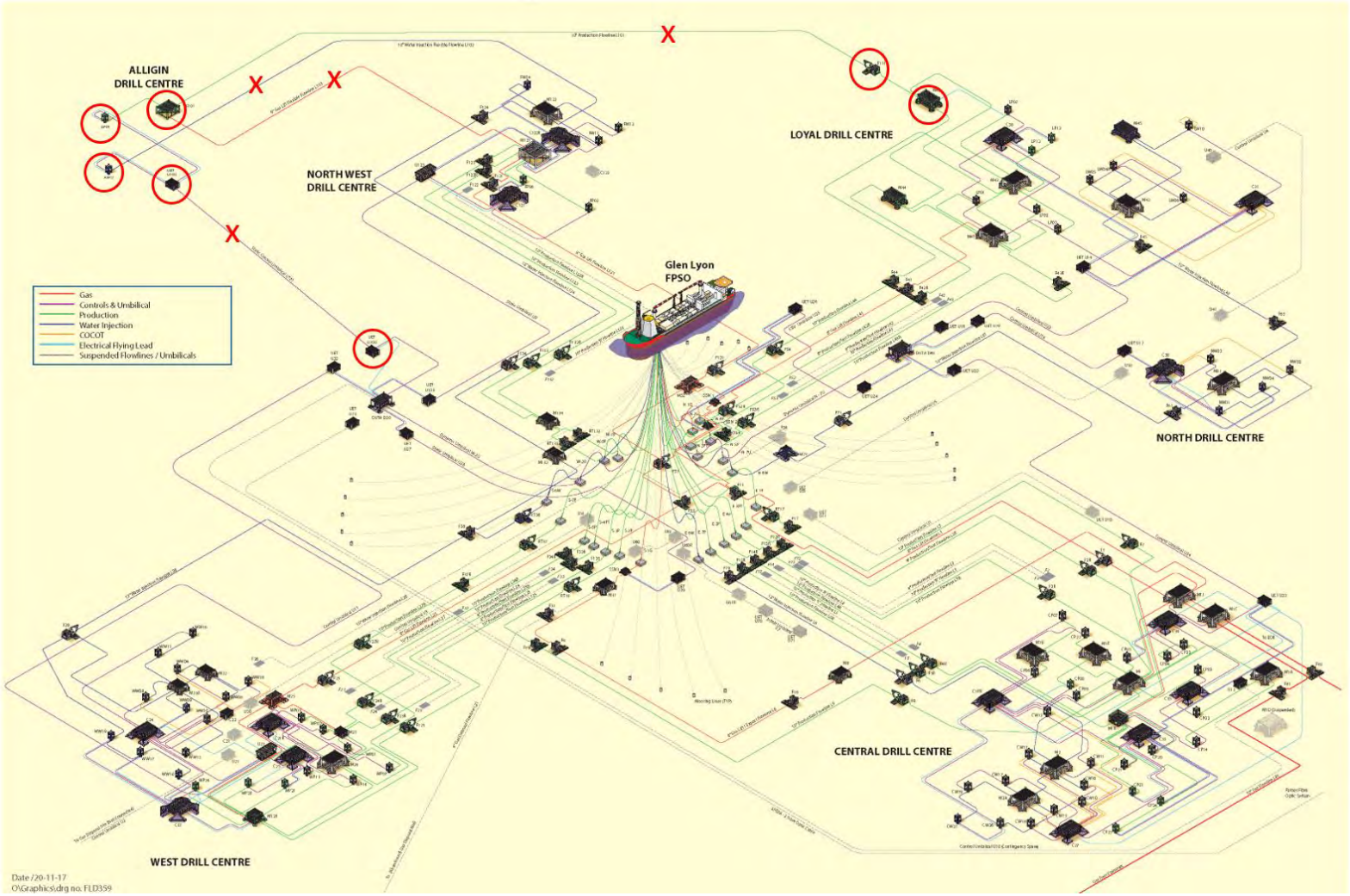

Figure 2: Schematic showing an over view of the proposed Alligin Project (red circles and 'X's) in relation to the existing Schiehallion and Loyal infrastructure.

Schedule of Activities

The activities associated with the drilling, installation, and commissioning of the Alligin Field are scheduled to take place in 2019 with First Oil in Q1 2020.

Baseline Environment

The Alligin Field is situated in Blocks 204/19a and 204/20a *c.* 140 km west of the Shetland Islands and *c.* 20 km from the UK/Faroe median line. The Field is situated on the continental slope in water depths ranging between *c.* 460 - 480 m Lowest Astronomical Tide (LAT) with a gentle slope downwards to the north-west.

The waters over the West of Shetland continental slope are exposed to a high-energy wave regime such that the wave climate is more severe than that found in the North Sea, especially in winter months. The annual mean significant wave height in the area is 2.8 m.

BPEOC commissioned an environmental survey at the Alligin Field and along a number of proposed pipeline routes (survey was carried out between September-November 2017). At the time of submission of this ES, the full results of the environmental survey were not available. The data that was available has been used to inform the impact assessment. In addition to using the available data from the Alligin Field environmental survey, the results from other surveys carried out within the Greater Schiehallion Area have been referenced. Figure 3 shows the extent of these surveys. It can be seen from Figure 3 that the extent of some of these surveys encompass the proposed Alligin Field Development location.

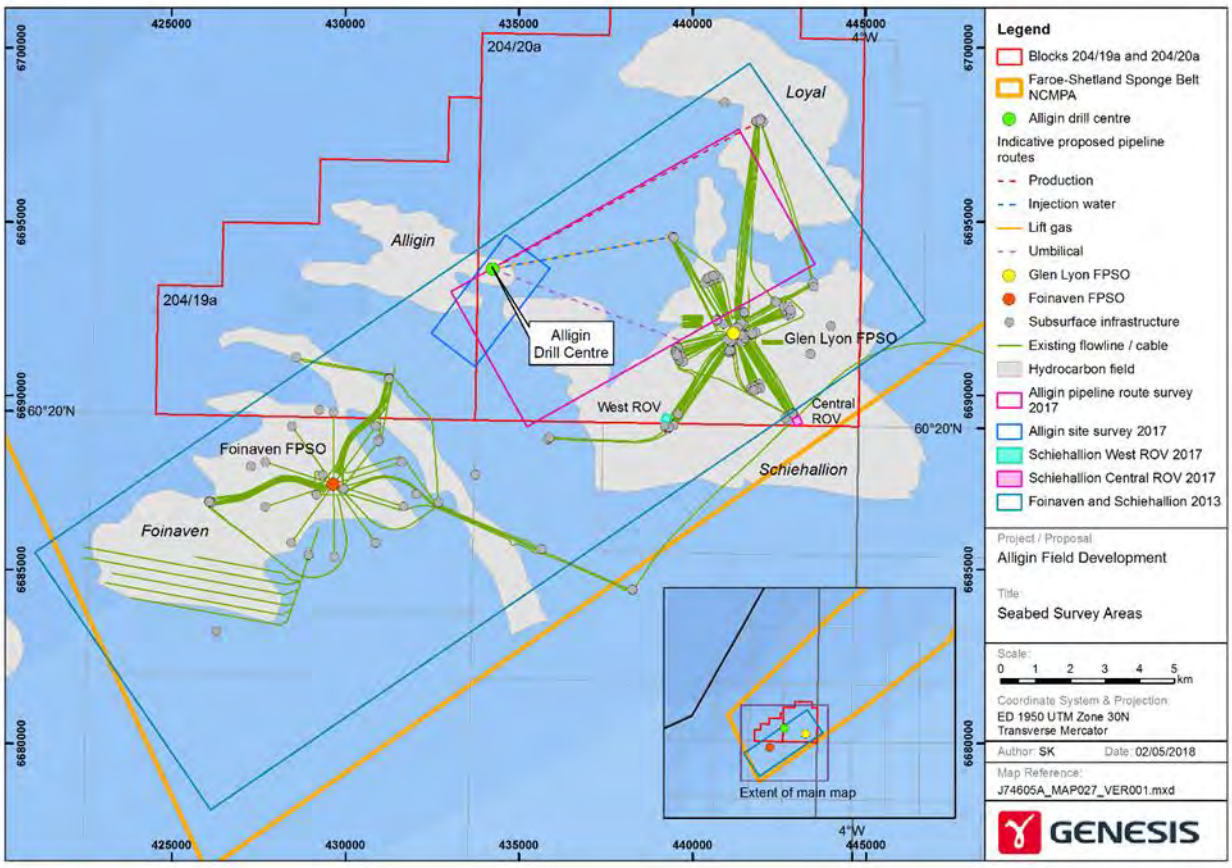

Figure 3: Extent of the environmental surveys used to support this ES.

The information available from these other surveys within the Greater Schiehallion Area and the preliminary results from the Alligin Field and pipeline route surveys were deemed sufficient to inform the impact assessment carried out in support of this ES. When completed the reports from the Alligin site and pipeline route surveys will be made available to BEIS and their consultees and will be used to support the relevant permit applications to be submitted at a later date.

Results from the grab samples taken during the Alligin field and pipeline route survey were not available at the time of writing the ES, however they are expected to be similar to those found at the Schiehallion Field and expected to include polychaetes such as *Galathowenia oculata*; the crustaceans *Ampelisca spinipes*, *Ampelisca sp., Haploops setosa* and *Haploops tubicola*; the burrowing brittlestar *Amphiura sp* and the *bivalves Astarte sulcata, Limopsis aurita* and *Thyasira succisa*.

The Alligin Field occurs within the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area. (NCMPA) which covers an area of 5,278 km^2 (Figure 4).

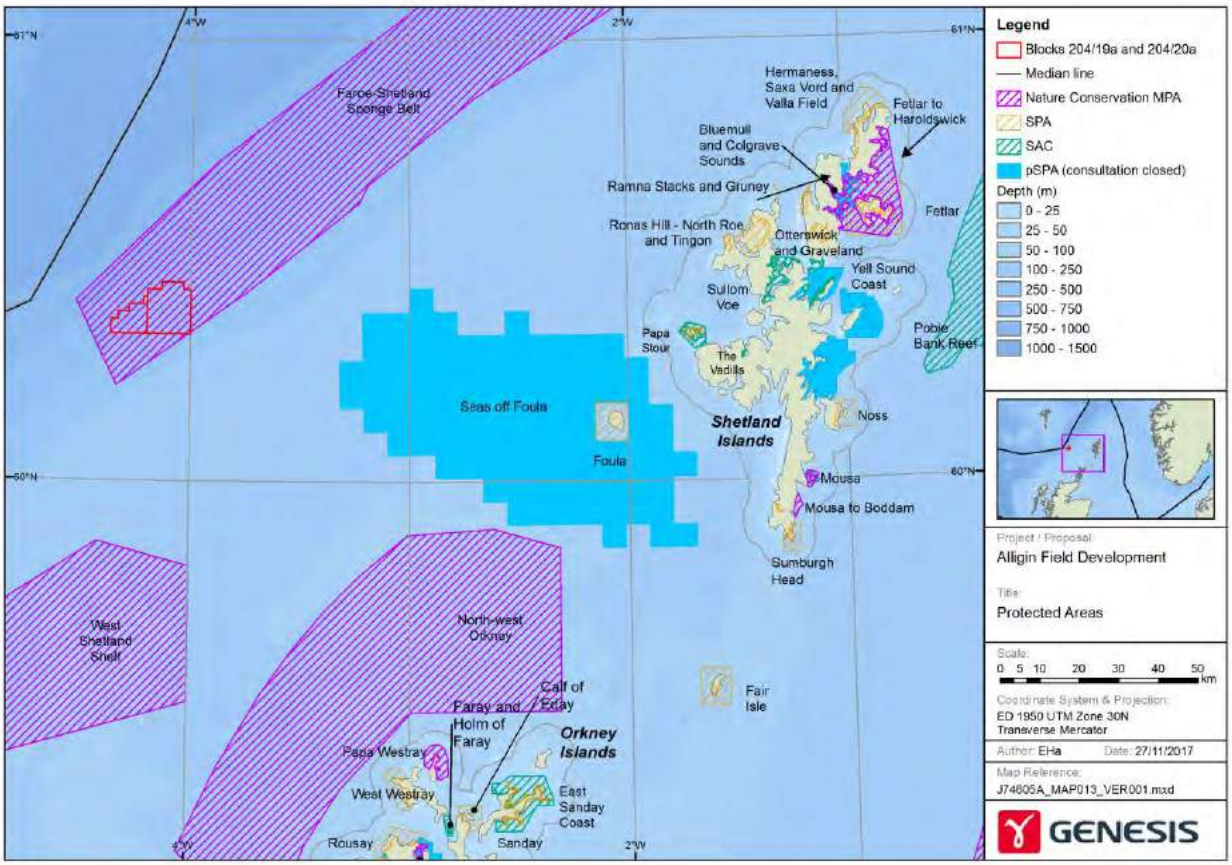

Figure 4: Location of Alligin Field within the Faroe Shetland Sponge Belt NCMPA.

The area is designated for a number of features:

- Deep-sea sponge aggregations;
- *Arctica islandica* aggregations;
- Offshore subtidal sands and gravels;
- Continental slope;
- Continental slope channels, iceberg plough marks, prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity area;
- Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area.

Preliminary results from the Alligin site and pipeline route interpreted seabed comprising gravelly fine to coarse sand with areas of pebbles, cobbles and small to medium sized boulders, consistent with surveys of the wider area. Based on broad scale predictive habitat mapping, the proposed Alligin Field Development is within the European Nature Information System (EUNIS) biotope 'deep sea mixed substrata' (A6.2).

Plankton communities in the area of interest are influenced by the inflow from the Atlantic through the Faroe-Shetland Channel. Dominant phytoplankton forms in this region include dinoflagellate genus Ceratium (mainly C. fusus, C. furca and C. tripos) with diatoms such as Thalassiosira spp. and Chaetoceros spp. also abundant. Zooplankton species found in the West of Shetland (WoS) include the calanoid copepods Calanus helgolandicus and C. finmarchicus (DECC, 2016).

The dominant epifauna taxa observed on the Alligin site and pipeline route survey included sponges (Porifera), hermit crabs (Paguroidea), starfish (Asteroidea) and sea urchins (Gracilechinus acutus). Where hard substrata were present for epilithic attachment, sessile fauna such as anemones (Actiniaria), sea squirts (Ascidiacea), sponges (Porifera) and bryozoans/hydroids (Bryozoan/Hydrozoa) were also observed.

The Alligin pipeline route survey used an Autonomous Underwater Vehicle (AUV) to acquire data for the environmental habitat survey along nine proposed pipeline routes. The objectives of the habitat assessment survey were to acquire enough data to describe all habitats recorded in the study area and to identify and delineate the extent of any potentially sensitive habitats or species, with a particular focus on 'deep-sea sponge aggregations'. The data was analysed for sponge density in line with the JNCC recommended methodology (Henry and Roberts,2014) and it was concluded that whilst the presence of sponges is ubiquitous, it is patchy with low densities overall such that there are no consolidated areas of high sponge density that can be thought to represent sponge aggregations.

The Alligin Field is *c*. 120 km southwest of the sponge aggregations that tend to be the main focus of habitat protection in the Faroe-Shetland Sponge Belt NCMPA. Though not identified in the surveys referenced in this ES, it is possible that the pipelines may pass through an area containing *A. islandica. A. Islandica* is found buried in sandy and muddy sediments from the low intertidal zone down to 400 m. Therefore, at water depths of *c*. 460 - 480 m, it is unlikely that aggregations of this species will occur at the drill centre location, however as can be seen from Figure 5 it is possible the pipeline routes could pass through an area containing this species (note water depths at Schiehallion and Loyal range from 350 m to 500 m).

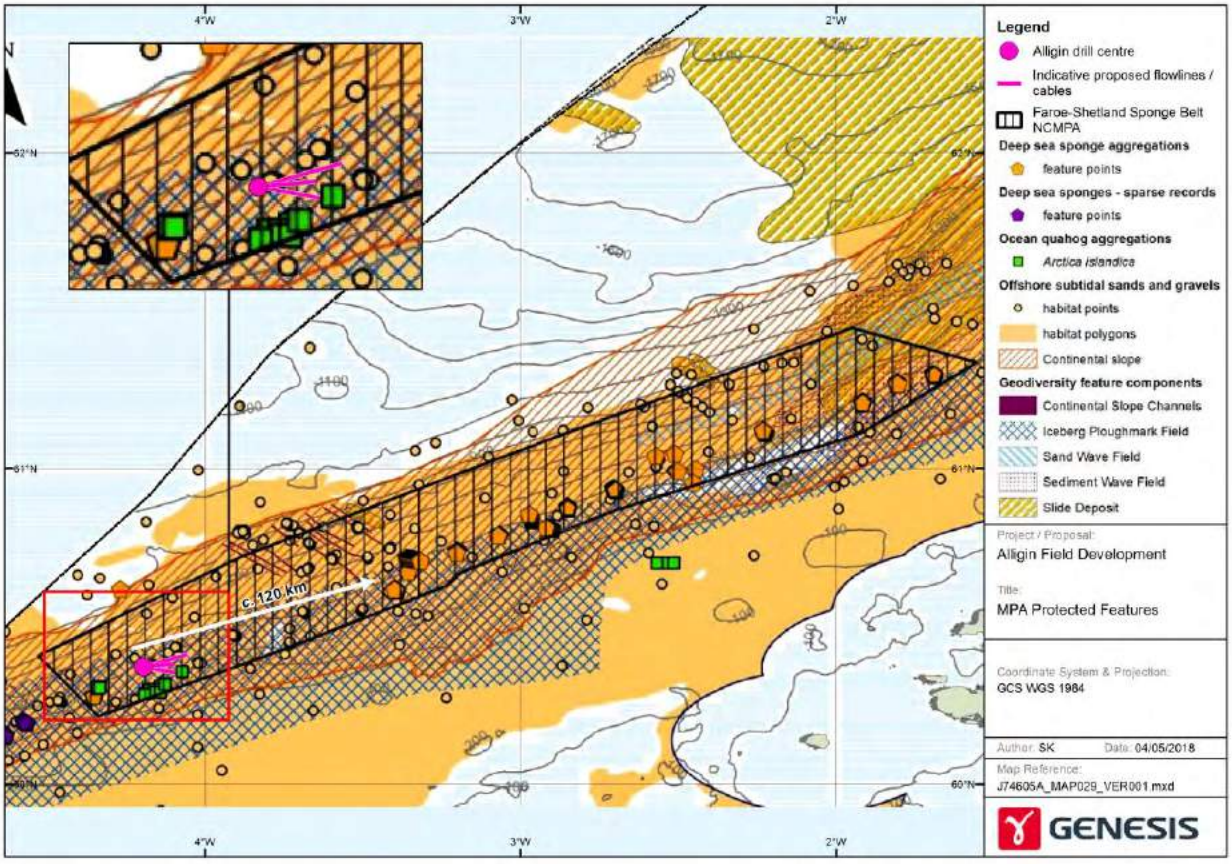

Figure 5: Location of the proposed Alligin drill centre in relation to the designating features within the Faroe-Shetland Sponge Belt NCMPA.

Spawning and nursery grounds for fish species including blue whiting, Norway pout, sandeels and mackerel have been identified in the area. The Arctic skate is a key feature of the assemblage in the Faroe-Shetland Channel.

A number of seabirds are known to occur in the area including northern gannet, great skua, Arctic skua, northern fulmar, black legged kittiwake, guillemot etc. Based on the Seabird Oil Sensitivity Index (SOSI) the sensitivity of seabirds to surface oil pollution is generally considered low to medium throughout the year within Blocks 204/19a and 204/20a, with the exception of November when seabird sensitivity is regarded as very high in both blocks.

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

Commercial fish species are targeted in the area by several nations including the UK, Spain, Norway, France, Germany and the Faroes. For management purposes the International Council for the Exploration of the Sea (ICES) collates fisheries information for area units termed ICES rectangles. The importance of an area to the fishing industry is assessed by measuring the fishing effort within each ICES rectangle. The proposed project area is located within ICES rectangle 49E5. UK commercial fishing effort within this rectangle varies throughout the year and is considered to be low with an average fishing effort of 270 days in 2016 which constitutes 0.20% of the overall UK fishing effort in days.

Shipping in the area is considered low whilst there are no military exercises in the area.

Environmental Impact Assessment

In order to determine the impact that the proposed Alligin Field Development may have on the environment an ENVironmental and socio-economic Impact IDentification (ENVIID) workshop was undertaken following a structured methodology. The purpose of the ENVIID was to identify the significance of the environmental and social risks associated with the planned activities and any possible unplanned events and to identify appropriate mitigation measures, controls and safeguards to minimise this risk.

For each of the planned activities an environmental and/or social significance of risk is assigned for the relevant aspects (e.g. emissions to air, discharges to sea, underwater noise etc.) by taking into account the duration of the activities and the severity of the impact.

For unplanned events the environmental and/or social significance of risk ranking also takes into account the severity of the impact, however, rather than considering the duration of the event it takes account of the likelihood of the unplanned event occurring.

A summary of the key findings of the proposed ENVIID and supporting impact assessment is presented here.

Physical Presence

The physical presence of the project vessels, the drilling rig and the subsea infrastructure has the potential to be a navigational hazard, to restrict fishing operations in the area and / or to cause disturbance to wildlife. However, taking account of the mitigation measures outlined in Table 1, which includes early consultation with the Scottish Fisheries Federation (SFF), and notification to other users of the sea regarding the project's activities, the social risk is considered minor and is therefore acceptable when managed within the mitigation measures described.

Emissions to Air

Gaseous emissions can contribute to global atmospheric concentrations of greenhouse gases, regional acid loads and ozone depletion with the main greenhouse gases being CO_2, methane (CH_4) and nitrous oxide (N_2O) all of which will be produced during the drilling, installation, commissioning and operational phases of the proposed Alligin Field Development Project.

It is anticipated that, as a worst-case scenario, the average annual CO_2 emissions associated with the drilling rig during the drilling of the two wells represents approximately 0.98 % of the annual total UK mobile drilling rig combustion emissions (UK figures for 2015). Average annual CO_2 emissions from other vessels required during the drilling phase (6,196 te) represent approximately 0.06 % of the annual UK domestic shipping emissions.

CO_2 emissions from the subsea installation are anticipated to comprise 0.12 % of shipping (domestic and international) emissions.

There will be an increase in emissions at start-up, however following start-up the processing of the Alligin fluids is not anticipated to impact on the emissions associated with Glen Lyon FPSO.

A range of mitigation measures to minimise emissions to air is proposed, as outlined in Table 1. These include optimisation of vessel use, review of vessel Common Marine Inspection Documents (CMID) as part of vessel assurance and compliance with UK legislation. When compared against other emission sources on the UKCS and taking the mitigation measures into consideration, the overall environmental risk from emissions to air resulting from the project is considered minor and is therefore acceptable when managed within the mitigation measures described.

Discharges to Sea

There will be a number of planned discharges to sea associated with the project.

Planned and permitted discharges to sea during drilling include water based mud (WBM) and WBM contaminated cuttings, cement and associated chemicals. Modelling using the ParTrack model was carried out to determine the impact of the discharge of the WBM cuttings on the water column and on the seabed. The latter is discussed below (under Seabed Disturbance). The impact of the discharge of the cuttings on the water column was considered short lived and not significant. Similarly, the discharge of cement from the drilling rig and those chemicals associated with the drilling operations were not considered to have a significant impact.

Planned and permitted discharges to sea during the installation and commissioning phase are primarily associated with testing the pipelines and infrastructure. All associated chemicals will be risk assessed and permitted in accordance with the Offshore Chemicals Regulations 2002 (as amended).

Discharges to sea during the production phase are primarily associated with the discharge of Produced Water (PW). PW may contain residues of reservoir hydrocarbons as well as chemicals added during the production process, along with dissolved organic and inorganic compounds (metals) that were present in the geological formation. Under normal operating conditions, all PW will be re-injected. Should reinjection fail during an abnormal event, the treated PW will be discharged overboard at the current Glen Lyon FPSO under the installations' Oil Discharge Permit.

In consideration of the control measures outlined in Table 1 the environmental risk of discharges to sea (other than the risk of the discharge of cuttings which is considered under 'Seabed Disturbance' resulting from the proposed Alligin Field Development are considered to minor and are therefore considered acceptable when managed within the additional controls and mitigation measures described.

Seabed Disturbance

A number of activities will be carried out which have the potential to impact on the seabed habitats populated by the benthic communities in the area.

The Deepsea Aberdeen semi-submersible drilling rig will be used to drill the wells and will be held on location via eight anchors and chains. It is estimated that the maximum area of impact associated with the mooring system is 0.113 km^2, though this area of impact is considered temporary and allows for a 10 m corridor of disturbance along each of the anchor chains.

Cuttings will be discharged during the drilling of the two wells and it is possible that solid cement deposits could occur on the seabed at the top of each well.

Modelling was carried out to determine the area of seabed that could be significantly impacted by the discharge of drill cuttings when four parameters are considered cumulatively: change in grain size; burial thickness, chemical toxicity and deoxygenation. As a worst case this area is estimated to be 0.44 km^2 and is expected to decrease over time. The area impacted by the cement deposits is estimated to be 0.0002 km^2 and will be within the footprint of the area impacted by the cuttings pile. The drill cuttings and the cement deposits will result in a change in composition of the seabed in a small area in close proximity to the wells. The drilling activities will result in small 'pieces' of rock being returned to the seabed whilst the cement will likely result in broken up pieces of concrete on the seabed. However, given that the area is known to comprise pebbles, cobbles and small to medium sized boulders, the addition of these 'pieces' of rock and cement are not expected to significantly change the composition of the seabed sediments in the area.

Several types of infrastructure will also be installed on the seabed including a manifold, flowline and umbilical tie-in structures, pipelines, umbilicals, rockdump, mattresses, grout bags etc. The estimated area of disturbance associated with the installation activities is 0.096 km^2 and of this c. 0.032 km^2 is expected to be permanently impacted. It is thought *A. islandica* could occur along the pipeline and umbilical routes, and could be impacted by sedimentation. However, surface laying of the pipelines and umbilical will minimise seabed disturbance and any associated sedimentation whilst A. *islandica* is not considered to be sensitive to low degrees of siltation change.

Combining the worst case impacts it is estimated that an area of 0.93 km^2, which comprises 0.02 % of the area of the Faroe-Shetland Sponge Belt NCMPA could be impacted significantly. In reality it is expect to be much less. This area of impact is out with the deep-sea sponge grounds considered to be the main focus of habitat protection within the NCMPA.

It is concluded that given the sediment type in the area, the minimal amount of sedimentation associated with surface lay operations and the distance of the project from the sponge aggregations of importance the environmental risks associated with installation of the subsea infrastructure and the discharge of the cuttings is moderate and is therefore acceptable provided the risks are reduced to as low as reasonable practicable, and managed under the additional controls and mitigation measures identified in Table 1.

Underwater Sound

The main sources of underwater sound associated with the proposed Alligin Field Development will primarily result from vessel use and drilling operations. There will be no piling and no use of explosives.

Many marine organisms use sound for navigation, communication and prey detection. Therefore, the introduction of man-made sources of underwater noise has the potential to impact marine animals if it interferes with their ability to receive and use sound. Types of impact include temporary avoidance or behavioural changes, the masking of biological sounds, auditory and other injuries.

Although the sound from the proposed Alligin Field Development does have the potential to cause disturbance to marine animals it is not expected to have a significant impact on any cetacean or fish species. Taking this into account and considering the mitigation measures outlined in Table 1, the environmental impact of the underwater noise associated with the vessels is considered minor and is therefore acceptable when managed within the mitigation measures described.

Waste

BPEOC is committed to reducing waste production and to managing all produced waste by applying approved and practical methods. Waste will only be disposed of if it cannot be prevented, reclaimed or recovered. A Waste Management Plan (WMP) will be developed for the Project and will identify (1) the types of waste generated and (2) management procedures for each waste stream. The Plan will detail appropriate waste contractors to be used to ensure the waste is correctly documented, transported, processed and disposed of in accordance with applicable legislation. A programme of regular audits will be carried out to verify correct implementation of the plan. With the application of the mitigation measures identified in Table 1 the impact of waste generation will be minimised. The overall environmental risk of waste generation is therefore considered to be minor and is therefore acceptable when managed within the mitigation measures described.

Accidental Hydrocarbon Releases

Oil spill modelling was carried out using the Oil Spill Contingency and Response (OSCAR) model. There is a potential risk to several environmental receptors from such spills, including internationally protected areas, the magnitude of which is dependent on the size of spill. However, in consideration of the control measures

listed in Table 1, the likelihood of an accidental hydrocarbon release reaching its full effect potential is such that the overall is reduced to as low as reasonably practicable. However, should an uncontrolled release occur there will be robust measures in place to ensure a co-ordinated and co-operative response.

Overall Conclusion

The proposed Alligin Field Development project will be developed using proven technology incorporating the current best practices. A robust design, strong operating practices and a highly trained workforce will ensure the proposed project does not result in any significant long-term environmental, cumulative or transboundary effects. Additional measures will be in place during the operating phase to effectively respond to potential emergency scenarios.

Where possible, mitigation measures / project specific commitments to reduce the environmental and social risks have been identified (Table 1). These will be captured in the project's Environmental Management Plan, which will include roles and responsibilities for their implementation.

Table 1: Alligin Field Development Project commitments.

Aspect	Commitments
Physical presence	• Ongoing consultation with the Scottish Fishermen's Federation; • Notice to Mariners will be circulated prior to rig mobilisation; • Notice will be sent to the Northern Lighthouse Board of drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the semi-submersible drilling rig; • The Deepsea Aberdeen drilling rig will abide by Consent to Locate conditions; • A Collision Risk Management Plan will be produced if determined to be required; • All vessels will adhere to the International Regulations for Preventing Collisions at Sea (COLREGS) and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.; • The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations; • Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site; • Flowlines will be designed in accordance with industry standards to minimise buckling and to minimise interactions with fishing gear; • All infrastructure will be laid within an existing charted Offshore Area Development; • A 500 m safety zone will be applied for at the Alligin drill centre whilst the infrastructure at Loyal will be laid within the existing 500 m exclusion zone at that drill centre; and • The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with industry SFF best practice.
Emissions to air	• The drilling rig will be subject to audits ensuring compliance with UK legislation; • The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity; • During drilling there will be adherence to good operating practices and maintenance programmes;

Aspect	Commitments
	Emissions from combustion equipment are regulated through European Union Emissions Trading Scheme (EU ETS) and Pollution Prevention Control (PPC) Regulations. As part of the PPC permit the following measures will be in place: • During production there will be adherence to good operating practices, maintenance programmes and optimisation of quantities of gas flared during emergency shut-downs; • The emissions from the combustion equipment will be monitored; • Plant and equipment will be subject to an inspection and energy maintenance strategy; • UK and EU air quality standards are not exceeded; • Fuel gas usage will be monitored; and • Energy assessments will be carried out as required.
Discharges to sea	• Deepsea Aberdeen is audited under BPEOC's marine assurance standards and subject to rig recertification audits; • All vessels used will be MARPOL compliant; • Where technically feasible BPEOC will prioritise the selection of chemicals which Pose Little or No Risk (PLONOR), or chemicals with a lower Risk Quotient; • The base case is for total reinjection of produced water (reaching a minimum target of 95 % availability); and • The discharges of produced water and associated chemicals are regulated by the Oil Pollution and Prevention (OPPC) regulations and the Offshore Chemicals Regulations (OCR) and reported through the Environmental Emissions Monitoring Scheme (EEMS). As such, during abnormal operations, BPEOC will ensure that sampling, analysis and reporting are undertaken in line with the regulations and permit conditions.
Seabed disturbance	• Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors; • Use of dynamically positioned vessels; • Surface laid pipelines; • The use of mattresses, rockdump and grout bags will be minimised through optimal project design; and • Sharing Alligin Site and Pipeline Route Survey reports with JNCC and MSS.
Underwater noise	• Optimise duration of drilling and installation activities. • No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels.
Waste	• BPEOC will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; • Existing asset and vessel Waste Management Plans will be followed; • Only permitted disposal yards / landfill sites will be used.

Aspect	Commitments
Accidental events	• Activities will be carried out by trained and competent offshore crews and supervisory teams; • An approved Offshore Pollution Emergency Plan (OPEP) will be in place prior to any activities being undertaken; • Records will be kept of oil spill training and exercises as required by the OPEP; • A co-ordinated industry oil spill response capability will be available; • Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for BPEOC personnel; Wells specific control measures: • A robust Blowout Preventer (BOP) pressure and functional testing regime will be in place; • Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed, as well as visual integrity checks whenever BOPs are recovered to the surface will be undertaken; and • Appropriate mud weights will be used to ensure well control is maintained; • A contract will be in place with a well capping advice provider, in case of emergency; Operations-specific control measures: • Import and export facilities will be secured by a combination of topside Emergency Shut Down Valves (ESDV) and Subsea Isolation Valves (SSIV); • Pipelines will be protected by pressure alarms and a leak detection system; and • Oil spill control measures will be followed as outlined in the OPEP.

The ES assesses the worst case impact of the project on the environment and is therefore very conservative. Even then applying the mitigations measures identified it is the conclusion of this ES that the current proposal for the Alligin Field Development can be completed without causing any significant long term environmental impacts or cumulative and transboundary effects.

ACRONYMS

>	More Than
%	Percentage
(H)	Height
(L)	Length
(W)	Width
“	Inches
<	Less Than
≤	Less than or equal to
≥	More than or equal to
°C	Degrees Celsius
µg/g	Micrograms per Gram
µg/l	Micrograms per Litre
µg/m^3	Micrograms per Meter Cubed
µm	Micrometres
µPa	Micropascal
‰	Parts per thousand
$(te/d)^2$	Tonnes per Day Squared
AFEN	Atlantic Frontier Environmental Network
AHV	Anchor Handling Vessel
AIS	Automatic Identification System
AIW	Arctic Intermediate Water
ALARP	As Low As Reasonably Practicable
API	American Petroleum Institute
ASCOBANS	Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas
Ba	Barium
BACs	Background Assessment Criteria
BAP	Biodiversity Action Plan
BAT	Best Available Techniques
BAT	Best Available Technology
bbl/day	Barrels per Day
bbls	Barrels of Oil
BEIS	(the Department of) Business, Energy and Industrial Strategy
BEP	Best Environmental Practice
BOD	Biological Oxygen Demand
BODC	British Oceanographic Data Centre
BOP	Blowout Preventer
BPEOC	BP Exploration Operating Company
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
c.	Approximately
CCS	Carbon Capture and Storage
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFSR	Climate Forecast System Reanalysis
CH_4	Methane
CHARM	Chemical Hazard Assessment and Risk Management
CHIP	Chemicals (Hazard Information and Packaging for Supply)
CITIES	Convention on International Trade of Endangered Species
cm	Centimetre
cm/s	Centimetre per Second
CNS	Central North Sea
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLREGS	Collision Regulations
CoP	Cessation of Production
CORAMM	Coral Risk Assessment, Monitoring and Modelling
COSHH	Control of Substances Hazardous to Health
cP	centiPoise
CRA	Corrosion Resistant Alloy
cSAC	Candidate Special Area of Conservation
CSIP	Cetacean Stranding Investigation Programme
CtL	Consent to Locate
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DepCon	Deposit Consent
DHSV	Down Hole Safety Valve
DP	Dynamic Positioning

DREAM	Dose-related Risk and Effect Assessment Model
dSAC	Draft Special Area of Conservation
DSV	Dive Support Vessel
DTHT	Drill Through Horizontal
DTI	Department of Trade and Industry
DUTA	Dynamical Umbilical Termination Assembly
DWH	Deep Water Horizon
EA	Environment Agency
EAC	Ecotoxicological Assessment Criteria
EBS	Environmental Baseline Survey
EC	European Commission
ECB	European Chemicals Bureau
ED	European Datum
EEA	European Environment Agency
EEC	European Economic Community
EEMS	Environmental Emissions Monitoring System
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Leads
EHC	Electric Hydraulic Control
EIA	Environmental Impact Assessment
EIF	Environmental Impact Factor
EMODnet	European Marine Observation and Data Network
ENVID	Environmental Issue Identification
EoFL	End of Field Life
EOR	Enhanced Oil recovery
EPS	European Protected Species
ERMS	European Register of Marine Species
ERRV	Emergency Response and Rescue Vessel
ERT	Emergency Response Team
ES	Environmental Statement
ESAS	European Seabirds at Sea
ESD	Emergency Shutdown
ESDV	Emergency Shutdown Valve
ETS	Emissions Trading Scheme
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUNIS	European Nature Information System
EZZ	Exclusive Economic Zone
FEAST	Feature Activity Sensitivity Tool
FEPA	Food and Environmental Protection Act
FPSO	Floating Production Storage and Offloading
FSCBW	Faroe-Shetland Channel Bottom Water
ft	Foot
FTA	Flowline Termination Assembly
FTP	Flowing Tubing Plug
g/m^2	Grams per Metre Squared
GEBCO	General Bathymetric Chart of the Oceans
GEL	Gardline Environmental Limited
GEN	National Marine Plan General Policies
GES	Good Environmental Status
GHG	Greenhouse Gases
GOR	Gas to Oil Ratio
GT	Gas Turbine
GWO	Global Wells Organisation
HAS	Habitat Assessment Survey
HCFC	Hydrochlorofluorocarbons
HDJU	Heavy Duty Jack-UP
HDPE	High Density Polyethylene
HDPE	High Density Polyethylene
HFC	Hydrofluorocarbons
HP	High Pressure
HQ	Hazard Quotient
hrs	Hours
HSE	Health Safety and Environment
HSSE	Health, Safety Security, Environment
HT	High Temperature
IAMMWG	Inter-Agency Marine Mammal Working Group
IAPP	International Association of Privacy Professionals
lbs	Pounds

ICES	International Council for the Exploration of the Sea
ILI	Inline Inspection
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
IoP	Institute of Petroleum
IOPPC	International Oil Pollution Prevention Certificate
IOTPF	International Tanker Owners Pollution Federation
IPPC	Integrated Pollution Prevention and Control
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
KCl	Potassium Chloride
kg	Kilogram
kg/m^2	Kilogram per Metre Squared
kHz	Kilohertz
km	Kilometre
km^2	Squared Kilometres
km^3	Cubed Kilometres
KPIs	Key Performance Indicators
KW	Kilowatts
KW/m	Kilowatts per metre
LAT	Lowest Astronomical Tide
Lb	Pound
LP	Low Pressure
LSA	Low Specific Activity
LTOBM	Lox Toxicity Oil Based Mud
LWI	Light Weight Interventions
m	Metre
m/hr	Metres per Hour
m/s	Metres per Second
m^2	Square Metres
m^3	Cubic Metres
m^3/d	Cubic Metres per Day

MAH	Major Accidents and Hazards
MARPOL	Maritime Pollution
MASTS	Marine Alliance for Science and Technology Scotland
MAT	Master Application Template
mbd	Thousand Barrels per day
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MDAC	Methane Derived Authigenic Carbonate
MEG	Monoethylene Glycol
MEI	Major Environmental Incident
mg/g	Milligrams per gram
mg/kg	Milligrams per Kilogram
mg/l	Milligrams per Litre
mm	Milometers
mm^2	Milometers squared
MMbbl	Million Barrels
MMboe	Million Barrels of Oil Equivalent
MMO	Marine Mammal Observer
MMO	Marine Management Organisation
MMscf	Million Standard Cubic Feet
MMscfd	Million Standard Cubic Feet per Day
MNAW	Modified North Atlantic Water
MNCR	Maritime Nature Conservation Review
MoD	Ministry of Defence
MODU	Mobile Drilling Units
MP	Manual Pump
MPA	Marine Protected Area
MPFM	Multiphase Flowmeters
MSFD	Marine Strategy Framework Directive
MSS	Marine Scotland Science
mTVDss	Metres True Vertical Depth Subsea
MU	Management Unit
MW	Mega Watt
MW(th)	Mega Watt (thermal)

N/A	Not Applicable
N_2O	Nitrous Oxide
NaCl	Sodium Chloride
NAW	North Atlantic Water
NCEP	National Centres for Environmental Prediction
NCMPA	Nature Conservation Marine Protected Area
ng/l	Nanograms per Litre
NLB	Northern Lighthouse Board
nm	Nautical Miles
NMFS	National Marne Fisheries Service
NMP	National Marine Plan
NMPi	National Marine Plant Interactive
NMR	National Monument Records
NNS	Northern North Sea
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NORSOK	Norsk Sokkels Konkuranseposisjon
NOx	Nitrogen Oxides
NPD	Naphthalenes, Phenanthrenes and Dibenzothiophenes
NSAIW	Norwegian Sea Arctic Intermediate Water
NSTF	National Science and Technology Forum
NT	Nearly Threatened
NWAD	North West Area Development
OBM	Oil Based Mud
^oC	Degrees Celsius
OCR	Offshore Chemicals Regulations
OD	Outer Diameter
OE	Operational Efficiency
^oF	Degrees Fahrenheit
OGA	Oil and Gas Authority
OGP	International Oil and Gas Producers
OGUK	Oil and Gas UK
OiPW	Oil in Produced Water
OiW	Oil in Water
OPEP	Oil Pollution Emergency Plan
OPF	Organic Phase Drilling Fluids
OPOL	Offshore Pollution Liability Association Ltd
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSD	Offshore Safety Directive
OSDR	Offshore Safety Directive Regulator
OSPAR	Oslo/Paris Convention
OSRF	Oil Spill Response Forum
OSRL	Oil Spill Response Limited
OVI	Offshore Vulnerability Index
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyl
PEC	Predicted Environmental Concentration
PETS	Portal Environmental Tracking System
PIP	Pipe in Pipe
PLEM	Pipeline End Manifold
PLONOR	Posing Little or No Risk
PMF	Priority Marine Features
pMPA	Possible Marine Protected Area
PNEC	Predicted No Effect Concentration
PON	Petroleum Operations Notice
ppb	Parts per Billion
PPC	Pollution Prevention and Control
ppm	Parts per Million
ppt	Parts Per Thousand
pSAC	Possible Special Area of Conservation
psia	Pounds per Square Inch Absolute
pSPA	proposed Special Protection Area
PT	Pressure Transmitter

PTT	Pressure and Temperature Transmitter
PW	Produced Water
PWA	Pipeline Works Authorisation
PWRI	Produced Water Re-injection
RBA	Risk Based Approach
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
ROV	Remotely Operated Vehicle
RQ	Risk Quotient
SAC	Special Areas of Conservation: cSAC, candidate; pSAC, possible; dSAC, draft
SACFOR	Superabundant, Abundant, Common, Frequent, Occasional, Rare
SAT	Subsidiary Application Template
SBM	Synthetic Based Mud
SCANS	Small Cetacean Abundance in the North Sea
SCF	Standard Cubic Feet
SCI	Sites of Community Importance
SCOS	Special Committee on Seals
SCR	Safety Case Regulations
SCSSV	Surface Controlled Sub-Surface Safety Valve
SDM	Species Distribution Modelling
SDS	Safety Data Sheet
SECAs	Sulphur Emission Control Areas
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fisheries Federation
SG	Specific Gravity
SI	Scale Inhibitor
SIMOPS	Simultaneous Operations
SINTEF	Stiftelsen for Industriell og Teknisk Forskning (The Foundation for Scientific and Industrial Research)
SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SOSREP	Secretary of State Representative
SOx	Sulphur Oxides
SPA	Special Protection Area
SSC	Suspended Sediment Concentrations
SSIV	Subsea Isolation Valve
SSSI	Special Sites of Scientific Interest
t/m^3	Tonnes per Metre Cubed
TBT	Tributyltin
te	Tonne
te/day(d)	Tonnes per Day
Te/hr	Tonnes per Hour
THC	Total Hydrocarbons
TOC	Total Organic Carbon
TOOPEP	Temporary Operations OPEP
TVDss	Total Vertical Depth Subsea°
UET	Umbilical End Termination
UHB	Upheaval Buckling
UK	United Kingdom
UK BAP	UK Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKOOA	UK Offshore Operators Association
UKOPP	UK Oil Pollution Prevention
UNCLOS	United Nations Convention on the Law of the Sea
UTM	Universal Transverse Mercator
VMS	Vessel Monitoring Systems
VOC	Volatile Organic Compounds
VU	Vulnerable
WAT	Wax Appearance Temperature
WBM	Water Based Mud
WGS	World Geodetic System
WI	Water Injection
WMP	Waste Management Plan
WoS	West of Shetland

WOSPL	West of Shetland Pipeline System	yr	Year
wt %	Percentage Weight	Zn	Zinc

1. INTRODUCTION

BP Exploration Operating Company Limited (BPEOC) on behalf of itself and its Co-Venturer, Shell, is proposing to develop the Alligin Field located on the United Kingdom Continental Shelf (UKCS), *c*. 140 km West of Shetland (WoS) and *c*. 20 km from the UK/Faroe median line (Figure 1-1). The majority of the Alligin reservoir lies within Block 204/19a and it also extends into Block 204/20a. Both part-blocks are associated with licence number P556. The Field is part of the Greater Schiehallion Area which comprises the developed Schiehallion and Loyal Fields, the Alligin discovery and a number of other prospects as shown in Figure 1-2.

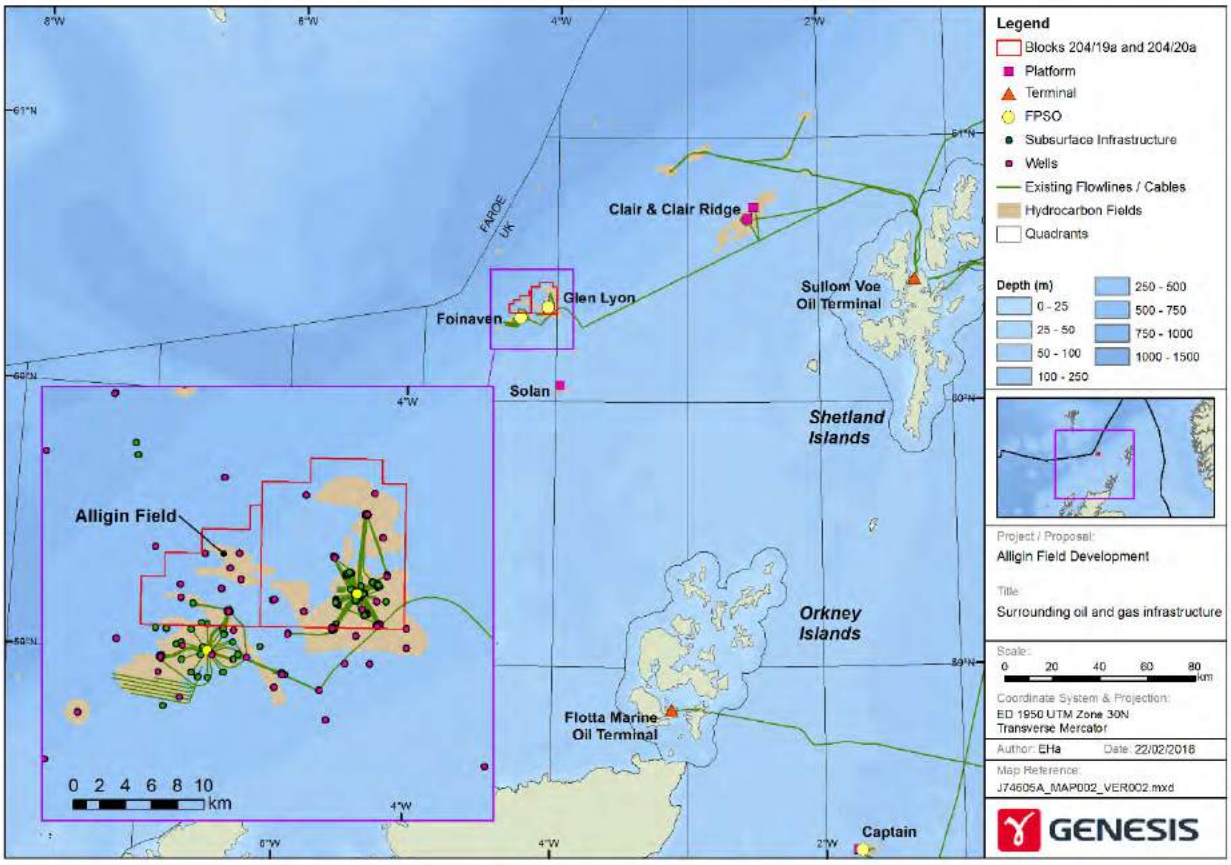

Figure 1-1: Location of the proposal Alligin Development.

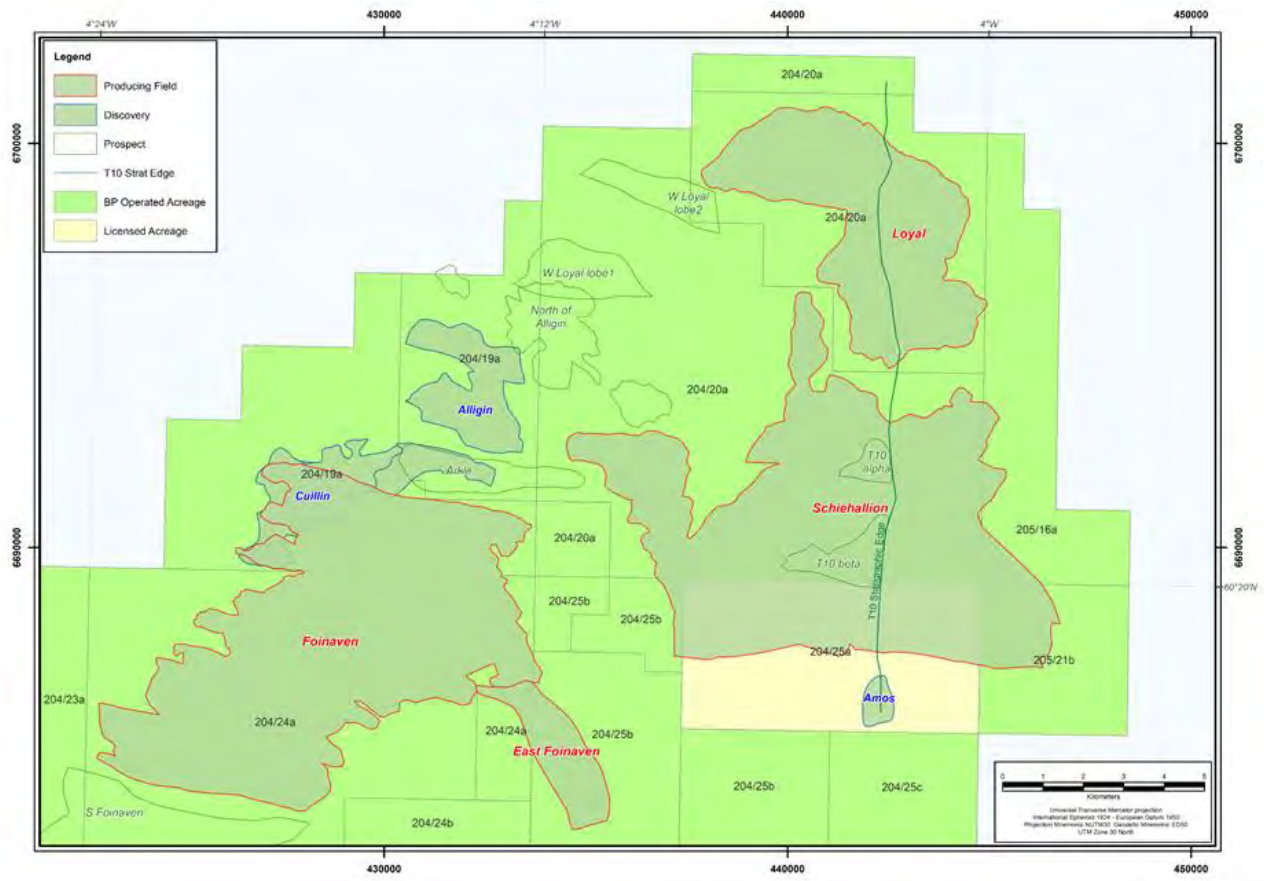

Figure 1-2: Map showing the Greater Schiehallion Area.

The field was discovered in 1995 and the licence interests are summarised in Table 1-1.

Table 1-1: Licence interests of the Alligin Field.

Equity holder	% holding
BPEOC	50
Shell UK Limited	50

The Alligin Field will be developed as a two well subsea tie-back (one production well and one Water Injection (WI) well) to the existing Schiehallion and Loyal infrastructure, using the processing and export facilities of the Glen Lyon Floating Production Storage and Offloading (FPSO) further downstream. Note the Glen Lyon FPSO is located at the Schiehallion Field.

Under the Offshore Petroleum Production and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 1999 (as amended), hereafter referred to as the EIA Regulations, an Environmental Impact Assessment (EIA) and Environmental Statement (ES) are required to be submitted to the Department for Business, Energy and Industrial Strategy (BEIS) for approval. This requirement is due to the anticipated volumes of hydrocarbons to be produced as *'consent is sought for the getting of 500 tonnes or more of oil per day or 500,000 m^3 or more of gas per day otherwise than as a by-product of the drilling or testing of any well'*.

1.1 The Greater Schiehallion Area

As mentioned previously the Alligin Field is part of the Greater Schiehallion Area and will tie back to infrastructure at the Schiehallion and Loyal Fields. The Schiehallion Field has been developed via four drill centres: North, West, Central, and North West whilst Loyal Field has been developed vial the Loyal drill centre. Alligin production fluids will be transported to the Glen Lyon FPSO via the Loyal drill centre whilst water injection and lift gas will be provided to the Alligin wells via the North West drill centre. Representative schematics are provided in Section 2 (Figures 2-3 and 2-4).

1.2 Overview of the Alligin Field Development Project

The proposed Alligin Field Development will comprise:

- The drilling of one production and one WI well;
- The installation of:
  - a *c*. 9 km x10/16" OD (outer diameter) pipe in pipe production flowline to the existing Loyal drill centre;
  - a *c*. 5.5 km x 10" OD injection water flowline and a *c*. 5.5 km x 6" OD lift gas flowline from the existing Schiehallion North West drill centre; and
  - a *c*. 5.7 km subsea control umbilical for power, communications and chemical supply tied back to an existing Dynamical Umbilical Termination Assembly (DUTA) D30[1];
- Increased production at the Glen Lyon FPSO (relative to operation without Alligin); and
- Decommissioning at End of Field Life (EoFL).

1.3 Purpose of the Environmental Statement

The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) require the undertaking of an Environmental Impact Assessment (EIA) and production of an Environmental Statement (ES) for certain types of offshore oil and gas projects likely to have a significant effect on the environment. The Regulations set trigger levels (see Section 1.6.1) for a mandatory EIA based on new or increased oil and gas production.

The purpose of this ES is to report on the EIA process undertaken to meet both statutory and BPEOC internal project requirements. The ES provides a public consultation document which supports consultees in the decision making process. It is therefore required to be a comprehensive report. The ES provides an opportunity to reassure the Regulator and consultees that BPEOC is informed and understands:

- the likely consequences of the activities, emissions, discharges and physical presence of the project;
- the local environment;
- the nature of the environmental and commercial issues arising from other users of the sea.

The ES has been prepared in accordance with the EIA Regulations and guidance from BEIS.

[1] Note: a DUTA is a structure which allows a number of subsea control modules to be connected to the same communications, electrical and hydraulic supply lines and allows multiple wells to be controlled via one umbilical.

1.4 Scope of the Environmental Statement

The scope of the EIA and resultant ES includes the following activities:

- The drilling of one production and one WI well;
- The installation and commissioning of the tie-back infrastructure;
- Processing of the Alligin hydrocarbons at the Glen Lyon FPSO;
- Decommissioning.

The EIA sets out to investigate and evaluate the impacts of any emissions to air, discharges to sea, seabed disturbance, noise, waste production and resource use resulting from the proposed development on a range of receptors including flora, fauna, water, air, climate and material assets. In addition, the potential interactions with other sea users are considered. These aspects are considered for planned activities and unplanned i.e. accidental events.

The Alligin Development is located within the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA) (details of designating features are provided in Section 3). The impacts of the proposed project on the NCMPA are considered in detail.

1.5 Document Layout

To determine the environmental and socio-economic impacts of the proposed Alligin Field Development Project, an understanding of the regulatory context, stakeholder concerns, the proposed activities and the environmental and socio-economic baseline is required. Table 1-2 details the structure of the ES report.

Table 1-2: Structure of the ES.

Section No.	Title	Contents
	Non-Technical Summary	A summary of the ES Report.
1	Introduction	Introduction to the project and scope of the ES. This chapter also includes a summary of applicable legislation, BPEOC's Management System, areas of uncertainty and the consultation process to date.
2	Project Description	A description of the drilling and subsea installation operations, an overview of the Glen Lyon FPSO and the anticipated production profiles.
3	Environmental and Socio-Economic Baseline	A description of the environmental and socio-economic receptors in the area.
4	Risk Assessment Methodology	Description of the methodology used to determine the significance of the environmental and social risk of the proposed activities.
5 to 10	Assessment of Aspects	Detailed assessment of Physical Presence (Section 5); Emissions to Air (Section 6); Discharges to Sea (Section 7); Seabed Disturbance (Chapter 8); Underwater Noise (Section 9); and Waste (Section 10).
11	Accidental Events	Details of accidental events identified during the ENVironmental and socio-economic Impact IDentification (ENVIID) workshop.
12	Conclusions	Key findings including a register of commitments.
13	References	Lists sources of information drawn upon throughout the ES.
Appendix A	Legislative Overview	Overview of legislation applicable to the project.
Appendix B	Scotland's National Marine Plan	Assessment of the project against the Scotland's National Marine Plan.
Appendix C	ENVIID Results	Results of the ENVIID workshop.
Appendix D	Oil Spill Modelling	Modelling of the impacts of a large hydrocarbon release in the event of a well blowout.
Appendix E	Drill Cuttings Modelling	Modelling of the impacts of discharging drilling cuttings from the Alligin production and water injection wells.

1.6 Legislative Overview

A brief overview of the current relevant legislation is provided here whilst Appendix A provides a more comprehensive summary of all applicable legislation.

1.6.1 Environmental Impact Assessment

Offshore environmental control has developed significantly over the past thirty years and is continuing to evolve in response to increasing awareness of potential environmental impacts. Strands of both primary and secondary legislation, voluntary agreement and conditions in consents granted under the petroleum licensing regime and International Conventions have all contributed to the current legislative framework.

The main controls for new oil and gas projects are EIAs, which became a legal requirement of offshore developments in 1998. Current requirements are set out in the EIA Regulations and accompanying Guidance Notes for Industry (BEIS, 2018).

The EIA Regulations require an ES to be prepared and submitted for:

I. New developments, or an increase in production which will produce 500 te or more per day of oil, or 500,000 m^3 or more per day of gas;
II. Pipelines of 800 mm diameter and 40 km or more in length;
III. Storage sites pursuant to Directive 2009/31/EC on the geological storage of CO_2;
IV. Installations for the capture of CO_2 for the purpose of storage; and
V. Any change to or extension of projects listed in parts (i) to (iii) above where such a change or extension in itself meets the thresholds specified above.

In addition to the mandatory ES conditions, a discretionary ES may be required for an oil and gas project if, for example, the new development is less than 40 km from the UK coast. Such projects will be considered on a case-by-case basis. Further details are contained in the Guidance Notes for Industry (BEIS, 2018).

Following submission of the ES, a period of formal public consultation is required under both the EIA Regulations and European Directive 2003/35/EC (Public Participation Directive).

The EIA needs to consider the impact on the surrounding environment including any protected areas. Protected areas have been designated as a result of European Directives, in particular the European Union (EU) Habitats Directive 92/43/EEC and the EU Wild Birds Directive 2009/147/EC (previously 79/409/EEC), and have been enacted in the UK by the following legislation:

- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended 2012) transpose the Habitats and Birds Directives into UK law. They apply to land and to territorial waters up to 12 nautical miles (nm) from the coast and have been amended a number of times.
- The Conservation of Habitats and Species Regulations 2010 (as amended 2012): These regulations consolidate all the various amendments made to the Conservation (Natural Habitats, &c.) Regulations 1994 (above) in England and Wales. In Scotland, the Habitats and Birds Directives are transposed through a combination of the Habitats Regulations 2010 as amended (in relation to reserved matters) and the 1994 regulations as amended.
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended 2009 and 2010) transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, Carbon Capture and Storage (CCS) plans and projects. The regulations apply to the UK's offshore marine area (i.e. outside the 12 nm territorial limit) and English / Welsh territorial waters.
- The Offshore Petroleum (Conservation of Habitats) Regulations 2001 (as amended 2007), similar to the Offshore Marine Conservation (Natural Habitats &c) Regulations, transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, CCS plans and

projects. These regulations apply to projects wholly or partially on the UKCS and adjacent waters outside territorial waters.

1.6.2 Protected Sites and Species

All offshore projects or developments must demonstrate that they are not "likely to have a significant impact on the integrity of the conservation objectives for the protected site" or "significantly disturb European Protected Species (EPS)" either alone or in combination with other plans and projects.

The disturbance of EPS has been further defined by the 2010 amendments to the Offshore Marine Conservation Regulations. It is an offence to:

- Deliberately capture, injure, or kill any wild animal of an EPS (termed the injury offence); and / or
- Deliberately disturb wild animals of any such species (termed the disturbance offence).

Disturbance of an animal includes in particular any disturbance which is likely to:

- Impair the animal's ability to survive, breed, reproduce, to rear and nurture their young and, where applicable, an animal's ability to hibernate or migrate; and/or
- Significantly affect the local distribution or abundance of the species to which they belong.

1.6.3 Discharges to Sea

Oil Discharges

In line with the Oslo / Paris Convention (OSPAR) Recommendation (2001/1), the UK through BEIS has introduced regulatory requirements which reduce the permitted average monthly oil in water discharge concentration to a maximum of 30 mg/l. OSPAR Recommendation 2001/1 also required contracting parties to reduce the total discharge of oil in Produced Water (PW) by 15 % by 2006 measured against a 2000 baseline. The permits replaced the granting of exemptions under the Prevention of Oil Pollution Act 1971 and are issued under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2010 and 2011). This target has been met and maintained by the industry as a whole.

Chemical Discharges

In June 2000, the OSPAR Convention for the Protection of the Marine Environment in the North East Atlantic made a decision requiring a mandatory system for the control of chemicals (OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals). This decision operates in conjunction with two OSPAR Recommendations:

- OSPAR Recommendation 2000/4: The application of a Harmonised Pre-Screening Scheme for Offshore Chemicals to allow authorities to identify chemicals being used offshore; and
- OSPAR Recommendation 2000/5: The application of a Harmonised Offshore Chemical Notification Format for providing data and information about chemicals to be used and discharged offshore.

The UK Government's offshore oil and gas regulator (BEIS) implemented OSPAR Decision 2000/2 on the control of chemical use offshore, through the Offshore Chemicals Regulations (OCR) (2002, as amended 2010 and 2011).

Risk Based Approach

OSPAR Recommendation 2012/5 for a Risk-Based Approach (RBA) to the Management of Produced Water (PW) Discharges from Offshore Installations aims to produce a method for prioritising mitigation actions for those discharges and substances that pose the greatest risk to the environment. The objective is that by 2020 all offshore installations with PW discharges in the OSPAR maritime area will have been assessed to determine the level of the risk and that, where appropriate, measures will have been taken to reduce the risk posed by the most hazardous substances. BEIS has issued guidance on the RBA for UK installations (DECC, 2014).

1.6.4 Atmospheric Emissions

Combustion installations on oil and gas platforms with a rated thermal input of 20 MW(th) or more require permitting under the EU's Emissions Trading Scheme (EU ETS) and implemented in UK regulations as the Greenhouse Gas ETS Regulations 2005 (as amended 2007). This includes the requirement to monitor and report carbon dioxide (CO_2) emissions, surrender allowances and to notify of any changes affecting the allocation of allowances.

Combustion installations on oil and gas platforms with a rated thermal input of 50 MW(th) or more require permitting under the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013. This includes conditions limiting releases notably for for carbon monoxide (CO), oxides of nitrogen (NOx), oxides of sulphur (SOx), methane (CH_4) and volatile organic compounds (VOCs) and the demonstration of the use of Best Available Technique (BAT).

1.6.5 Marine and Coastal Access Act

The Marine and Coastal Access Act (MCAA) came into force in November 2009. The Act covers all UK waters except Scottish internal and territorial waters which are covered by the Marine (Scotland) Act (2010), which mirrors the MCAA powers. Licensing provisions in relation to the MCAA came into force on 1st April 2011. The MCAA replaces and merges the requirements of the Food and Environmental Protection Act (FEPA) Part II (environment) and the Coastal Protection Act (navigation).

The following activities are exempt from the MCAA as they are regulated under different legislation:

- activities associated with exploration or production / storage operations that are authorised under the Petroleum Act; and
- additional activities authorised solely under the BEIS environmental regime, e.g. chemical and oil discharges.

Therefore, activities which are not regulated by the Petroleum Act or under the BEIS environmental regime require an MCAA licence as of April 2011.

The MCAA enables the designation of Marine Conservation Zones (MCZs) in the territorial waters adjacent to England and Wales and UK offshore waters. In Scotland offshore MCZs are referred to as Nature Conservation Marine Protected Areas (NCMPAs) in order to be consistent with the designation of MPAs within Scottish Territorial waters under the Marine (Scotland) Act.

1.6.6 National Marine Plan

The National Marine Plan (NMP) comprises plans for Scotland's inshore (out to 12 nautical miles) and offshore waters (12 to 200 miles) as set out under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009. The NMP represents a framework of Scottish Government policies for the sustainable development of marine resources. The NMP is underpinned by strategic objectives:

- Achieving a sustainable marine economy;
- Ensuring a strong, healthy and just society;
- Living within environmental limits;

- Promoting good governance;
- Using sound science responsibly.

These objectives are to be achieved through the application of 21 'General Planning Principles'. Development projects should take these principles into account in order to support the overall NMP objectives for sustainable development of Scotland's marine environment.

The NMP sets out specific key issues for oil and gas sector in supporting the objectives of the plan:

- Maximise extraction;
- Re-use infrastructure;
- Transfer of skills to renewables and CCS;
- Co-operation with the fishing industry;
- Noise impacts to sensitive species;
- Chemical and oil contamination of water, sediments and fauna;
- Habitat changes.

The NMP also sets out general policies and objectives as part of the UK's shared framework for sustainable development. The proposed operations as described in this ES have been assessed against all NMP objectives (Appendix B) and policies, but specifically GEN 1, 4, 5, 9, 12, 14 and 21:

GEN 1- General Planning and Principle

Development and use of the marine area should be consistent with the Marine Plan, ensuring activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment.

GEN 4 - Co–existence

Where conflict over space or resource exists or arises, marine planning should encourage initiatives between sectors to resolve conflict and take account of agreements where this is applicable.

GEN 5 - Climate Change

Marine planners and decision makers should seek to facilitate a transition to a low carbon economy. They should consider ways to reduce emissions of carbon and other greenhouse gasses.

GEN 9 - Natural Heritage

Development and use of the marine environment must:

- Comply with legal requirements for protected areas and protected species.
- Not result in significant impact on the national status of Priority Marine Features (see Section 3.3.5).
- Protect and, where appropriate, enhance the health of the marine area.

GEN 12 – Water Quality and Resource

Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.

GEN 14 – Air Quality

Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits. Some development and use may result in increased emissions to air, including particulate matter and gases. Impacts on relevant statutory air quality limits must

be taken into account and mitigation measures adopted, if necessary, to allow an activity to proceed within these limits.

GEN 21 – Cumulative Impacts

Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.

These NMP policies and objectives have been considered during the development of the proposed project and when undertaking the EIA. An assessment of the proposed operations against the Scottish National Marine Plan criteria is provided in Appendix A.

1.7 BPEOC Management System

BPEOC are committed to conducting activities in compliance with all applicable legislation and in a manner that will minimise impacts on the environment. The proposed Alligin Field Development will be delivered in compliance with BPEOC's Environmental Management System which has been developed in line with the principles of the International Standard for Environmental Management Systems (ISO14001:2004).

BP North Sea UK HSSE Policy

BP's commitment to **health, safety, security** and **environmental** (HSSE) performance

Our HSSE goals are simply stated:

No accidents, no harm to people and no damage to the environment.

We strive to be a safety leader in our industry, a world-class operator, a good corporate citizen and a great employer. Nothing is more important to us than the health, safety and security of our workforce and the communities in which we operate, and behaving responsibly towards our shared environment. We must be vigilant, disciplined and always looking out for one another. We are committed to:

- relentlessly pursue the ultimate objective of an injury free workplace
- not compromising our focus on safety to achieve any other business objective
- believing that our safety actions are most effective when we genuinely care about each other
- maintain an environment for open and transparent reporting and recognize behavior which is consistent with our values
- will hold to account those who knowingly disregard our rules.

Everyone who works for BP has a part to play in meeting our HSSE commitment and working safely is a legal requirement and condition of employment. We expect all staff and contractors on BP-operated sites to comply with all applicable legislation, BP requirements, policies, practices, standards, rules and procedures.

We expect all staff and contractors to stop work when there is an unsafe act or behaviour, noncompliance with legislation or when unable to meet BP requirements.

These expectations exist to protect us, the environment and to safeguard the integrity of our operations. "we will actively seek acts of compliance, intervention and positive safety behavior and recognize these individuals and teams whether they staff or contractors.

Our Operating Management System (OMS) sets out how we systematically achieve these goals and manage our operating activities and risks. It also defines how we report and improve our HSSE performance and learn from internal and external HSSE events.

Mark Thomas
Regional President - North Sea
1 July 2017 (updated 3 yearly)

N3-REC-12-0001

Figure 1-3: BPEOC's HSSE Policy.

1.8 Areas of Uncertainty

This ES was prepared during the Optimise and Define Phase of the project. As a result, some assumptions have been made in order to undertake the EIA. Where assumptions have been made, the environmental worst case option was assessed. Assumptions and uncertainties are outlined below.

1.8.1 Rock Cover, Mattresses and Grout Bags

Maximum anticipated quantities of rock cover, mattresses and grout bags are presented in the ES to assess the worst case scenario in terms of impacts on the seabed. The requirements for mattresses and grout bags will be further assessed and confirmed in later SAT/PWA (Pipeline Work Authorisation) applications.

1.8.2 Production Profiles

Production profiles based on models have a certain degree of uncertainty associated with them. The production profiles presented in this ES are based on a high case and are an annualised average of the projected production from the Alligin Field.

1.9 Consultation Process

During the process to assess the environmental impact of the proposed project, BPEOC consulted a number of stakeholders. A summary of the issues raised at a stakeholder meeting held in January 2018 is provided in Table 1-3. Stakeholders represented at the meeting included BEIS, the Joint Nature Conservation Committee (JNCC), the Scottish Fishermen's Federation (SFF) and Marine Scotland Science (MSS). In addition, in February 2018, BPEOC issued a Scoping Report to a number of stakeholders. Issues, recommendations, requests raised in the responses received are also detailed in Table 1-3. The process of consultation will continue throughout the project.

As required by the EIA Regulations (BEIS, 2018), a copy of the ES and the public notice has been made publicly available on the Company's website at the time of submission: https://www.bp.com/en_gb/united-kingdom/where-we-operate/north-sea/north-sea-portfolio.html.

Table 1-3: Summary of consultations.

Consultee	Comment	BPEOC response
Summary/ feedback from Stakeholder Engagement meeting held on 31/1/18: attended by BEIS, JNCC, SFF and MSS		
	• MSS requested that the worst-case well blow out impact modelling considers the impact on local aquaculture.	Addressed in Section 11.2.2.
	• SFF stated that their preference would be for pipelines to be trenched and buried to reduce risk to fishing vessels. They also requested that the ES includes information on why there are several pipeline routings to different drill centres rather than a single route.	Addressed in Section 2.3.
	• SFF asked whether there was any plan to consider non-UK vessel fishing activity in the ES. BPEOC stated that there may be anecdotal evidence referenced within the ES however with a lack of data this may be all that can be provided. SFF then stated that they would be happy with this.	Addressed in Section 3.6.3
	• MSS stated that it would be good to capture the stakeholder engagement within the ES.	Addresses in Section 1.9.
	• JNCC stated that it would be good to see the results of the Survey and Habitats Assessment before the submission of the ES.	Available results included in Section 3.
	• Stakeholders agreed that cuttings modelling was not required and that modelling carried out for the Quad204 project could be referenced. They advised it would be useful to include “ground truthing” surveys that confirm the effect of drill cuttings.	Subsequent to the meeting, BPEOC commissioned a modelling study to determine the impacts of the discharged cuttings. Results are presented in Section 8 and Appendix E.
	• A request was made to capture the impact of Alligin fluids on Glen Lyon’s produced water system.	Addressed in Section 2.8.3 and Section 7.3.1.
	• Details were requested for the protection structures on the wells.	Addressed in Section 2.6.1.
Response to Scoping Report issued on 26/2/18		
BEIS	• The ES should address option selection with particular focus on pipeline route selection / installation method, etc. In addition, the pipeline installation method (e.g. surface lay vs. trench and bury) should be discussed.	Addressed in Section 2.3.
	• The Alligin ES can use the cuttings modelling carried out for Quad204 as a basis for determining the impacts of the Alligin cuttings with particular consideration being given to protected features e.g. deep-sea sponge aggregations. When using this modelling the Alligin ES should draw on recent survey work to confirm/supplement the original results.	Subsequent to the meeting, BPEOC commissioned a modelling study to determine the impacts of the discharged cuttings. Results including the impacts on deep-sea sponge aggregations are presented in Section 8 and Appendix E.
	• An upfront description of the site survey should be provided. This should highlight the sampling methodologies and the rationale behind the location of environmental sampling stations. A clearly labelled map showing the location of sampling stations should be included, with sampling stations linked to photographs provided. BEIS are aware that the full environmental survey results may not be available at the time of ES submission.	Addressed in Section 3.2.

	• Request that details of any modifications to the Glen Lyon topsides are captured. In addition, request that any impacts on the FPSO's produced water system performance e.g. volume, temperature, separation efficiency, oil in water are captured.	Addressed in Sections 2.7 and Section 7.3.1.
JNCC	• JNCC recommend that a full deep-sea sponge aggregation assessment is carried out using the JNCC Henry and Roberts 2014 guidelines.	Addressed in Section 3.4.2.1.
	• JNCC request that BPEOC explicitly assess the impact on offshore subtidal sands and gravels (not only as a supporting habitat for ocean quahog).	Addressed in Section 8.5.
	• JNCC request that survey data is included within the ES, given the sensitive nature of the location of the development.	Available results included in Section 3.
	• JNCC recommend that BPEOC supply JNCC with copies of relevant survey reports (in addition to the ES).	Survey reports will be sent to JNCC.
	• JNCC recommend best practices are followed when planning the project to ensure, where possible, the smallest possible footprint of operations, in order to reduce potential disturbance.	Addressed in Section 2.3 and Section 8.
	• JNCC request that surface lay of pipelines is clearly justified in the ES.	Addressed in Section 2.3.
	• JNCC recommend that, where practical, deposition of stabilisation/ protective materials (e.g. concrete mattresses and rock dump) are kept to a minimum and that infrastructure is not placed on the seabed features or habitats of conservation importance.	Addressed in Section 2.6.4 and Section 8.
	• JNCC considers it best practice to consider the full worst case scenario in order to enable a meaningful assessment of the full environmental impacts of a project.	Worst case scenarios addressed throughout ES.
Marine Scotland Science (MSS)	• MSS would ask that an option selection and alternatives section is included in the ES which should discuss why the proposed development is the best available option. In addition to including justification for the selected pipeline installation method MSS also ask that the chosen pipeline routes are discussed and that the ES demonstrates that the chosen option represents Best Environmental Practice (BEP) using Best Available Technology (BAT) and takes account of decommissioning.	Addressed in Section 2.3.
	• MSS request that a detailed schedule of works is provided with any contingency periods identified.	Addressed in Section 2.4.
	• MSS advise that cementing operations are presented and associated environmental / socio economic impacts are assessed.	Addressed in Section 7.1.2
	• MSS recommend a brief summary is provided detailing the scope of the surveys used in the EIA process along with a description of how the sampling stations were selected. MSS also advise a map labelled with individual sampling stations from each survey is included.	Addressed in Section 3.2.
	• MSS request copy of the site survey for our archive as and when it becomes available.	Survey reports will be sent to MSS.
	• MSS provided a number of data sources for reference with respect to describing the environmental and socio-economic baselines.	Where applicable data sources used in Section 3.
	• MSS recommend that baseline is supported with seabed photographs.	Addressed in Section 3.3.3.
	• MSS request that sediment contaminant levels are discussed and compared against OSPAR background levels.	Addressed in Section 3.3.3.
	• MSS recommend that in addition to discussion aquaculture sites in the area, Shellfish Water Production Areas are considered.	Addressed in Section 3.6.5.

	• MSS request that a description of the impact assessment methodology is included in the ES.	Addressed in Section 4.
	• MSS request information on what structures will be fishing friendly.	Addressed in Section 2.6.2 and Section 5.2.1.
	• MSS request that the worst case volume of rock and number of concrete mattresses / other protective materials are detailed in the ES.	Addressed in Section 2.6.4.
	• MSS request that consideration is given to produced water discharges over the lifetime of the project.	Addressed in Section 2.8.3 and Section 7.3.1.
	• MSS request that an estimate of chemical usage over the life of the project is included.	Addressed in Section 2.8 and 7.3.1.
	• MSS accept that modelling from Quad204 project can be used to support the ES, however they request that similarities and differences between the proposed development and that modelled should be highlighted (e.g. depth, substrate, currents etc.). MSS also recommends that if available results from post drilling surveys in the area are reviewed to ground truth the predictive models and provide an indication of the accuracy of these (i.e. were the actual findings reflective of the model?).	Subsequent to issuing the Scoping Report, BPEOC commissioned a modelling study to determine the impacts of the discharged cuttings. Results are presented in Section 8 and Appendix E.
	• MSS advise that the overall footprint of the development is quantified and the spatial extent of the impact area is expressed a percentage of the size of the Faroe-Shetland Sponge Belt NCMPA to provide some scale and context for the impacts.	Addressed in Section 8.
	• MSS advised that the ES identifies, describes and assesses direct and indirect significant effects resulting from the vulnerability of the project to risks of major accidents or disasters in accordance with BEIS guidance.	Addressed in Section 11.
	• MSS request the predicted effectiveness of the stated mitigation measures should be made clear, and the ES should demonstrate a firm commitment to implementing the proposed measures, where appropriate, indicating how and when the measures will be implemented and confirming lines of responsibility for ensuring implementation.	Mitigation measures are identified where relevant throughout the impact assessment chapters and in the ENVIID table.
	• MSS request that any commitments relating to matters addressed in the ES are drawn together into one section or table and are clearly identifiable. MSS recommend the BPEOC should also indicate how they intend to monitor these commitments to ensure compliance.	Addressed in Section 12.
	• MSS recommended that the ES considers decommissioning upfront and details how all installed infrastructure / protective material would be removed should this be the policy in place at that time.	Impact of decommissioning on each of the aspects considered is addressed through Sections 5 to 10.
	• MSS requests that the ES contains a comprehensive conclusion summarising the main environmental sensitivities and how these are to be mitigated or why they are not considered to be significantly affected.	Addressed in Section 12.
Scottish Fisheries Federation (SFF)	SFF have raised concerns regarding the proposal to surface lay the pipelines and umbilical. SFF request assurance that significant loading evaluations on the surface laid pipelines are sufficient to interact with different fishing methods deployed in and around the Alligin Development area.	Addressed in Section 2.3.
Others	The scoping report was also issued to: The Faroe Islands Environmental Agency, The Shetland Islands Council; and Orkney Council.	No comments were received.

2. PROJECT DESCRIPTION

2.1 Introduction

BPEOC propose to develop the Alligin Field via a two well subsea tie-back (one production well and one WI well) to the existing Schiehallion and Loyal infrastructure, and onwards to the Glen Lyon FPSO for processing. In addition to WI, gas lift will be required at the production well. A new production pipeline will tie back to existing Loyal infrastructure whilst injection water, gas lift and controls will be supplied via tie-ins to existing Schiehallion infrastructure.

2.2 Nature of the Reservoir

The Alligin Field fluids are high density oils with a relatively low proportion of volatile components. Characteristics for the Alligin reservoir are summarised in Table 2-1.

Table 2-1 Reservoir Properties.

Property	Value
Reservoir type	Oil
Reservoir Depth	2100 mTVDss*
Reserves	*c.* 20 MMBOE**
Density at standard conditions (kg/m^3)	895
Oil gravity	27.1°API ***
Gas gravity	0.596
Wax content	4-8 %
*mTVDss – metres True Vertical Depth subsea **MMboe – Million Barrels of Oil Equivalent *** American Petroleum Institute	

The Alligin reservoir comprises the Alligin North and the Alligin South fault blocks. It was discovered in 1995 (exploration well 204/19-6) which encountered gas and oil contacts in the Alligin North fault block. Further appraisal drilling showed the Alligin South fault block had independent contacts to Alligin North. The Lower Palaeocene reservoirs of Alligin comprise deep water confined turbidite sands and are linked to similar aged reservoirs on Schiehallion, sharing similar reservoir properties. The fields are independent due to a structural saddle between the accumulations. The proposed Alligin Field Development Project covered by this ES is solely focused on Alligin South where fluids are comparable to the adjacent Schiehallion and Loyal Fields. Figure 2-1 illustrates the planned Alligin producer and injector well target boxes (though it should be noted these could shift as the project progresses).

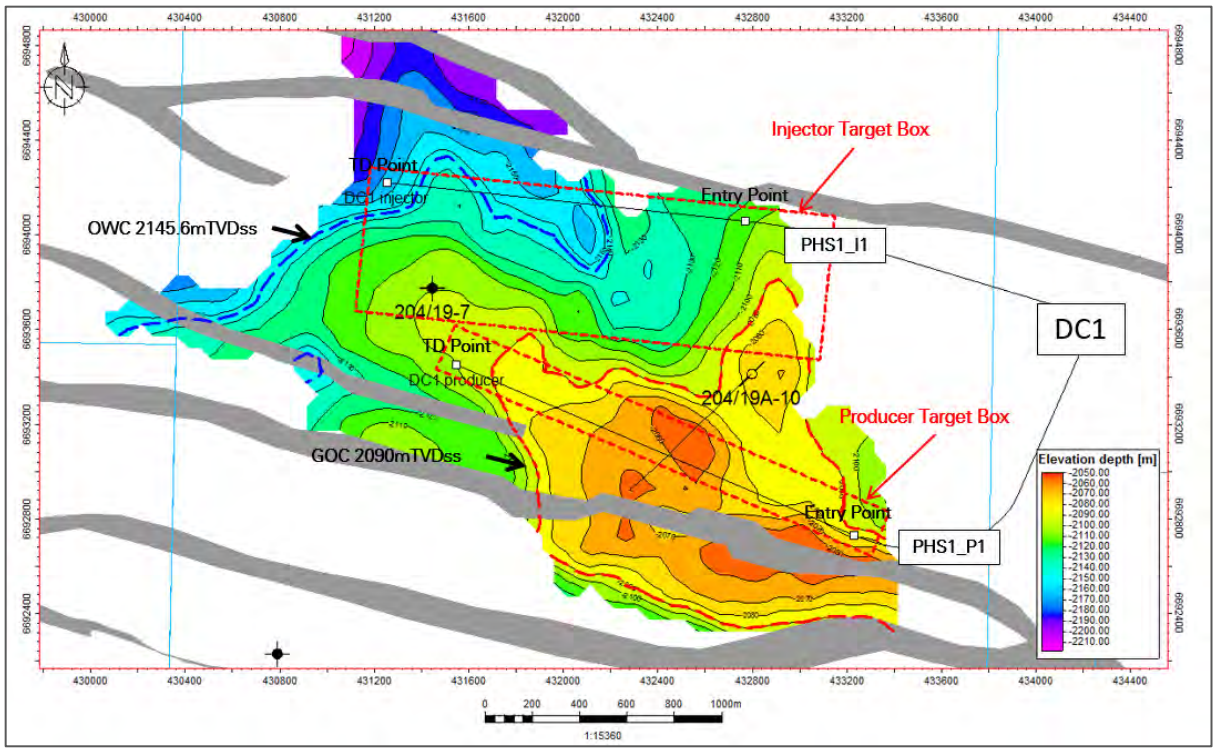

Figure 2-1: Composite top reservoir structure map for Alligin South. Producer and Injector well trajectories are shown from the planned DC1 drill centre. Target boxes are shown for the wells in red.

2.2.1 Anticipated Recoverable Volumes

The estimated total recoverable volumes of oil from the Alligin Field is anticipated to be *c*. 20 MMBOE.

2.3 Option Selection

A number of development options were considered for the Alligin Field Development, with the aim of optimising the value of the field and the surrounding infrastructure, through a safe and environmentally responsible development, incorporating justified opportunities and accounting for risks and capital exposure. Early on in Option Selection it was determined due to the size, and proximity of the Alligin field to existing infrastructure, a standalone development was not economically feasible and therefore this option was ruled out at this stage.

2.3.1 Well Development Options

A high-level summary of the different well development options for the proposed Project are provided in Table 2-2. During well optimisation, it was determined that the proposed development option, comprising one production and one WI well, provided the most efficient method for optimised reservoir recovery.

Table 2-2 Alligin well development options.

Option	Summary	Considerations
1 (Selected Option)	One production well and one WI	• Best reserves per well.
2	One production well and two vertical WI wells	• Guarantee of water injection into more channel complexes. • The third well for this development has no significant cost saving when drilling a vertical versus a horizontal well. • Reserves per well lower than development Option 1.
3	Two production wells and two WI wells	• Reserves per well lower than development Options 1 and 2 • No improvement in ultimate recovery vs. Options 1 and 2.

2.3.2 Subsea Tie-in Options

As described in Section 1.1, the Schiehallion Field is produced via four drill centres: West Drill Centre, North West Drill Centre, Central Drill Centre and North Drill Centre and the Loyal Field has been developed via a single drill centre. Consideration was given to tying back to each of the drill centres and to the Glen Lyon FPSO directly. Table 2-3 identifies the selected tie-back option and summarises the justifications for the selected option. Figure 2-3 and Figure 2-4 show the selected options and the location of the drill centres references in Table 2-3.

Table 2-3: Alligin subsea tie-back options.

Justification for selected option
Production Pipeline
Selected Option: Tie-back to the Loyal Drill Centre The Loyal Drill Centre infrastructure has more capacity than North West Drill Centre having three flow lines connecting to the Glen Lyon FPSO whilst the North West Drill Centre has two. The Loyal Field has been producing since 1997 and relative to North West Drill Centre has fewer remaining reservoir targets. Production from Alligin is therefore unlikely to fill up the remaining 'subsea capacity' such that it would not result in any future constraints on production from Loyal. The North West Drill Centre is a more recent development (2007) and the reservoir is not yet fully understood such that it is possible that future production could be increased to fill up the remaining capacity. A tie-back from Alligin to the North West Drill Centre could therefore result in future production at Alligin or the North West Drill Centre being constrained. Similarly, it is anticipated that production at the West Drill Centre could be increased in the future to fill up remaining capacity. The North Drill Centre is a WI drill centre and therefore not a suitable option for tie-back of the production flowline. A tie-back to Loyal (*c*. 8.8 km) also has additional benefits such as simplification of commercial negotiations. The Alligin Joint Venture partners have the same equity share in Loyal which differs to that of Schiehallion. Simplified commercial negotiations enables the project to progress at a faster pace, increases project value, and reduces commercial risk. A tie-back directly to the Glen Lyon FPSO would result in high levels of vessel activity in close proximity to the facility and also significant brownfield topsides construction work on the Glen Lyon FPSO. This option would require an additional riser or splitter manifold resulting in greater process safety implications (and would not be considered inherently safe design), and higher costs for construction and tie-in.
Injection Water Pipeline
Selected Option: Injection Water to be supplied from the North West Drill Centre The North West Drill Centre is the closest (*c*. 5 km) drill centre to the proposed Alligin Drill Centre location compared to Loyal (*c*. 8.8 km), West (*c*. 6.8 km), Central (*c*. 9.5 km) and North (*c*. 9.2 km). Therefore, supply of injection water via the North West Drill Centre minimises the flowline length and associated seabed disturbance. The West Drill Centre has no additional/excess capacity for water injection. Water supply directly from the Glen Lyon FPSO also would require a longer pipeline. In addition, the supply of injection water from the Glen Lyon FPSO would require an additional riser or splitter manifold, resulting in greater process safety implications and higher costs for construction and tie-in.
Gas Lift Pipeline
Selected Option: Lift Gas to be supplied from the North West Drill Centre The North West Drill Centre is the closest (*c*. 5 km) drill centre to the proposed Alligin Drill Centre location compared to Loyal (*c*. 8.8 km), West (*c*. 6.8 km), Central (*c*. 9.5 km) and North (*c*. 9.2 km). Therefore, supply of lift gas via the North West Drill Centre minimises the flowline length and associated seabed disturbance. The West Drill Centre has no additional/excess capacity for gas lift. The supply of gas from the Glen Lyon FPSO would require a longer pipeline. In addition, the supply of lift gas from the Glen Lyon FPSO would require an additional riser or splitter manifold, resulting in greater process safety implications and higher costs for construction and tie-in. Connection to Loyal infrastructure would require flooding of the gas lift flowline and disconnecting an existing jumper and inserting a manifold. This would constitute more extensive construction work resulting in increased risk and cost.
Umbilical
Selected Option: Controls to be supplied from DUTA D30 A new umbilical will connect the existing Dynamic Umbilical Termination Assembly (DUTA) D30 to the Alligin Drill Centre. An umbilical from the North West Drill Centre was assessed and would have been similar in length (5-6 km), however, the total length of umbilical from the Glen Lyon FPSO to Alligin via the North West Drill Centre would be *c*. 3 km longer than via DUTA D30. It was considered that the risk of power loss over that distance would be unacceptable. In addition, the North West Drill Centre umbilical was installed in 2005-2006 and tying into this umbilical would add technical risk due to line specifications which would not occur with the DUTA tie-in.

2.3.3 Pipeline Installation Method

Trenched and backfilled, and surface lay options were evaluated for the installation of the Alligin pipelines and umbilical. The option to surface lay was selected for the following reasons:

- Surface lay results in a significantly smaller corridor of seabed disturbance and turbidity during installation, with subsequent impact to protected benthic species (including the designated deep-sea sponge aggregations associated with the area: see Section 3.4.2.1) being limited to the immediate footprint of the pipeline;
- Based on the results of preliminary analysis, the surface laid solution for the Alligin production flowline is feasible without specific engineered buckle mitigation scheme (reducing requirements for rock dumping);
- Clay berms created by trenching may result in an additional serious snagging hazard whilst the use of a chain mat to break up these berms would further impact on the designated deep-sea sponge aggregations associated with the area;
- Alligin flowlines have been designed to meet the required load and impact cases determined by design standards;
- Surface laid flowlines are potentially recoverable at the time of decommissioning;
- Surface lay aligns with the existing Greater Schiehallion Area pipe lay philosophy; and
- Surface lay flowlines can easily be visually inspected.

The 10/16" OD (outer diameter) Alligin production pipe-in-pipe system trawl gear loading will be assessed in accordance with DNVGL-RP-F111 and the pipeline will be designed to Safebuck III guidelines for buckling. The proposed 10/16" OD (outer diameter) Alligin production pipe-in-pipe system will be conservatively designed to meet the requirements for potential impact loads (such as interference with trawl gear) in line with design standards. With regards to the smaller diameter flexible flowlines and umbilical it is expected that the reduced diameter and relatively low submerged weight means that snagged fishing gear will displace the flowline, both laterally and vertically, enough to increase the likelihood of the fishing gear releasing and thus not causing serious damage to the flowlines or the fishing gear.

2.4 Schedule of Activities

The activities associated with the drilling, installation, and commissioning of the Alligin Field are scheduled to take place in 2019 with First Oil in Q1 2020 as shown in Table 2-4. It should be noted that the schedule presented is not fixed and is liable to change as the project develops.

Table 2-4 Anticipated schedule of activities for the proposed Alligin Field Development.

Activity	2019				2020
	Q1	Q2	Q3	Q4	Q1
Drilling of Alligin wells					
Installations of subsea infrastructure					
Tie-ins and commissioning					
First oil					

2.5 Drilling

It is proposed to drill the Alligin wells using the Deepsea Aberdeen; a semi-submersible Mobile Offshore Drilling Unit (MODU). Each well is expected to take around 100 days to drill and as shown in Table 2-4 drilling is anticipated to be carried out in Q2/Q3 2019.

2.5.1 Drilling Location

The proposed Alligin drill centre location is: 60º 22' 21.039" N and 04º 11' 31.918" W.

Each wellhead will be located between *c*. 80 and 200 m from a new PipeLine End Manifold (PLEM) to be installed at the drill centre.

2.5.2 Positioning and Anchoring of the MODU

Anchor Handling Vessels (AHVs) will be required to help position the MODU which will be held on site using eight anchors. Once on location the Deepsea Aberdeen will be held in position using 8 x *c*. 6,900 m chain anchors. The precise anchor mooring spread around the MODU will be defined by a mooring analysis which will be undertaken prior to bringing it into the field and will take account of the water depth, currents, tides, prevailing wind conditions and any seabed features at the drilling locations.

Details of the placement of the anchors will be provided in the Consent to Locate (CtL) permit application which will be submitted under the drilling operations SAT.

2.5.3 Blowout Preventer

The Deepsea Aberdeen is equipped with a Blowout Preventer (BOP) which is rated for pressures beyond the maximum pressure anticipated for the wells being drilled. The BOP is a subsurface BOP positioned on the wellhead at the seafloor during drilling.

The function of the BOP is to prevent uncontrolled flow from the well to the surface during drilling by positively closing in the well in the event of uncontrolled release from the reservoir into the well bore. The BOP is made up of a series of hydraulically operated rams that can be closed in an emergency from the drill floor, or from a safe location elsewhere on the rig. The BOP can also be operated subsea from Remotely Operated Vehicle (ROV).

The integrity of the BOP will be tested prior to usage and periodically during the drilling. Inspection and testing of the BOP will be undertaken in line with the operator, BPEOC procedures and UK legislation.

2.5.4 Well Design

The Alligin wells will be drilled and completed in accordance with BPEOC's Common Wells Process. The basic well design is summarised in Table 2-5 and illustrated in Figure 2-2. Detailed well design specifics are still under analysis but will be provided in future drilling SAT permit applications.

Table 2-5: Alligin well details.

Hole Section	Total vertical depth below seabed (m)	Total length along hole (m)
46"	103	103
26"	238	135
17½	1,209	971
12¼"	2,292	1,083
8½"	4,323	2,031

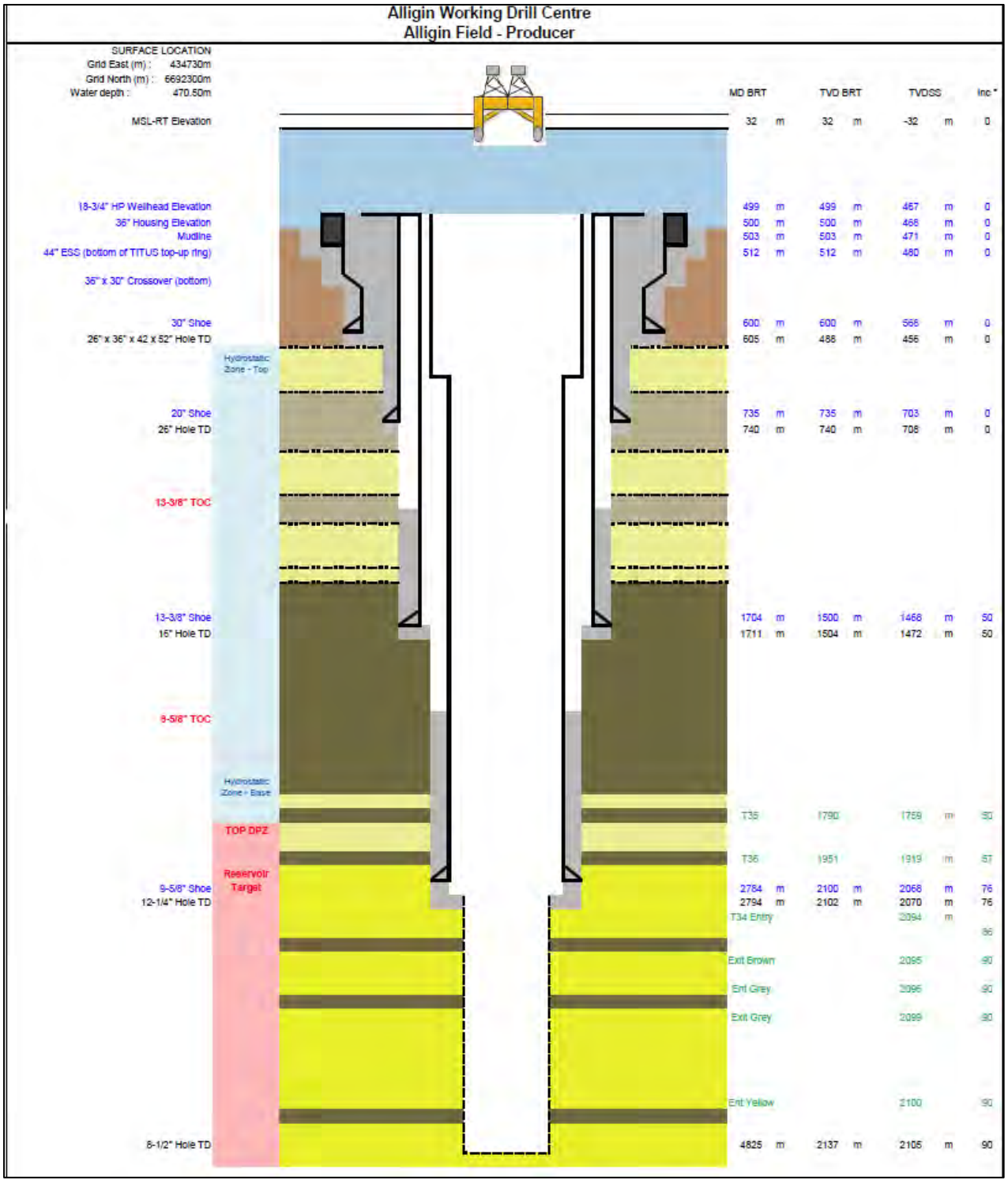

Figure 2-2: Example schematic of the production well.

2.5.5 Drilling Mud and Cuttings

Drilling fluids are required for a number of reasons including:

- Managing hydrostatic pressure and primary well control;
- Transportation of the cuttings to the surface;
- Preservation of the wellbore to facilitate casing / completion installation and;
- Cooling and lubrication of the drill bit.

Drilling fluid is continuously pumped down the drill string to the drill bit and returns to the surface through the annular space between the drill string and the sides of the well. Different mud formulations are required at different stages in the drilling operation because of variations in pressure, temperature and the physical characteristics of the rock being drilled.

Table 2-6 summarises the anticipated mud volumes and mass of cuttings associated with each well section. The fate of the drill cuttings from each section is also shown. Full details of the mud volumes to be used will be provide in subsequent SAT applications to BEIS.

Table 2-6: Anticipated mud requirements and cuttings mass associated with each well.

Hole Size (“)	Drilling fluid	Volume of mud (m^3)	Mass of cuttings (te)	Cuttings disposal route
46"	Seawater and bentonite sweeps	113	226	Discharged at the seabed
26"		85	96	
$17^1/_2$	WBM	299	319	Discharged at the surface
$12^1/_4$"	LTOBM	289	178	Skipped and shipped
$8^1/_2$"	WBM	278	167	Discharged at the surface

The cuttings returned from the $8^1/_2$" section will contain some reservoir hydrocarbons, further details of which are presented in Section 8.1.2 and Appendix E. These hydrocarbons are ‘trapped’ within the particles such that there is no visible sheen associated with the discharge. Further options for offshore treatment of cuttings from this section such as thermal treatment, are not deemed technically feasible to separate oil at the low concentrations, at which it occurs. Based on the residual composition of fluids discharge to sea, it is deemed that this represents reduced impact to the environment if factors such as vessel activity, vessel emissions and associated onshore disposal are considered when viewed against other options (e.g. skip and ship).

2.5.6 Cementing Chemicals

Cement is used to secure the steel conductor and casings in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry. During cementing operations, the majority of these chemicals are left downhole but a small quantity of cement may be discharged onto the seabed around the top of the 30” conductor while filling the annulus between the casing and the seabed with cement. This excess over the annulus volume is required to give confidence that the cement has completely filled the conductor annulus and displaced all the mud present to provide a strong bond, on which the entire well is secured. Subsequent use of cement is contained downhole as subsequent casings do not require the cement to be pumped into the annulus all the way up to the surface.

Discharges of other cementing chemicals such as cement mix water and spacers may occur when cleaning out the cement mixing and pumping equipment. Cement mix water is the term used to describe the fluids used to mix the cement, whilst spacers are the fluids used to aid the removal of drilling fluids before cementing.

At the time of writing the detailed cement design has yet to be finalised, however estimates are provided in Table 2-7.

Table 2-7: Estimated cement requirements per well.

Cement job	Volume of cement (bbls)	Cement type
30" conductor	570	Class G
20" surface casing	560	Class G
$13^{3}/_{8}$" intermediate casing	190	Class G
$13^{5}/_{8}$ " intermediate casing	340	Class G

All cementing chemicals to be used will be selected based on their technical specifications and environmental performance. Class G cements have no additions other than calcium sulphate and/or water, and are intended for use as a basic well cement. Chemicals with substitution warnings (i.e. chemicals that are considered to be harmful to the environment) will be avoided where technically possible. The cementing chemicals to be used have not yet been determined but will be detailed in subsequent drilling SAT permit applications.

Similar to the drilling and cementing chemicals, the chemicals associated with the completions operations will be captured in the subsequent drilling SAT permit applications.

2.5.7 Relief Well Location

A relief well plan will be put in place to intersect the Alligin wells in the event of a blowout and will include a proposed rig location from which a relief well could be drilled.

2.5.8 Drill Rig Support Activity

Various support vessels will be associated with the drilling operations such as AHVs, supply vessels etc. Table 2-8 summarises the estimated duration that each vessel will be on site and their estimated fuel use. Estimates provided are based on an indicative maximum drilling duration of 100 days per well. Helicopter trips twice per week are assumed with a round trip of 3 hours from Scatsta airport in the Shetland Islands.

Table 2-8: Fuel consumption of vessels associated with the drilling of the Alligin wells.

Vessel type	Days on site[1]	Fuel consumption (te/d)[2]	Total fuel use (te)
MODU	200 (assumes 100 days per well)	10	2,000
AHV (in transit) x 2	8 (assumes four days for rig mobilisation (therefore 2 x 4)	25	200
AHV (rig positioning)	8 (assumes four days for rig mobilisation (therefore 2 x 4)	25	200
Emergency Response and Rescue Vessel (ERRV)	200	1.5	300
Supply vessel (in transit)	100	10	1,000
Supply vessel (working)	100	1.5	150
Helicopter (te/hr)	Twice a week (57 trips – 3 hours each) = 171 hours or 7.125 days	0.5 per hour	85.5
Total fuel use			**3,935.5**

[1] Drilling schedule still being developed, duration presented is the maximum anticipated.
[2] Source: The Institute of Petroleum, 2000.

2.6 Subsea Infrastructure

Figure 2-3 shows the infrastructure to be installed as part of the proposed Alligin Field Development in relation to the existing infrastructure at the Loyal and Schiehallion Fields. Figure 2-4 shows an alternate view focusing on the Alligin infrastructure whilst Table 2-9 provides summary details on the infrastructure.

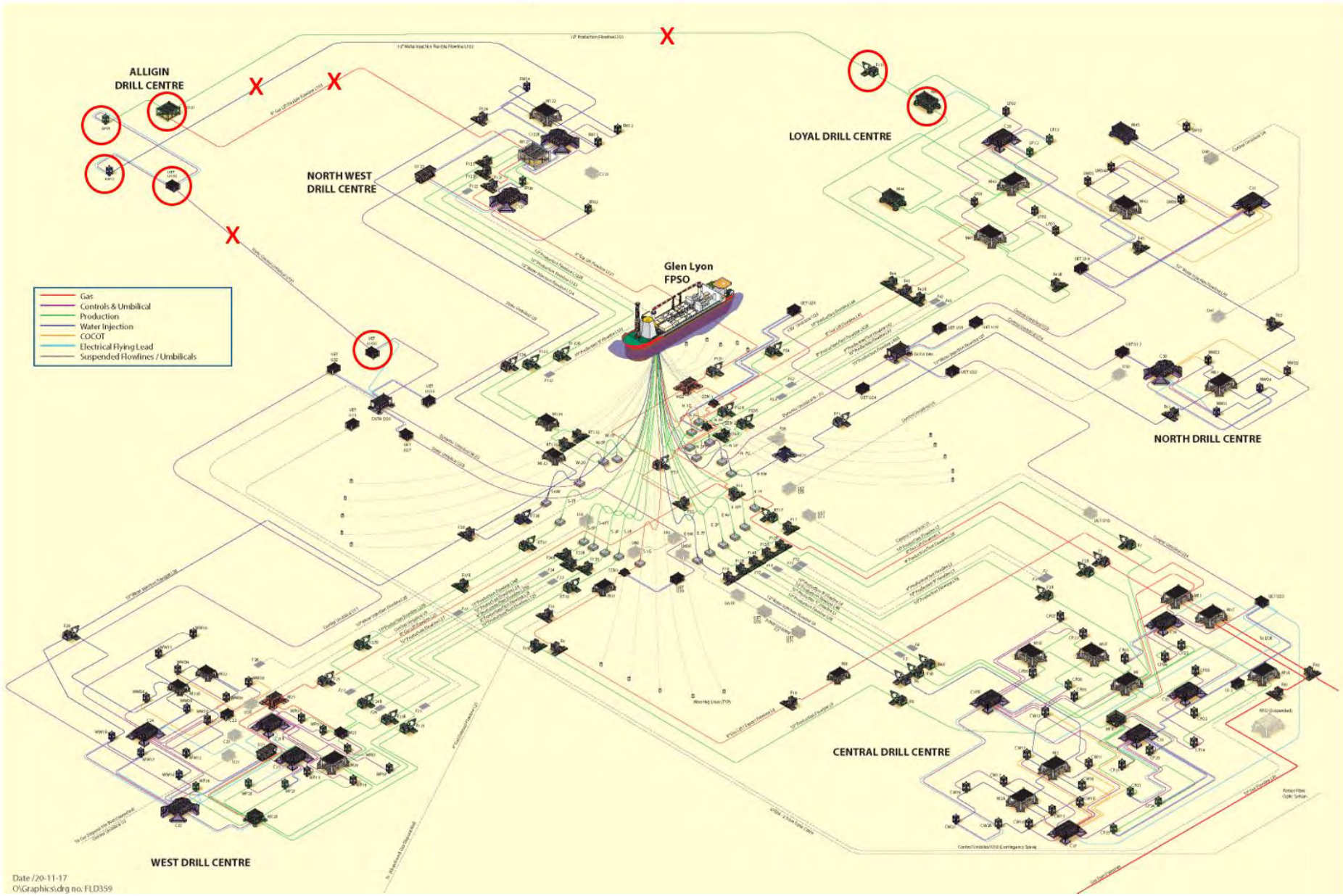

Figure 2-3: Schematic showing the proposed Alligin Project (red circles and 'X's) in relation to the existing Schiehallion and Loyal infrastructure. Note in addition to the infrastructure highlighted, a number of jumpers, Fly to Places, etc. will be installed between the structures.

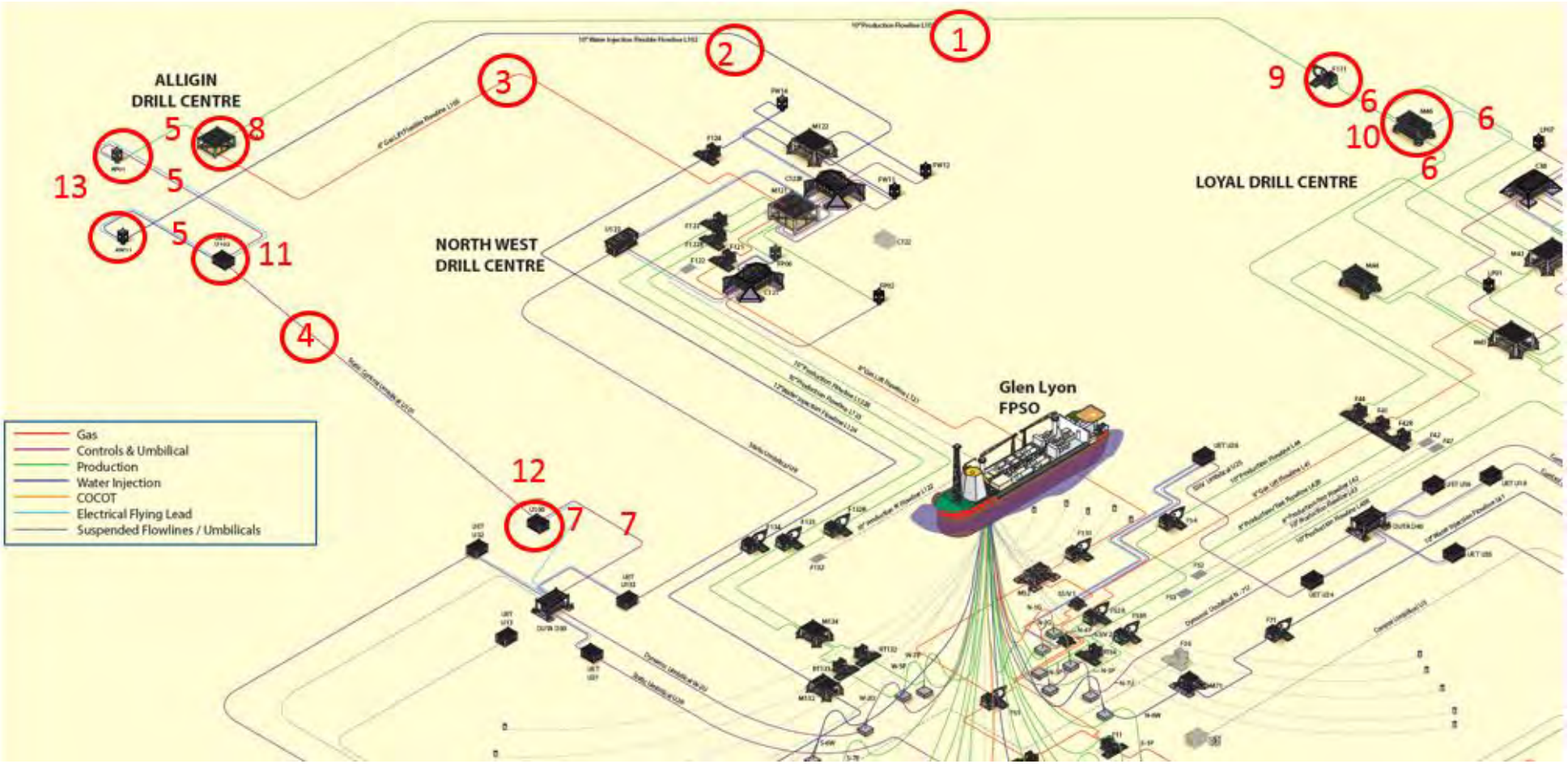

Figure 2-4: Schematic showing new infrastructure required for the proposed Alligin Project. Numbers correspond to the Ident numbers in Table 2-9.

Table 2-9: Subsea infrastructure associated with Alligin Field Devlopment.

Ident number from Figure 2-4	Description
1	A *c*. 9 km x 10/16" OD Pipe in Pipe production pipeline from a new Pipeline End Manifold (PLEM) at the Alligin drill centre to new splitter manifold at the Loyal Drill Centre.
2	A *c*. 5.5 km x 10" OD flexible injection water pipeline from an existing manifold (M122) at the North West Drill Centre to the new Alligin WI well.
3	A *c*. 5.5 km x 6" OD flexible lift gas pipeline from an existing manifold (M121) at the North West Drill Centre to the new PLEM at the Alligin Drill Centre.
4	A *c*. 5.7 km x 6" OD flexible control umbilical from a new Umbilical End Termination (UET) at the Alligin Field to a new UET in close proximity to the existing DUTA D30.
5	Jumpers, Electrical Flying Leads (EFLs) and Fly to Place connectors (FTPs) tying into the Alligin wells. - Two production and one lift gas jumper between PLEM and the production well. These will be bundled and will be *c*. 95 m in length. - Two EFLs (bundled) and one FTP from UET to production well. These will be *c*. 210 m in length. - Three EFLs (bundled) and one FTP from UET to WI well. These will be *c*. 100 m in length.
6	Three jumpers (two production and one test) tying new splitter manifold into existing manifolds at Loyal drill centre. Lengths of each estimated to range between 80 m and 170 m. Note: For determining the impact of installing these jumpers the ES assumes worst case of 170 m for each. Each jumper will be tying into a different manifold such that they are not bundled.
7	EFLs and FTPs between new UET and existing DUTAD30. - Four EFLs (laid in two bundles of two) and one FTP will connect these structures. These will be *c*. 95 m in length.
8	PLEM at Alligin Drill Centre Dimensions: 12 m (L) x 8 m (W) x 4 m (H) This will be a gravity based structure.
9	Flowline Termination Assembly (FTA) on production pipeline Dimensions: 8 m (L) x 8 m (W) x 3 m (H) This will be a gravity based structure.
10	Splitter manifold at Loyal Drill Centre Dimensions: 12 m (L) x 8 m (W) x 4 m (H) At the time of writing it had yet to be determined if the manifold would maintain its position using suction anchors or if it would be gravity based.
11	UET at Alligin Field Dimensions: 6 m (L) x 4 m (W) x 5 m (H) This will be a gravity based structure.
12	UET in close proximity to existing DUTA D30 Dimensions: 6 m (L) x 4 m (W) x 5 m (H) This will be a gravity based structure.
13	Two wells (one production well and one WI well) and associated Xmas trees etc.

2.6.1 Wellheads and Xmas Trees

The Xmas trees will be of similar design to those used at the Schiehallion and Loyal fields. The vertical Xmas trees will have an arrangement of hydraulically operated valves, with manual back-up valves, to provide integrity barriers from the reservoir. The trees will also feature a Downhole Safety Valve (DHSV) which is a hydraulically operated isolation device. It will be possible to fully close the master valves and the Surface Controlled Subsurface Safety Valves (SCSSVs) within thirty minutes from start of initiation of Emergency Shutdown (ESD).

Scale Inhibitor will be injected at the production well which will require the provision of injection metering and control valve.

Methanol will be injected at the production and water injection trees on an intermittent basis primarily for the inhibition of hydrates during transient operations. Methanol use will be metered at the Glen Lyon FPSO.

Meters for injection water volumes and lift gas will be located on the WI and production well respectively.

The production tree will be installed with acoustic sand detectors on the flow base. This technology "listens" for the sound of sand particles impacting on the infrastructure and relays raw data to a monitoring system to calculate the sand rate. This allows immediate action to be taken to minimise sand entering the oil and gas systems which in turn optimises oil and gas production.

2.6.2 PLEM, Flowline Termination Assembly, Manifold and UETS

Table 2-9 summarises the subsea structures to be installed in support of the Alligin Development, whilst their location relative to the Schiehallion and Loyal infrastructure is shown in Figure 2-3. Where subject to fishing interaction, the Alligin structural (manifold and trees) design shall adopt the same approach as the Greater Schiehallion Area such that the structures are designed using the loads / energies specified in NORSOK U-001.

A PLEM will be installed at the Alligin Field in order to support connections between the production flowline and the corresponding jumpers connecting to the production well. This structure will be laid within the Alligin Field 500 m exclusion zone.

At the Loyal end of the production flowline a FTA will be installed and this will be connected via a *c*. 110 m jumper to a new splitter manifold. The FTA host a diverless connector to allow connection to the splitter manifold. At the splitter manifold the Alligin production flowline will be connected via three jumpers (two production and one test) to the FTA and two different Loyal manifolds as can be seen in Figure 2-3 and Figure 2-4. The FTA and splitter manifold will be laid within the existing exclusion zone at Loyal.

In support of the controls system two new UETs will be installed. The UETs are positioned at either end of the *c*. 5.7 km static umbilical and allow the static umbilical to be connected to the wells at the Alligin field and to DUTA D30 at the Glen Lyon FPSO end via FTPs and EFLs. The UET at the Alligin Field will be laid within the Alligin 500 m exclusion zone whilst the UET at D30 will also be laid within an existing 500 m zone.

Dimensions of each of the structures identified are summarised in Table 2-9. In addition, the table identifies whether the structures are gravity based or if they will maintain position via suction anchor.

2.6.3 Pipelines, Static Umbilicals, Jumpers, FTPs and EFLs

Table 2-10 summarises the lengths and sizes of the flowlines and static umbilical associated with the Alligin Development and their tie-in locations. As described in Section 2.3, the production flowline will connect to the Loyal drill centre; the injection water and lift gas flowlines will connect to the North West Drill Centre and the controls and chemicals will be provided via DUTA D30. Specific details regarding which existing subsea

structures will to be tied into will be presented in subsequent permit applications. Where possible the umbilical and flowlines will follow the most direct route between locations.

Similar to the flowlines at the Schiehallion and Loyal Fields, the production, lift gas and injection water flowlines and the static umbilical will be surface laid (see Section 2.3.3). The *c*. 9 km x 10/16" Pipe in Pipe production flowline will be clad with a Corrosion Resistant Alloy (CRA) consistent with the existing Glen Lyon FPSO operating philosophy (no corrosion inhibitor injection facilities). The *c*. 5.5 km x 10" injection water flowline will be a flexible flowline whilst gas lift will be provided to the production well via a *c*. 5.5. km x 6" flexible flowline. A *c*. 5.7 km x 6" subsea control umbilical with the capability to provide power, hydraulics, methanol, scale inhibitor etc. will be installed.

Where required and as summarised in Table 2-9, jumpers will be installed to connect the new wells and existing infrastructure to the new Alligin infrastructure. In addition, EFLs and FTP connectors will be installed to provide electrical and chemical connections respectively between the new UET and the wells at the Alligin Field and between the new UET and DUTA D30 at the Glen Lyon FPSO end of the static umbilical.

The proposed Alligin lift gas flowline will cross over an existing 12" water injection flowline (L124).

Once the pipelines and umbilical have been installed, post lay surveys will be undertaken to determine the presence of any excessive free-spans (areas where the pipeline bridges depressions or hollows in the seabed) that may need to be mitigated.

2.6.4 Subsea Infrastructure Protection

Within the subsea installation methodology, the reference case is to not rock cover flowlines, however it is possible that rock may be required to mitigate spans identified during post lay surveys. As a worst case this ES assesses the impact of 20,000 te of rock being laid to mitigate spans on the production flowline to Loyal.

Mattresses and 25 kg grout bags will be used to protect the tie-in jumpers, FTPs and EFLs. In addition, they will be laid to protect existing infrastructure at the Loyal, North West Drill Centre and DUTA D30 drill centres, over which the Alligin infrastructure will be laid and to support a crossing on the existing L124 pipeline. It is estimated that a maximum of 39 mattresses measuring 6 m (L) x 3 m (W) x 0.15 m (H), will be required. An estimated 10 te of 25 kg grout bags (400 bags) will be used for tie-in support. Table 2-10 summarises the estimates of rock cover, mattresses and grout bags required and their approximate location.

Prior to laying any rock cover, mattresses or grout bags BPEOC will submit a Deposit Consent application to OGA and a supporting EIA Direction to BEIS.

Table 2-10: Anticipated quanties of protection features.

Item	Number/Mass (te)
Rock cover: anticipated maximum of 20,000 te	
Mass of spot rock cover on the production pipeline	20,000
Mattresses: anticipated maximum of 39 mattresses	
Number of mattresses at the Alligin drill centre	10
Number of mattresses at the Loyal drill centre	10
Number of mattresses at the North West drill centre	10
Number of mattresses at DUTA D30	2
Number of mattresses at L124	7
25 kg grout bags: anticipated maximum of 400 bags	
Number of 25 kg grout bags at the Alligin drill centre	200
Number of 25 kg grout bags at the Loyal drill centre	50
Number of 25 kg grout bags at the North West drill centre	50
Number of 25 kg grout bags at DUTA D30	100

2.6.5 Pipeline Testing and Commissioning

Following installation, flooding and strength-testing operations will be performed to ensure system integrity, to test for any leaks, to dewater the pipeline system and to prepare the system for introduction of hydrocarbons.

After completion of the flooding operations, a hydrostatic pressure test (strength test) will be performed to verify integrity of the welded joints within the ‘as-installed’ pipelines. Subsequently, once the complete pipeline system has been connected, a further hydrostatic pressure test (leak test) will be carried out to prove the integrity of the tie-in connection points. The pipelines will be pressurised in accordance with design codes to pressures above the maximum operating pressure. On completion of the testing programme the pressurisation fluid is expected to be contained in cargo tanks and shipped for treatment and appropriate disposal at an onshore facility. However, it is possible that the fluids will be discharged to the sea, or flowed back to the Glen Lyon FPSO and either discharged to sea or injected into the reservoir.

The permitted discharge of chemicals to the marine environment is a routine part of subsea installation operations. The quantities of chemicals to be used and whether or not they are to be discharged will be determined during the project detailed design stage, and will be subject to a permit under the OCR. As the chemical regime will be subject to a separate permit (a chemical SAT); there is no foreseen benefit gained from replicating a risk assessment at this stage, a risk assessment that will be carried out as per the OCR with known chemicals, profiles and associated application. Based on current methodologies, there are no chemicals planned for use/discharge that significantly differ from those currently on associated permits, that would imply that specific chemical risk assessment requires to be carried out as part of this ES.

2.6.6 Subsea Installation Support Vessels

Various support vessels will be associated with the subsea installations activities. Typical vessel use, duration and fuel usage by vessels during installation are provided in Table 2-11.

Table 2-11: Vessel type and anticipated fuel usage during the installation of subsea infrastrucutre at Alligin.

Vessel type	Days on site	Fuel consumption (te/d)[1]	Total fuel use (te)
Survey vessel	29	10	290
Construction support vessel	181	18	3,258
Rockdump vessel	9	18	162
Total fuel use			3,710

[1] Source: The Institute of Petroleum (2000).
Note vessel days provided include a 30% wait on weather delay

2.7 Glen Lyon FPSO Overview

The proposed concept for the Alligin Field Development means that the gas and liquids can be processed within the existing capacity of the Glen Lyon FPSO without modifications to processing facilities. As a result, only a brief overview of the Glen Lyon FPSO is provided here.

The Glen Lyon FPSO replaced the retired Schiehallion FPSO in 2017. It is operated by BPEOC and has been designed for a 25-year service. Details of the Glen Lyon FPSO, including storage capacity, are provided in Table 2-12.

Table 2-12: Details of the Glen Lyon FPSO.

Description		Value
Length		270 m
Breadth		52 m
Depth		30 m
Draft		14 m – 20 m
Accommodation (max)		168 personnel
Storage Capacity	Total fluids	50,900 m^3/day
	Crude oil	20,700 m^3/day
	Produced water	49,300 m^3/day
	Processing capacity	51, 000 m^3/day
	Gas handling capacity	6,230,000 sm^3/day (220 MMscfd)

Existing facilities on the Glen Lyon FPSO include: separation and oil processing, gas compression and dehydration, water processing and injection. The utility systems include chemical injection, instrument air supply, fuel gas, flare and oil storage facilities.

The Glen Lyon FPSO has a total liquids processing capacity of 51,000 m^3/d (320 mb/d) and 220 mmscf/d of gas handling. Increased inputs from Alligin will not result in total liquids exceeding the existing Glen Lyon FPSO capacity.

The Glen Lyon FPSO is designed to handle significant quantities (49,300 m^3/d) of Produced Water (PW). PW systems are designed to treat the PW to minimise oil and sand content to within permitted limits for disposal into the reservoir (produced water reinjection (PWRI)) or overboard dumping.

Production fluids contain significant quantities of solids (primarily sands). In order to ensure efficient operation of downstream systems sand must be removed from process streams. As mentioned in Section 2.6.1 acoustic sand detectors on the Xmas tree will detect sand particles impacting on the infrastructure which allows immediate action to be taken to minimise sand entering the oil and gas systems. The Glen Lyon FPSO has a number of sand removal technologies with options for additional enhancements if required in the future. Removed sand is sent to the sand clean-up package and cleaned sand is disposed overboard in a slurry form via a spray nozzle.

The Glen Lyon FPSO power generation system comprises four dual fuel turbine generators with a total load requirement of 89 MW. The design philosophy is for three of the turbines to be available for operations with one spare to ensure gas compression facilities and PWRI systems can remain operational. The turbines are fuelled by either produced gas or low sulphur diesel. Gas imported from the West of Shetland Pipeline System (WOSPS) makes the Glen Lyon FPSO less reliant on diesel for power. Existing power generation facilities are sufficient to meet the power requirements of the Alligin Field Development.

2.8 Production

Chemicals are used during the production of hydrocarbons to maintain process efficiency, for example: emulsifiers improve the separation of oil and water; scale inhibitors slow down the build-up of scale in pipework and valves and biocides reduce microbial growth.

Chemical usage and discharge will be captured in an update to the Glen Lyon FPSO production permit prior to production commencing. Anticipated chemical requirements associated with the production of hydrocarbons from the Alligin Field are not expected to differ to those associated with the current Glen Lyon FPSO tie-backs such that a specific chemical risk assessment has not been carried out as part of this ES.

Production profiles have been developed for the purpose of the Alligin Field Development Project. These forecast the likely volumes of oil, gas and PW that will be produced. Anticipated high case volumes of oil and gas and resultant PW profiles are presented here as the impacts associated with the production of these volumes are likely to be greatest with respect to, for example, atmospheric emissions, discharges to sea etc.

2.8.1 High Case Oil Production Profiles

Table 2-13 and Figure 2-5 show the anticipated high case oil production rates from the Alligin Field, assuming start-up in 2020. Maximised annual oil production is anticipated in 2021 at a rate of c. 1,812 te/day. Including the Alligin production, peak oil production at Glen Lyon FPSO is anticipated in 2018 at a rate of c. 15,676 te/day. This is two years before production at Alligin is anticipated to commence.

Table 2-13: High case oil production rate.

Year	High Case Oil Production Rate (te/day)		
	Glen Lyon FPSO without Alligin	Alligin	Glen Lyon FPSO plus Alligin
2017	3,736	0	3,736
2018	15,676	0	15,676
2019	13,914	0	13,914
2020	12,741	787	13,528
2021	9,936	1,812	11,748
2022	8,103	1,006	9,109
2023	7,740	805	8,545
2024	6,813	671	7,484
2025	6,029	554	6,583
2026	5,007	491	5,498
2027	4,688	344	5,032
2028	4,699	354	5,053
2029	4,433	297	4,730
2030	4,151	264	4,415
2031	3,790	253	4,043
2032	3,379	193	3,573
2033	3,680	218	3,898
2034	3,304	255	3,560
2035	3,146	259	3,405
2036	3,029	266	3,295
2037	2,593	32	2,625
2038	2,503	0	2,503
2039	2,404	0	2,404
2040	2,297	0	2,297
2041	2,216	0	2,216
2042	2,038	0	2,038
2043	2,075	0	2,075
2044	1,986	0	1,986
2045	1,859	0	1,859
2046	1,795	0	1,795
2047	1,736	0	1,736

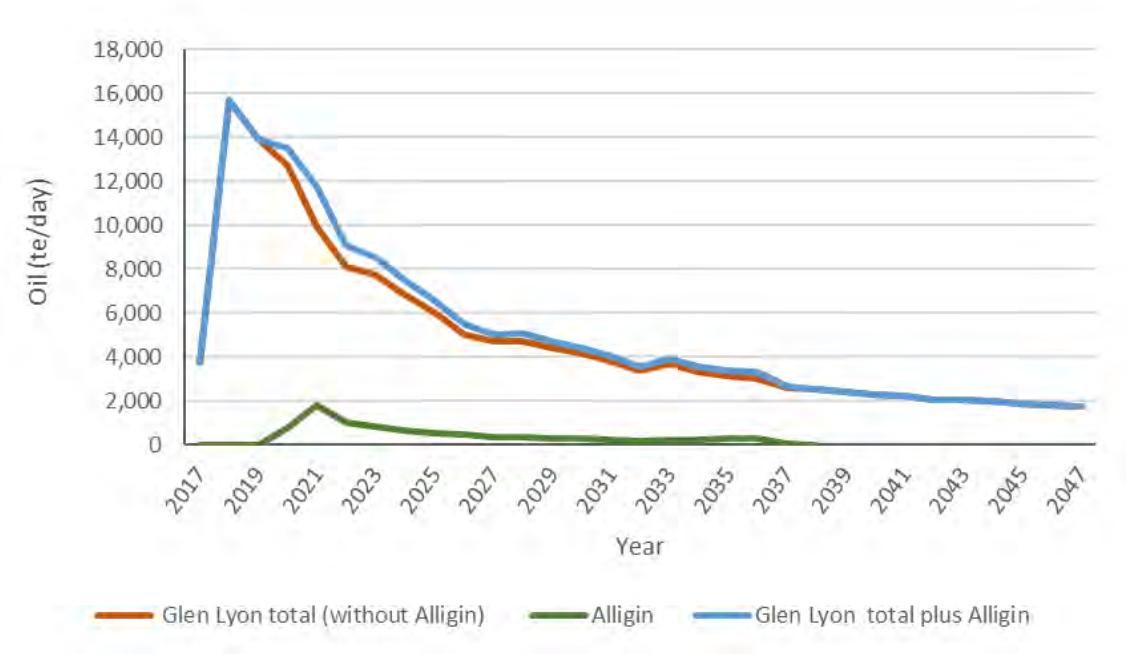

Figure 2-5: High case oil production rate.

2.8.2 High Case Gas Production Profiles

Table 2-14 and Figure 2-6 show the anticipated high case gas production rates from the Alligin Field, assuming start-up in 2020. Maximised annual gas production is anticipated in the first year of production (2020) during at a rate of *c*. 577 Mm^3/day. Including the Alligin production, peak gas production at Glen Lyon FPSO is anticipated in 2019, at a rate of *c*. 2,481 Mm^3/day. This peak production occurs a year before production is anticipated to commence at Alligin.

Table 2-14: High case gas production rate.

Year	High Case Gas Production Rate (Mm^3/day)		
	Glen Lyon FPSO without Alligin	Alligin	Glen Lyon FPSO plus Alligin
2017	647	0	647
2018	2,282	0	2,282
2019	2,481	0	2,481
2020	1,296	577	1,873
2021	1,084	474	1,558
2022	1,190	86	1,276
2023	663	62	725
2024	828	57	885
2025	777	56	832
2026	515	51	566
2027	439	32	471
2028	373	38	411
2029	355	41	396
2030	282	34	315
2031	234	32	266
2032	226	21	248
2033	253	29	282
2034	222	38	261
2035	236	35	271
2036	200	35	235
2037	161	4	164
2038	158	0	158
2039	148	0	148
2040	141	0	141
2041	137	0	137
2042	123	0	123
2043	128	0	128
2044	121	0	121
2045	111	0	111
2046	108	0	108
2047	105	0	105

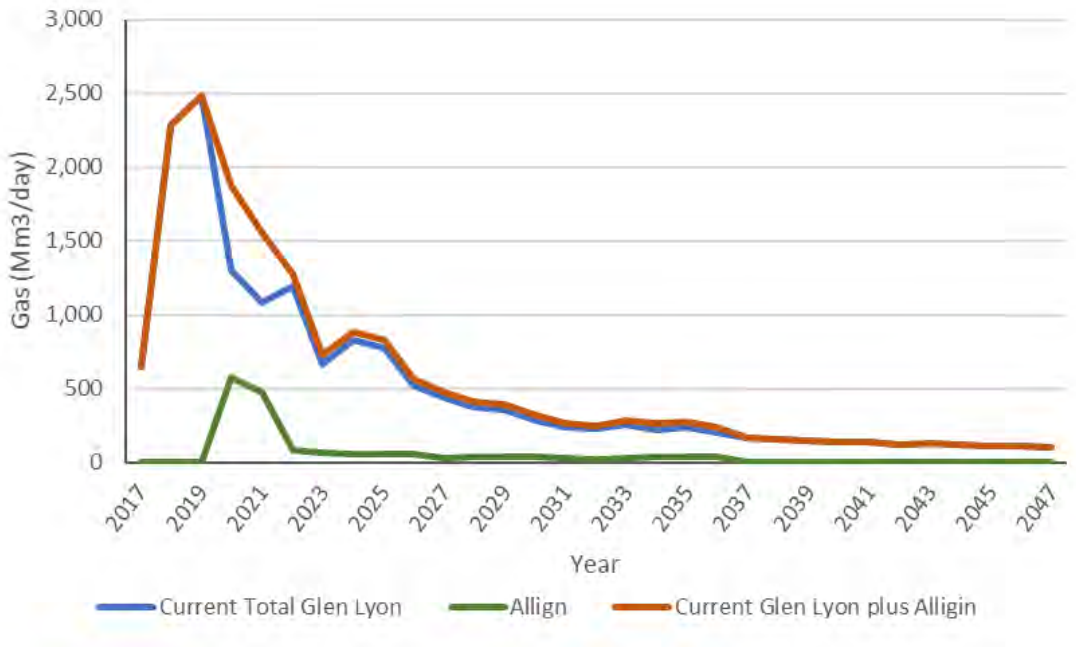

Figure 2-6: High case gas production rate.

2.8.3 High-Case Water Production Profiles

Table 2-15 and Figure 2-7 show the anticipated high case water production rates from the Alligin Field, assuming start-up in 2020. Maximised annual water production is anticipated in the final year of production (2037) at a rate of *c.* 6,568 te/day. Peak water production at Glen Lyon FPSO is anticipated in 2036, at a rate of *c.* 43,145 te/day.

Table 2-15: High case water production rate.

Year	High Case Water Production Rate (te/day)		
	Glen Lyon FPSO without Alligin	Alligin	Glen Lyon FPSO plus Alligin
2017	8,807	0	8,807
2018	28,417	0	28,417
2019	31,062	0	31,062
2020	27,221	0	27,221
2021	30,404	0	30,404
2022	28,411	0	28,411
2023	32,977	479	33,456
2024	33,758	698	34,456
2025	34,648	716	35,364
2026	36,080	938	37,017
2027	32,673	158	32,831
2028	36,408	620	37,028
2029	36,700	623	37,322
2030	37,085	601	37,686
2031	37,541	799	38,341
2032	34,296	112	34,408
2033	37,605	537	38,142
2034	38,047	2,946	40,994
2035	38,170	3,808	41,978
2036	38,327	4,818	43,145
2037	27,980	6,568	34,547
2038	28,859	0	28,859
2039	28,632	0	28,632
2040	28,191	0	28,191
2041	28,391	0	28,391
2042	27,058	0	27,058
2043	28,785	0	28,785
2044	28,955	0	28,955
2045	26,784	0	26,784
2046	26,797	0	26,797
2047	26,732	0	26,732

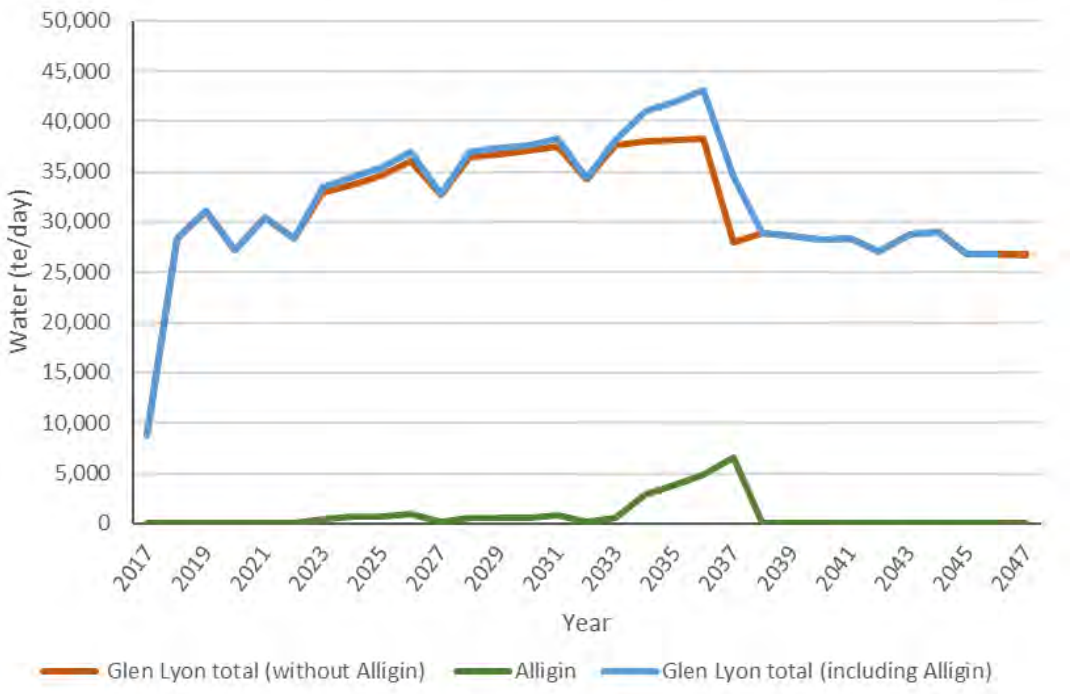

Figure 2-7: High case water production rate.

2.9 Key Permits and Consents

The Portal Environmental Tracking System ('PETS') is BEIS's environmental permitting system accessed via the UK Energy Portal. PETS integrates permits and consents under one centralised Master Application Template (MAT). There are six types of MAT available on the PETs system:

- Drilling Operations;
- Pipeline Operations;
- Production Operations;
- Decommissioning Operations;
- Well Intervention Operations; and
- A Standalone application.

Once a MAT has been created it can support various types of Subsidiary Application Templates (SATs). The following types of SATs are available:

- EIA Direction;
- Chemical Permit;
- Consent to Locate;
- Oil Discharge Permit (OPPC);
- Offshore Combustion Installations Permit (PPC);
- Marine Licence, EPS Disturbance Licence; and
- Marine Survey.

Note that OPEPs and EU ETS Permits are not available on the PETS system.

2.9.1 Pollution Prevention and Control (PPC) Permit

It should be noted that Alligin requires no changes to power generation equipment on the Glen Lyon FPSO. However, the existing PPC permit will be reviewed and any changes to fuel use as a result of the Alligin tieback will be captured in a variation.

2.9.2 EU Emissions Trading Scheme (EU ETS)

No new Greenhouse Gas (GHG) Permit under the EU ETS Trading Scheme will be required; however, the description of the installation in the existing Glen Lyon FPSO permit application will be updated to reflect Alligin coming online.

2.9.3 Oil Pollution, Prevention and Control (OPPC)

Discharges of oil to sea are controlled under The Petroleum Activities (Oil Pollution, Prevention and Control) Regulations 2005. The existing Glen Lyon FPSO Oil Discharge Life Permit will be updated to capture Alligin coming on line. In addition, Oil Discharge Term Permits will be issued for the drilling activities.

2.9.4 Chemical Use and Discharges to Sea

The relevant permits to use and discharge chemicals offshore will be applied for in accordance with the Offshore Chemicals Regulations (OCR). All offshore activities are covered by the Regulations including oil and gas production, drilling of wells, discharges from pipelines and discharges made during decommissioning.

2.9.5 Oil Pollution Emergency Plan (OPEP)

BPEOC on behalf of their Co-Venturers will submit a Temporary Operations OPEP (TOOPEP) or consolidate into the existing OPEP for the drilling of the proposed Alligin wells. The Glen Lyon FPSO OPEP will be updated to incorporate production from Alligin.

2.9.6 Consent to Drill

BPEOC on behalf of their Co-Venturers will submit a PON4 for consent to carry out drilling at the proposed project.

2.9.7 Consent to Carry out Surveys and Shallow Drilling

If required, BPEOC will submit Marine Survey SATs to BEIS describing any proposed surveys associated with the proposed project. In addition, they will submit a Survey Closeout Report following the survey. A report detailing marine mammals sighted during the surveys using standard forms from the Joint Nature Conservation Committee (JNCC) will also be submitted.

2.9.8 Consent to Locate (CtL)

Where applicable, BPEOC will apply for the following CtLs:

- Mobile Installation, e.g. mobile drilling units (MODUs);
- Permanent / Fixed Structure, e.g. Xmas trees;
- Pipeline or Cable System, e.g. gas and liquid flowlines, and control umbilicals; and
- Other Operation, e.g. Installation of surface buoys and moorings.

2.9.9 Pipeline Works Authorisation (PWA) and Deposit Consent (DepCon)

BPEOC will submit an application for a PWA detailing the pipelines, structures and umbilical to be installed whilst an application for a DepCon will be submitted providing the location of any rockdump, grout-bags and mattresses required on the route.

2.10 Decommissioning

At Cessation of Production (CoP) the Alligin infrastructure will be decommissioned in line with legislation in force at that time. In 2018 this would constitute the following:

- The Petroleum Act 1998 (as amended) and other relevant Regulations at the time of decommissioning;
- BEIS Decommissioning Guidance (Draft guidance, December 2017);
- The UK Guidelines for Suspension and Abandonment of Wells;
- The Pipeline Safety Regulations 1996 requiring the safe decommissioning of pipelines;
- Any additional applicable legislation in place at the time of decommissioning; and
- Any other agreements with the BEIS and relevant regulatory bodies.

2.10.1 Pipeline and Subsea Infrastructure

In line with current guidelines and legislation the decommissioning of the subsea pipelines would be subject to a Comparative Assessment and Decommissioning Programme. It is expected that the subsea structures will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted however this would be subject future legislative requirements and guidance.

2.10.2 Wells

All well programmes will be subject to a well notification assessed by the Health and Safety Executive (HSE) under the Offshore Installations (Offshore Safety Directive) (Safety Case etc). Wells will be plugged and permanently abandoned in accordance with the OGUK Guidelines for the Abandonment of wells (OGUK, 2015) (or applicable guidance at that time). All well programmes will have been reviewed by the HSE Offshore Safety Department as required under the Design and Construction Regulations.

On completion of the well abandonment programme each conductor and internal tubing will thereafter be cut below the seabed. The subsea wellheads will then be recovered at location which could occur through utilising either a dive support vessel (DSV) or semi-submersible mobile drilling unit.

Nearer the time of CoP, a full decommissioning plan will be developed in consultation with the relevant statutory authorities. The plan will be designed to ensure that potential effects on the environment resulting from the decommissioning of the facilities are considered and minimised. The Schiehallion and Loyal Fields are currently subject to a Decommissioning Programme (DECOM-SCH-HS-IA-BP-0079). It is anticipated that Alligin will form part of a future Decommissioning Programme along with the wider Schiehallion and Loyal infrastructure.

3. ENVIRONMENTAL BASELINE

3.1 Introduction

This section describes the current nature and status of the environment in the vicinity of the proposed Alligin Field Development. An understanding of the baseline environment is required in order to identify the potential environmental impacts of the development and to provide a basis for assessing the potential interactions of the proposed project with the environment.

3.2 Environmental Baseline Surveys

The Alligin Field is situated WoS in Blocks 204/19a and 204/20a *c*. 140 km from the Shetland Islands and *c.* 20 km from the UK/Faroe median line.

Table 3-1 summarises the most recent environmental surveys that have been carried out in the vicinity of Alligin whilst Figure 3-1 shows the spatial extent and coverage of each survey. A combination of seabed samples and seabed imagery were acquired during these survey campaigns to determine the physico-chemical status of the seabed, as well as the typical biological communities in the region. The presence of potentially sensitive species and habitats was also ascertained.

BPEOC commissioned an environmental survey at the Alligin Field in Q3/Q4 2017. At the time of writing this ES the samples collected had not yet been analysed. Some provisional data e.g. seabed stills and information on deep-sea sponges at the site and along the pipeline route survey were available. This data has been included in this section, whilst the final survey reports will be made available to BEIS and their consultees once they become available.

Table 3-1: Environmental surveys undertaken in the development area.

Survey	Date of Survey	Report Reference
Alligin Site and Pipeline Route Survey (UKCS Quad 204)	26/09/17 – 21/11/17	Fugro, 2017 (draft report)
Schiehallion West ROV Environmental Survey Footage – Data Analysis 11022	17/02/17	Gardline, 2017b
Schiehallion Central ROV Environmental Survey Footage – Data Analysis 11046	23/05/17	Gardline, 2017a
Foinaven and Schiehallion Environmental Survey Environmental Monitoring Report 9554-5	09/2013	Gardline, 2013 & 2014

Figure 3-2 shows the location of the environmental sample locations from the Alligin and Foinaven and Schiehallion surveys, and where appropriate, a summary of the data from these and other historic regional surveys have been included in the relevant sections.

The Alligin survey sampling station locations were selected on the basis of providing a representative overview of the seabed at the proposed drill centre locations (at the time of the survey, more than one location was being considered for the drill centre location). Sampling stations were arranged in a grid pattern, with ~500 m separation between stations, across a *c*. 1.5 km by 3 km rectangular grid orientated with the longer axis in the direction of the prevailing current. Weather conditions in the field and seabed conditions prevented sampling at all the planned stations and survey effort was targeted on priority sights closest to the proposed well sites.

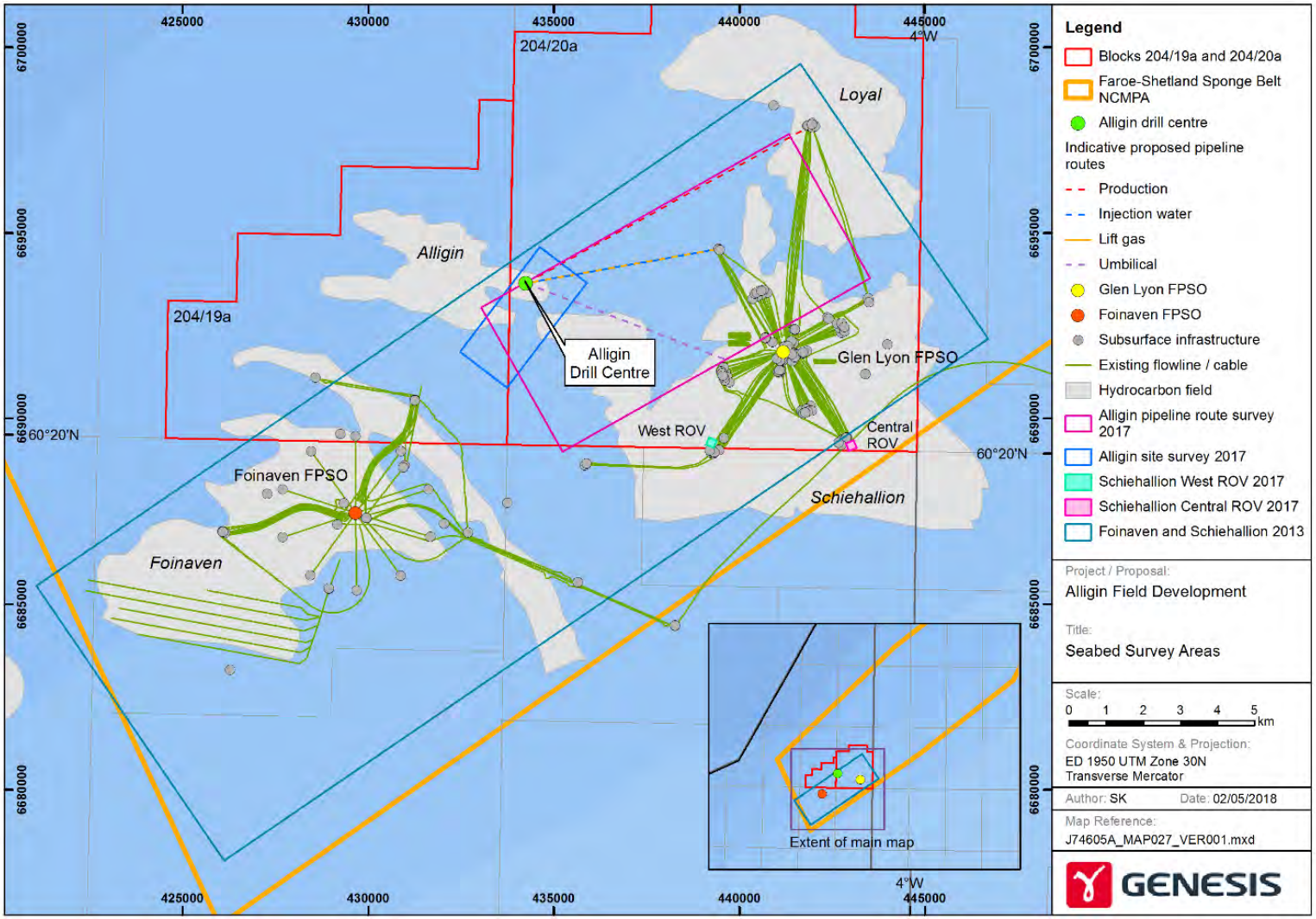

Figure 3-1: Location of environmental surveys carried out in Blocks 204/19a and 204/20a in the vicinity of the proposed Alligin Field Development. (Note: the survey date refers to actual survey and not the report reference date).

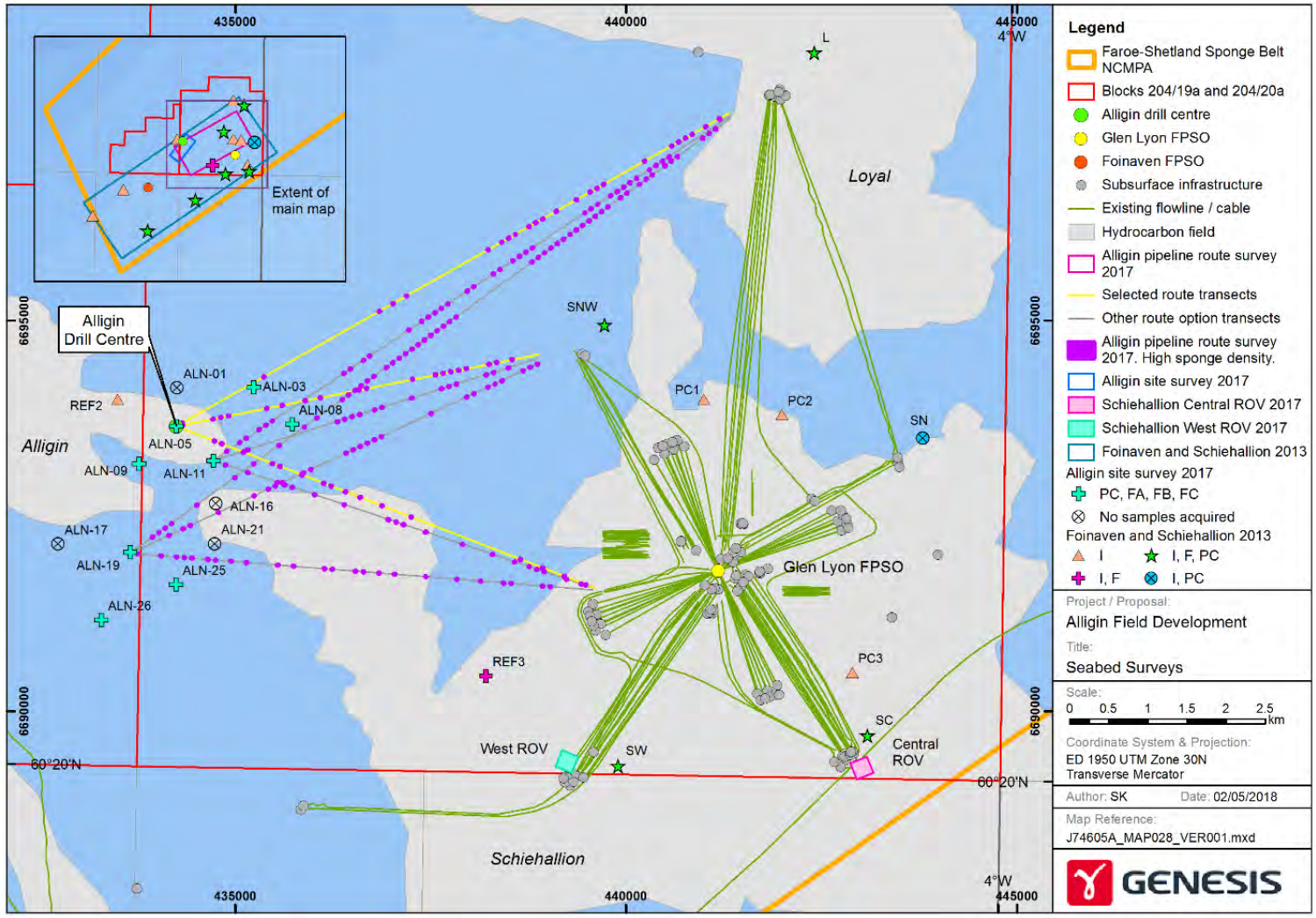

Figure 3-2: Location of environmental stations from the Alligin and the Foinaven & Schiehallion surveys (Fugro, 2017draft report; Gardline, 2013). Areas of high sponge density recorded during the Alligin pipeline route survey are also shown. (NOTE: for sample stations I – Imagery, F – Faunal, PC – Physico-Chemical).

3.3 Physical Environment

The type and distribution of marine life is influenced by the physical conditions of the surrounding environment, biological interactions and anthropogenic activities. These physical factors, which include, currents and tides, wave, temperature, salinity and wind also help set the design parameters for offshore facilities and influence the fate and behaviour of any emissions and discharges from an installation and the risk associated with them.

3.3.1 Hydrology

3.3.1.1 Bathymetry

The WoS region can be described as being an extremely dynamic environment and can be divided into three main regions: WoS Continental Shelf (100 – 200 m depth), the WoS Continental Slope (200 – 1000 m depth) and the Faroe-Shetland Channel (>1,000 m depth). The Alligin Field is situated on the continental slope in water depths ranging between *c.* 460 - 480 m, with a gentle slope downwards to the north-west (Fugro, 2017; draft report).

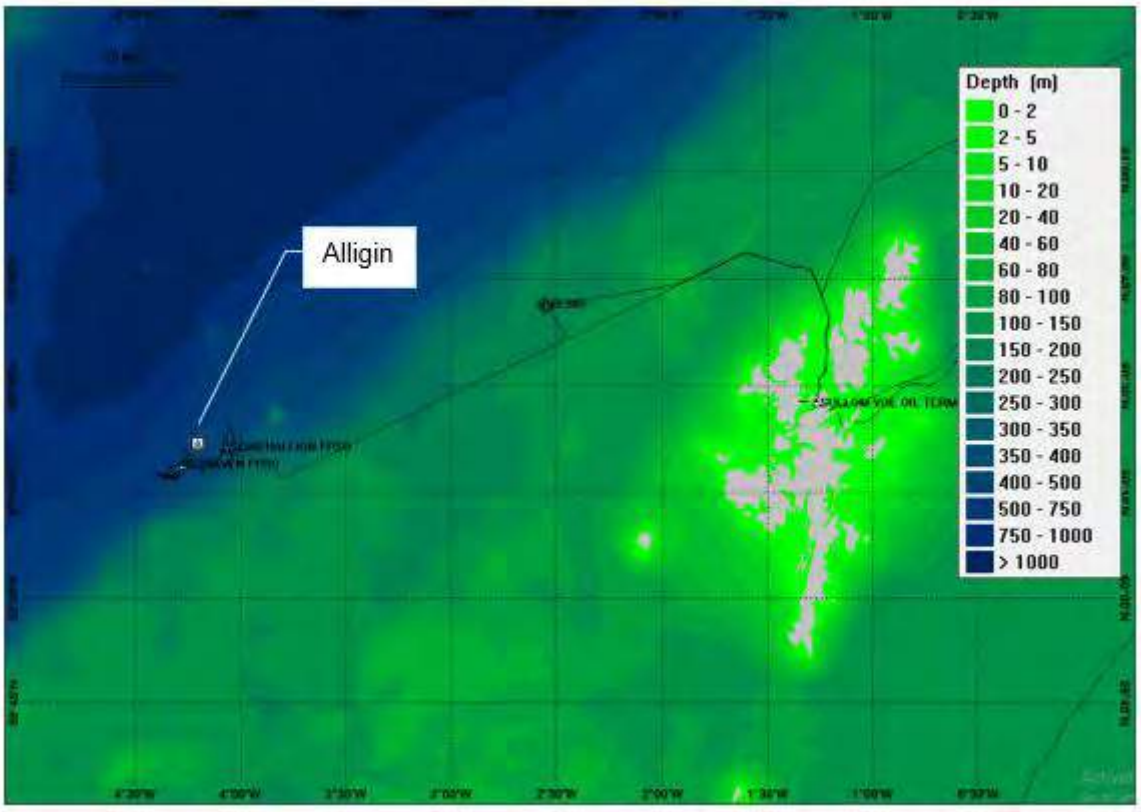

Figure 3-3: Bathymetry in vicinity of the proposed development.

3.3.1.2 Water masses, currents and tides

The water current patterns in the WoS are complex, with various well-mixed non-tidal currents interacting with the relatively weak tidal flow adding to seasonal stratification (DECC, 2016). Five separate water masses are recognised within the Faroe-Shetland Channel on the basis of their salinity and temperature characteristics (Turrell *et al*., 1999).

The inflowing North Atlantic Water (NAW) occupies the upper surface waters of the Faroe-Shetland Channel. A branch of the NAW travels north-eastwards across the Rockall Plateau and through the Rockall Trough

towards the Faroe-Shetland Channel (Pollard *et al.,* 2004). The remaining surface water consists the cooler, slightly less saline Modified North Atlantic Water (MNAW) which originates to the west of the Rockall Plateau. The Fair Isle/Dooley current is also a contributing circulatory body of water which flows directly to the North Sea via the Faroe-Shetland Channel.

Surface waters originating from the NAW occupy the upper 200-400 m of the water column, and the colder, denser, Arctic Intermediate Water (AIW) flows anticlockwise along the southern edge of the Norwegian Sea Basin and around the Shetland Channel at *c.* 400 – 600 m (Turrell *et al*., 1999). Below the AIW the Norwegian Sea Arctic Intermediate Water (NSAIW) and Faroe-Shetland Channel Bottom Water (FSCBW) flow towards the south amalgamating with the Atlantic via the Faroe Bank Channel (Turrell *et al.,* 1999).

WoS current speeds are between 0.26 m/s and 0.5 m/s during spring peak flow, and during neap peak flow are between 0.11 m/s and 0.25 m/s. The mean spring tidal range is between 2 m and 3 m.

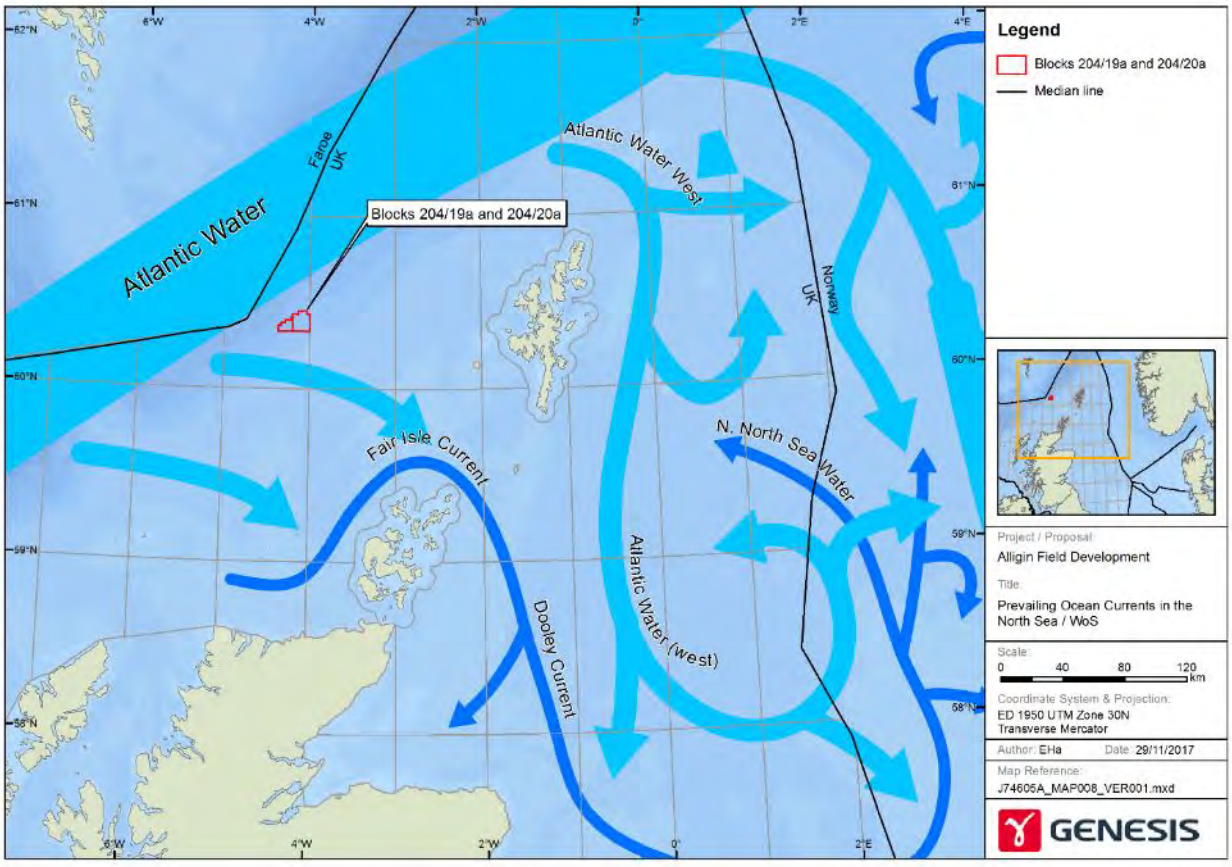

Figure 3-4: Schematic of ocean circulation in the North Sea and the WoS (Turrell, 1992).

3.3.1.3 Waves

The waters over the West of Shetland continental slope are exposed to a high-energy wave regime, influenced by a long fetch to the west, by prevailing winds from the west and south-west, and frequent low pressure systems. The wave climate is more severe than that found in the North Sea, especially in winter months. The annual mean significant wave height in the area is 2.8 m (Scottish Government NMPi, 2017). There has been a steady increase in significant wave heights of approximately 2 – 3 cm annually in the 30 years leading up to 2000 (AFEN, 2001). Offshore coastal regions see significant wave heights which can exceed 3 m for over 10% of the time and 1 m for 75% of the time (Draper, 1991).

3.3.1.4 Temperature and salinity

The temperature of the sea affects both the properties of the sea water and the fates of discharges and spills to the environment. Seawater temperatures vary with season, depth and proximity to land. Annual mean near-bed water temperatures are fairly constant at 9°C, in winter months (February – March). Annual mean surface temperatures are 10°C, peaking at 12°C with August (Scottish Government NMPi, 2017).

Fluctuations in salinity are largely caused by the addition or removal of freshwater to or from seawater through natural processes such as rainfall and evaporation. Salinity increases with water depth and distance from shore. The salinity of seawater around an installation has a direct influence on the initial dilution of aqueous effluents such that the solubility of effluents increases as the salinity decreases. Salinity in the area of the blocks show little variation with season and water depth. The annual mean near-bed salinity and surface salinity is *c.* 35.2 ‰ (Scottish Government NMPi, 2017).

3.3.1.5 Water quality

Regional inputs from coastal discharges and localised inputs from existing oil and gas developments may affect water quality in different areas off the west coast of Shetland. Fundamentally, water samples with the highest levels of contaminants are found at inshore sites prone to high levels of industrial usage. High hydrocarbon concentrations in offshore locations are normally in the immediate vicinity of installations, originating primarily from the discharge of produced water and contaminated drill cuttings.

Hydrocarbon inputs from drill cuttings has been essentially eliminated due to Low Toxicity Oil Based Mud (LTOBM) no longer being discharged directly to sea; implemented by the Oslo and Paris Convention (OSPAR) 2000/3. However, there is a legacy of contamination which remains in the form of historic cuttings piles around some installations, which can release hydrocarbons if disturbed by subsea works or trawling (OSPAR Commission, 2010). Concentrations of contaminants generally fall to background levels within a very short distance of the point of discharge (CEFAS, 2001).

Polycyclic Aromatic Hydrocarbons (PAHs) generally adsorb to particulate matter / suspended solids as they have low water solubility and are hydrophobic. Background water concentrations of PAHs are therefore often below the limit of detection. Similarly, due to their low solubility, Polychlorinated Biphenyl (PCB) concentrations in water are usually extremely low (<1 ng/l) and difficult to detect.

There is limited data on the levels of contaminants in northeast Atlantic waters (OSPAR, 2000). However, water quality around the Alligin Field Development is predicted to be good, with contaminants being close to background levels due to the distance from anthropogenic inputs and prevailing ocean current systems which disperse and dilute pollutants (OSPAR, 2000; NSTF, 1993).

3.3.2 Meteorology

3.3.2.1 Winds

Wind direction and speed directly influence the transport and dispersion of atmospheric emissions from an installation. These factors are also important for the dispersion of marine discharges, including oil spills, influencing the movement, direction and break up of substances on the sea surface. The UK is subject to strong maritime influences with coastal areas and island locations (Shetland and Orkney) being strongly impacted. The WoS is exposed to some of the highest wind speeds in the UK which propagate from a west to south-west origin. In winter months' wind speeds ≥ 8 m/s are reported around 70% of the time and 30% in summer. Average wind speed for the area in the summer is 8.1 – 8.5 m/s and 13.5 m/s in winter.

Air temperatures range between 0-19°C. Periods of easterly winds lead to extreme cold in winter and warm conditions in the summer. The extent of this influence varies over time as changes in the strength and persistence of the westerly winds are influenced by the winter North Atlantic Oscillation (a pressure gradient

between Iceland and the Azores) (Scottish government NMPi, 2017; OSPAR Commission, 2000; DECC, 2016).

3.3.3 Seabed Sediments

The characteristics of the local sediments and the amount of sediment transport within a project area are important factors in determining the potential effects of possible developments (drill cuttings, installation of pipelines, anchor scouring) on the local seabed environment.

Seabed sediments comprising mineral and organic particles occur commonly in the form of mud, sand or gravel and are dispersed by processes driven by wind, tides and density driven currents. The distribution of seabed sediments within the WoS is determined by a combination of hydrographic conditions, bathymetry and sediment supply. The seabed sediment distribution in the WoS is illustrated in Figure 3-5 which shows Alligin in an area dominated by upper bathyal sediment, characteristic of the continental slope. This is predicted to be 'deep sea mixed substrata' (EMODnet, 2017).

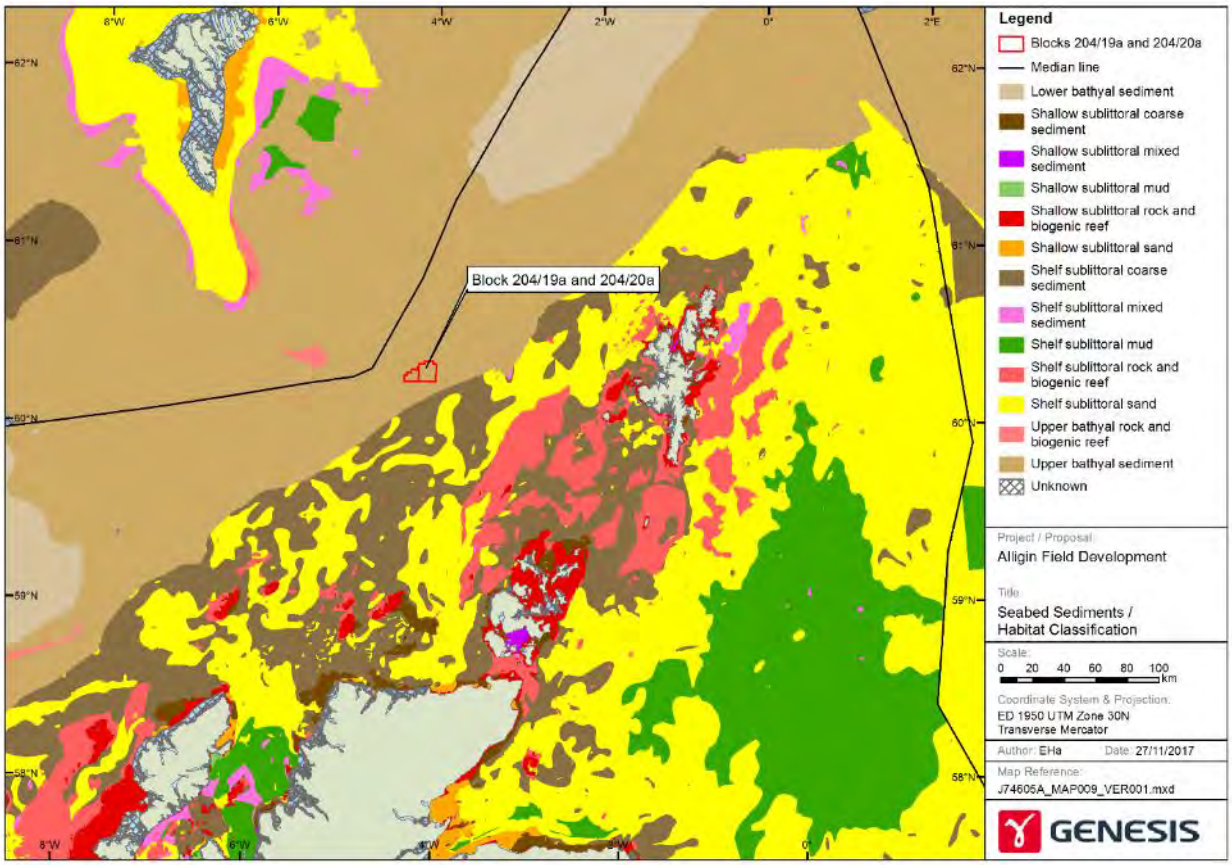

Figure 3-5: North Sea sediment distribution (Marine Strategy Framework Directive (MSFD) predominant habitat classification) (EMODnet, 2017).

WoS sediments are composed mainly of coarse sediments at shallow depths and finer sediments in deeper areas (DECC, 2016). The seabed sediment physiography of the WoS shelf largely reflects the reworking by near-bottom currents of the sediments deposited since the glaciations (Holmes *et al.,* 2003). In the south-west of the Faroe-Shetland Channel ice-rafted boulders and gravel feature, whereas towards the north-east finer sediments are abundant (Jones *et al*., 2007). Surveys conducted by Gardline Environmental Limited (GEL) in 2008 for the Schiehallion and Foinaven fields (<2 km from the Alligin Field) identified sediments comprised of coarse sand with variable contributions of gravel, cobbles and small boulders (particles > 16

mm featured predominantly) (GEL, 2008). Recent surveys (e.g. Gardline 2014) also identified sediments showing similar properties.

Environmental surveys have identified heterogeneous seabed sediments near the Alligin Field predominantly comprising gravel and sand with varying cobbles and boulders (Gardline, 2013). Sample composition ranged between 26.8% and 90.7% for sand sized particles (≥63µm and <2mm) and between 4.2% and 68.8% gravel (≥2mm). All samples described as poorly to extremely poorly sorted (Gardline, 2013). The coarse sediments are consistent with strong currents causing seabed scour, and suspending fine particles into the water column. Fine particles can therefore be transported and deposited over reasonable distances (GEL, 2008). Preliminary results from a recent survey of the Alligin site and pipeline route interpreted seabed comprising gravelly fine to coarse sand with areas of pebbles, cobbles and small to medium sized boulders, consistent with surveys of the wider area (Fugro, 2017 draft report). Example deck images of successful grab samples (Figure 3-6) show the generally coarse mixed nature of the sediments assessed as present during the Alligin survey data review. Sample station locations are shown on Figure 3-2.

Station: ALN-03

Station: ALN-05

Figure 3-6: Example deck images of successful grab samples taken during the Alligin survey (Fugro,2017).

Sediment supply and distribution causes the surface sediment to have variable characteristics depending on depth and current motion within the water column. Seabed surveys conducted in Quadrant 204 concluded the surface sediment feature a thin sand veneer with underlying soft to firm sandy clays and silty clays with gravel and occasional pebbles (Fugro, 2003, Gardline, 2003).

3.3.3.1 Seabed Features and Shallow Geology

Surveys conducted in the Schiehallion and Foinaven fields identified an abundance of iceberg plough marks. Typical plough marks are several tens to a few hundred metres in width and are now infilled with sediment. In the area of the development the plough marks are generally orientated in a northeast to southwest direction. Plough marks are less frequent to the north and west of Schiehallion and Foinaven (Fugro, 2003). These plough marks are one of the geomorphological protected features of the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA) which provide ideal settlement substrate for a variety of fauna, especially deep sea sponge aggregations (The Faroe-Shetland Sponge Belt NCMPA is discussed further in Section 3.5.3.1).

Figure 3-7 shows an excerpt from a Gardline survey showing gravel with fine sand and some cobbles. At station '0697' sand ripples were also observed at a depth of 380 m (Gardline, 2017b).

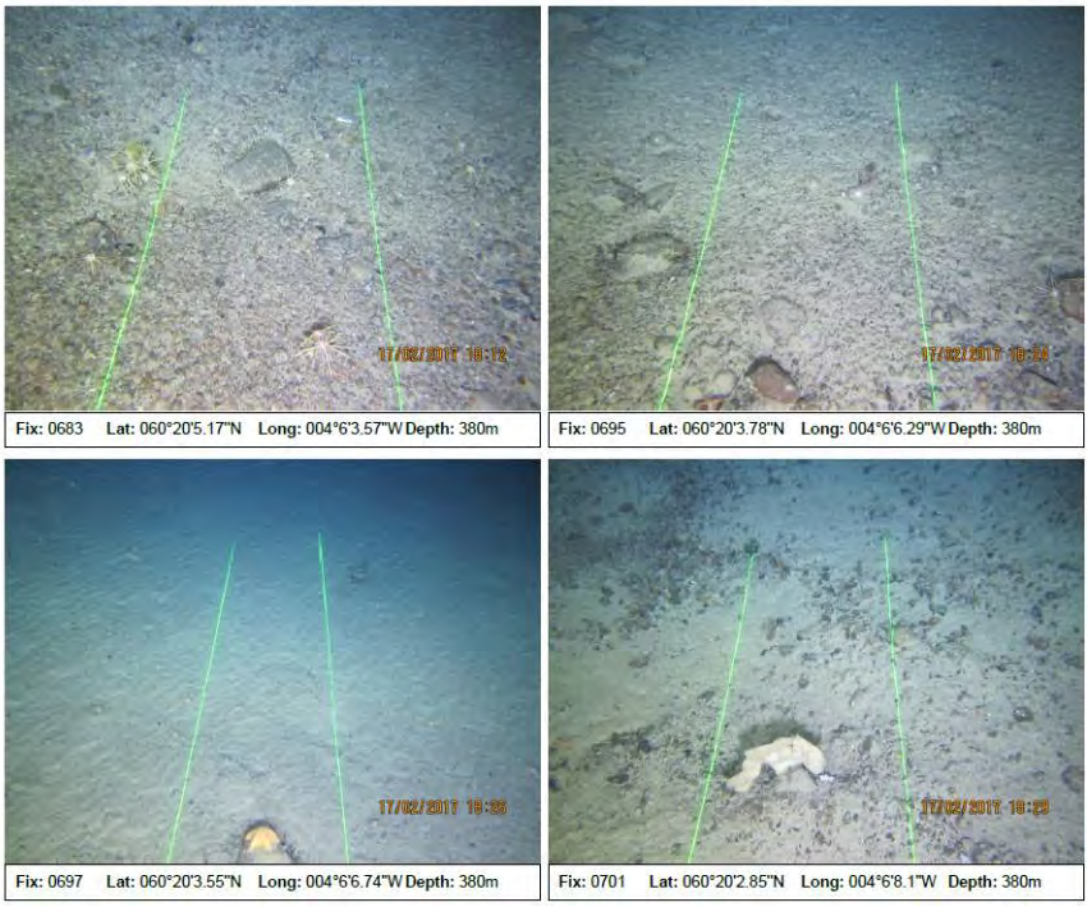

Figure 3-7: Example seabed and benthos analysed in the Gardline 2017 ROV Environmental Survey (Schiehallion West) (Gardline 2017b).

Anthropogenic activities can impact the seabed, the surrounding environment and species. Evidence of seabed scarring was observed in the majority of transects taken in an Environmental Survey at Schiehallion Central (*c.* < 2 km away from Alligin) (Gardline, 2017a). Anthropogenic debris (plastic rings, sheeting and gloves) were observed in two still images and four video snapshots. Pipelines could also be identified in six still images and six video snapshots. A possible cable and possible pipe/cable were also observed on images taken during the Alligin pipeline route survey (Fugro, 2017 draft report).

3.3.3.2 Sediment Chemistry

Deep-water marine environments generally show relatively low levels of contamination compared to coastal waters and industrial estuaries.

Exposure of marine organisms to contaminants can occur either through uptake of dissolved fractions across the gills or skin or direct digestion of the pollutant. Organisms spending the majority of their lifecycle in the water column are likely to receive the highest exposure to contaminants that remain in solution, though some will also accumulate sediment bound contaminants indirectly through their diet (i.e. digestion of animals that have accumulated the contaminants in their tissues). Organisms associated with the seabed (benthic organisms) are more exposed to particle bound contaminants with the main exposure route being either directly through ingestion of contaminated sediments or through their diet. Benthic organisms can also absorb contaminants through the surface membranes as a result of contact with interstitial water.

Heavy/Trace Metals

Elevated levels of contaminants can affect organisms (flora and fauna) in a variety of ways, ranging from cellular effects in individuals to ecosystem effects resulting from changes in population sizes or even the loss of an entire species (UK Marine SACs Project, 2001). Trace metal contamination of barite and bentonite can be noticeable in sediments for at least ten years after drilling has ceased. However, the trace metals generally have low bioavailability and are therefore unlikely to bio-accumulate (Gardline, 2014).

Across the Foinaven and Schiehallion survey area (Gardline, 2014), concentrations of barium (Ba) ranged from 274 µg g^{-1} to 797 µg g^{-1} which were typical of previous baseline studies across the wider area (AFEN, 2000). These are considered typical of background and undisturbed sediments. Following fusion, comparatively elevated concentrations ≥ 901 µg g^{-1} were found in samples from the drill monitoring stations, including stations L and SN, and replicate samples at SC and SW (Schiehallion). This is suggestive of possible evidence of barite within sediments most likely associated with drilling discharges at the associated wells together with natural variation across the area. At Station SC, adjacent to Schiehallion Central, Ba concentrations in three samples ranged between 970 µg g^{-1} and 2,730 µg g^{-1}, although concentrations had decreased by at least half since previous surveys. Overall there was evidence of drilling fluid discharges derived from recent WBM discharges and/or the continued residual presence of barite from historical drilling fluid contaminants recorded north east of the Foinaven and Schiehallion installations. For other metals, sample analyses showed that metal concentrations were typical for the area given the historical and ongoing drilling activity. Levels of copper (Cu) in some samples at Loyal, chromium (Cr) at Loyal, Foinaven East, Schiehallion Central and West, vanadium (V) at Foinaven East and Loyal, and Zinc (Zn) at Foinaven East, Loyal and Schiehallion Central recorded of comparatively higher concentrations. These metals are characteristic of contamination of sediment with drilling muds, or cuttings and may be indicative of the low level contamination derived from drilling discharges within the sediment (Gardline, 2014).

Hydrocarbons

The incorporation of minimal quantities of hydrocarbons in the tissue of a marine organism can affect its predators. At every link in the food chain, organisms consume *c.* 10 kg of matter from the level below to produce 1 kg of their own living matter. If a contaminant passes from one level to another without being broken down, its concentration in the living matter multiples nearly ten times at each link in the chain. Organisms at the top of the food chain can therefore be exposed to detrimentally high concentrations of a product which will not affect the organisms further down the chain. This is known as the bioaccumulation of chemicals through the food chain. Many of the components of oil and petroleum products are biodegradable at some level of the food chain and only the rarer, higher molecular weight PAHs tend to have significant bioaccumulation potential. The primary risk from these PAHs is that some are carcinogenic with the impacts including acute toxicity, liver neoplasm and other abnormalities.

Particles of various types and sizes, notably the silt/clay fraction, can absorb petroleum hydrocarbons from seawater and, through this pathway, hydrocarbons become incorporated into the sediment system. Organic matter within the sediment matrix is also likely to absorb hydrocarbons and heavy metals, providing a means of transport and incorporation into sediments. The bioavailability of contaminants that are adsorbed to sediment or organic matter is poorly understood. However, in general terms, prolonged contact between hydrocarbons and sediment may result in stronger bond formation and a subsequent reduction in bioavailability (Van Brummelen *et al.,* 1998). This phenomenon is referred to as 'ageing' and is especially important for sediments with historic contamination such as prolonged discharge of drill cuttings or produced water.

The Foinaven and Schiehallion survey (Gardline, 2014) found Total Hydrocarbon Concentrations (THCs) across the survey area to be low ranging from 1.1 µg g^{-1} to 6.0 µg g^{-1}. This is well below the recognised threshold of 50 µg g^{-1} above which concentrations are expected to have a Significant Environmental Impact (SEI) on macrofauna communities (Kjeilen-Eilertsen *et al*., 2004; UKOOA, 2002; UKOOA, 2005). Total Polycyclic

Aromatic Hydrocarbons (PAH) and NPD (Naphthalene, Phenanthrene and Dibenzothiophene) were also analysed during the survey. These compounds can occur naturally as pyrogenic PAHs (e.g. from forest fires, plants or oil seeps), or they can be petrogenic (e.g. from anthropogenic activities such as oil and gas extraction). The distribution of PAHs within the current survey was low, ranging from between 0.0070 µg g^{-1} and 0.0730 µg g^{-1} and revealed a predominance of pyrogenically derived aromatic hydrocarbons. Several of the samples, including those at Stations SN, SC and SW (Schiehallion), revealed low evidence of minor petrogenic signal, which was very low in concentration.

3.3.3.3 Seabed Habitats

Based on broad scale predictive habitat mapping, the proposed Alligin Field development is within the European Nature Information System (EUNIS) biotope 'deep sea mixed substrata' (A6.2) (Scottish Government NMPi, 2017). Deep-sea mixed sediment has not been sampled widely for infauna so little is currently known about infaunal community structure. Epifauna tend to be sparse mobile species (JNCC, 2015a) (see Section 3.4.2).

3.4 Biological Environment

3.4.1 Plankton

Plankton are drifting organisms that inhabit the pelagic zone of a body of water and include single celled organisms such as bacteria as well as plants (phytoplankton) and animals (zooplankton). Phytoplankton are the primary producers of organic matter in the marine environment and form the basis of marine ecosystem food chains. They are grazed on by zooplankton and larger species such as fish, birds and cetaceans. Therefore, the distribution of plankton directly influences the movement and distribution of other marine species. Meroplankton includes the eggs, larvae and spores of non-planktonic species (fish, benthic invertebrates and algae). This meroplankton population may have a very different seasonal cycle depending on the life cycle strategy of the fish species and benthic organisms which inhabit the area.

The composition and abundance of plankton communities varies throughout the year; influenced by several factors including depth, tidal mixing, temperature stratification, nutrient availability and the location of oceanographic fronts. Species distribution is directly influenced by temperature, salinity, water inflow and the presence of local benthic communities (Robinson, 1970; Colebrook, 1982).

Plankton communities in the area of interest are influenced by the inflow from the Atlantic through the Faroe-Shetland Channel (Johns and Wootton, 2003). Dominant phytoplankton forms in this region include dinoflagellate genus *Ceratium* (mainly *C. fusus, C. furca and C. tripos*) with diatoms such as *Thalassiosira spp.* and *Chaetoceros spp.* also abundant. Zooplankton species found in the WoS include the calanoid copepods *Calanus helgolandicus* and *C. finmarchicus* (DECC, 2016).

3.4.2 Benthos

Bacteria, plants and animals living on or within the seabed sediments are collectively referred to as benthos. Species living on top of the sea floor may be sessile (e.g. seaweeds) or freely moving (e.g. starfish) and collectively are referred to as epibenthic or epifaunal organisms. Animals living within the sediment (e.g. clams, tubeworms and burrowing crabs) are termed infaunal species. Semi-infaunal animals, including sea pens and some bivalves, lie partially buried in the seabed. The majority of marine benthic invertebrates exhibit a life cycle that includes a planktonic larval phase from which the bottom dwelling juvenile and adult phases recruit.

Benthic animals display a variety of feeding methods. Suspension and filter feeders capture particles which are suspended in the water column (e.g. sea pens) or transported by the current (e.g. mussels). Deposit feeders (e.g. sea cucumbers) ingest sediment and digest the organic material contained within it. Other

benthic species can be herbivorous (e.g. sea urchins), carnivorous (e.g. crabs) or omnivorous (e.g. nematodes). Benthic communities show a strong correlation with habitat type, with depth mainly influencing epifauna, and sediment characteristics typically influencing the infauna (Basford *et al.,* 1990). Benthic communities in deeper soft sediment habitats tend to be spatially distributed over large scales, with distinctive species assemblages associated with particular substrate types. However, depending on the intensity and spatial extent of sampling, localised community types or subtler variations may be distinguished, often associated with topographic features (DECC, 2016).

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

At the time of writing the ES the benthic samples collected as part of the Alligin Field environmental survey had not yet been analysed. The following information with respect to the benthic animals identified in the Greater Schiehallion Area surveys is expected to be reflective of the benthic community at the proposed Alligin Field Development location.

Epifauna

The benthos which feature within the Schiehallion area is indicative of the types and characteristics of the sediment identified in the region. Sandy gravel sediments with varying proportions of pebbles, cobbles and boulders features support a sparsely populated epifaunal community typical of the WoS (Gardline, 2017a, 2017b).

The dominant epifauna taxa observed on the Alligin site and pipeline route survey included sponges (*Porifera*), hermit crabs (*Paguroidea*), starfish (*Asteroidea*) and sea urchins (*Gracilechinus acutus*). Where hard substrata were present for epilithic attachment, sessile fauna such as anemones (Actiniaria), sea squirts (Ascidiacea), sponges (*Porifera*) and bryozoans/hydroids (Bryozoan/Hydrozoa) were also observed (Fugro, 2017 draft report).

Environmental footage from a Remotely Operated Vehicle (ROV) at Schiehallion West Development (Block 204/20) identified visible fauna of Annelida (Polychaeta), Arthropoda (including indeterminate Caridea sp., possible *Cancer pagurus*, possible *Lithodes maja*, Decapoda, *Munida* sp., Paguroidea and Portunidae), Mollusca (including Bivalvia, Brachiopoda, Gastropoda and indeterminate Mollusca), Echinodermata (including Asteroidea, possible *Echinus esculentus*, *Cidaris cidaris*, Echinoidea, *Parastichopus tremulus*, *Porania (Porania) pulvillus*), Cnidaria (Actiniidae), Pisces (indeterminate Actinopterygii, *Chimaera monstrosa*, Lumpeninae, *Molva molva*, *Pollachius sp*. and Sebastidae), Porifera *(Antho (Antho) dichotoma*, *Aplysilla sulfurea*, possible *Phakellia ventilabrum*, *Halichondria (Halichondria) panacea*, *Haliclona* sp., Petrosiidae and *Hymedesmia (Hymedesmia) paupertas*) and indeterminate Animalia (Gardline, 2017b).

The most abundant mobile fauna was *C. cidaris* which was referred to as ‘common’ (using the SACFOR scale) across the whole survey site at Schiehallion west (Gardline, 2017b). *P. tremulus* was ‘frequent’ at every transect and *M. molva* varied between ‘occasional’ to ‘common’ across all transects.

The most abundant sessile fauna was Indeterminate Animalia sp and *haliclona* sp which were both ‘frequent’ across the survey site. The sponge *P. vetilabrum* was identified as occurring ‘occasionally’ across several

transects. Figure 3-8 shows observed species in still imagery taken using an ROV at Schiehallion west, including the most abundant species (listed above) *C. cidaris*.

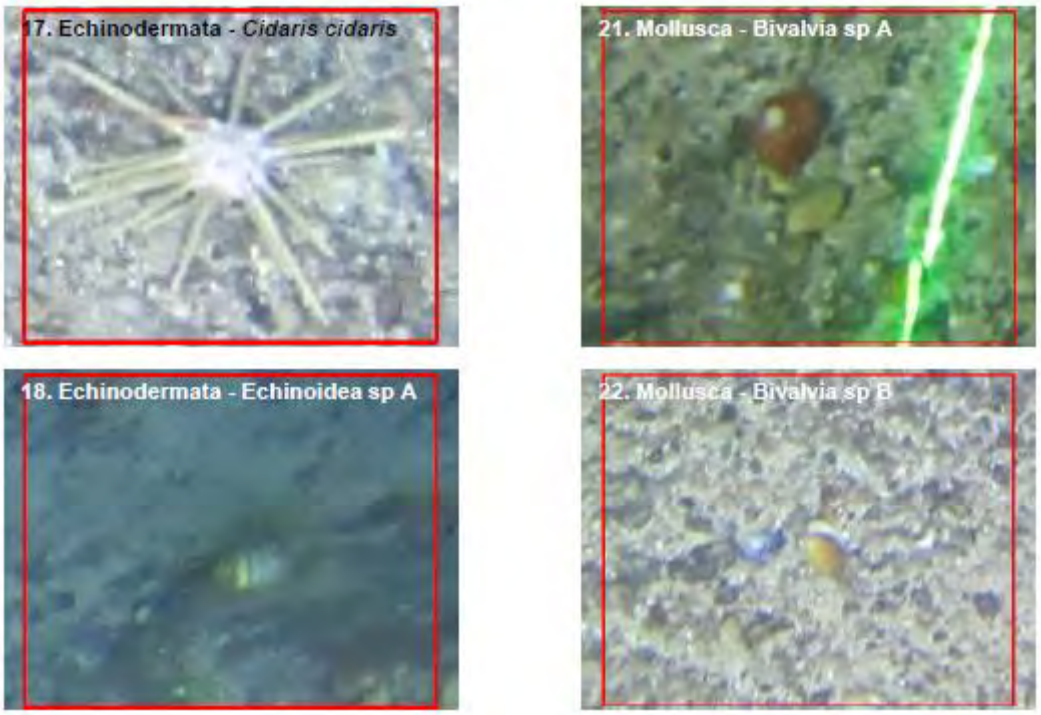

Figure 3-8: Examples of visable epifauna species from seabed imagery (Gardline, 2017b).

Infauna

Sponge aggregations can influence the density and occurrence of small infaunal species by providing shelter within the oscula and canal system, and an elevated perch for larger fauna like brittlestars (Konnecker, 2002). Recent surveys indicate that the faunal community is moderately diverse (Gardline, 2014).

Imagery from the Gardline survey observed faunal densities which were highly varied and identified populations to be 'rare' to 'occasional' in accordance with the JNCCs Maritime Nature Conservation Review (MNCR) SACFOR (Superabundant, Abundant, Common, Frequent, Occasional, Rare) abundance scale (Gardline, 2017a).

Environmental surveys investigated sample stations around the Schiehallion West and Schiehallion Central (*c.* < 2 km from Alligin Field) with digital camera systems. 4,224 and 2,668 individuals were recorded within the survey area representing 53 and 52 taxa, respectively. Seabed imaginary results confirmed that the seabed was relatively uniform.

Gardline (2014) found the most dominant infaunal species recorded across the Greater Schiehallion Area were characteristic of gravelly sandy sediments of the north-east Atlantic, with polychaetes representing 50% of the individuals sampled.

Gardline (2017b) reported the benthic faunal community within the Foinaven/Schiehallion survey area to be sparse with an average of 52 individuals and 25 taxa identified per 0.1 m^2, and typical of a deep-water location. The ten most abundant species within the survey area included the polychaete *Galathowenia oculata*; the crustaceans *Ampelisca spinipes*, *Ampelisca sp., Haploops setosa* and *Haploops tubicola*; the burrowing brittlestar *Amphiura sp* and the *bivalves Astarte sulcata, Limopsis aurita* and *Thyasira succisa*.

3.4.2.1 Deep-Sea Sponge Aggregations – Faroe-Shetland Sponge Belt

Deep-sea sponge aggregations principally comprise sponges from two classes: Hexactinellida and Demospongia. Sponge aggregations can develop under certain geological, hydrological and biological conditions to form a structural habitat. They are known to occur in water depths between 250 m and 1,300 m (Bett and Rice, 1992), with water temperatures ranging from 4°C to 10°C and where there is moderate current velocity (0.5 knots). Deep-sea sponge aggregations are mainly found on hard substrata such as boulders and cobbles. Iceberg plough mark zones provide an ideal habitat for sponges, where stable boulders and cobbles are exposed on the seabed, providing numerous settlement points for sponge larvae. Further, deep-sea sponges have similar habitat preferences to cold-water corals, and hence are often found at the same area. Dense aggregations of deep-sea sponges are known to occur in various places in the Northeast Atlantic (Klitgaard and Tendal, 2001). Examples have been found close to the shelf break at 250 m to 500 m depth around the Faroe Islands (Klitgaard and Tendal, 2001; Gardline, 2017a).

The habitat 'deep-sea sponge aggregations' is designated to be 'threatened and/or declining' by OSPAR. The OSPAR recommendation 2010/10 defines this habitat as aggregations of deep-sea sponges extending over at least 25 m^2, with a density more than 0.5 sponge per m^2. The proposed Alligin Field Development (along with the Loyal, Schiehallion and Foinaven Fields), is located in the south west corner of the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA) (Figure 3-1 and Figure 3-17). This NCMPA has been designated for the protection of a number of different habitats, species and geomorphological features which include the 'deep-sea sponge aggregations' habitat (The Faroe-Shetland Sponge Belt NCMPA is discussed further in Section 3.5.3.1).

The Faroe-Shetland Sponge Belt NCMPA is at the meeting point for five different water masses in the Faroe-Shetland Channel, which interact with each other and the continental slope to generate ideal conditions for the boreal 'ostur' type of deep-sea sponge aggregations to settle. These aggregations typically have a high abundance of species of giant sponge (Demospongia), referred to by local fishermen as 'Osterbunds' or 'cheese-bottoms' due to their appearance. The sponges support a wide range of other species, for example by providing shelter for fish and perches for filter feeders such as brittlestars. In UK waters, the boreal 'ostur' sponge is only found within the biogeographic region which includes the Faroe-Shetland Channel (JNCC, 2018).

Recent observations of *Haliclona* sp sponge aggregations at Schiehallion West (Gardline 2017b) were at densities meeting the criteria set out by Henry and Roberts (2014), for qualifying OSPAR deep-sea sponge aggregations. However, when this species was considered across the whole site the density did not meet the criteria and the area is identified as having low to medium resemblance to the OSPAR habitat definition of a deep-sea sponge aggregation (OSPAR, 2010).

The Alligin pipeline route survey (Fugro, 2017 draft report) used an Autonomous Underwater Vehicle (AUV) to acquire data for the environmental habitat survey along nine proposed pipeline routes (see Figure 3-2). The objectives of the habitat assessment survey were to acquire enough data to describe all habitats recorded in the study area and to identify and delineate the extent of any potentially sensitive habitats or species, with a particular focus on 'deep-sea sponge aggregations'. The data from the AUV was analysed from a series of photo mosaics, each spaced 100 m apart and comprised five continuous frames. This created 578 mosaics in total which were analysed for sponge density. The categories applied and the number of mosaics within each category are summarised in Table 3-2 and shown spatially in Figure 3-9.

Table 3-2: Mosaic Sponge Density Categorisation.

Sponge Category	Number of Sponges (per m^2)	Number of Mosaics
Category 1	< 0.5 m^2	200
Category 2	≥ 0.5 m^2 – 1 m^2	29
Category 3	> 1 m^2 - 2 m^2	3
Category 4	> 2 m^2 – 4 m^2	0
Category 5	> 4 m^2 – 5 m^2	0
No Category	NA	346

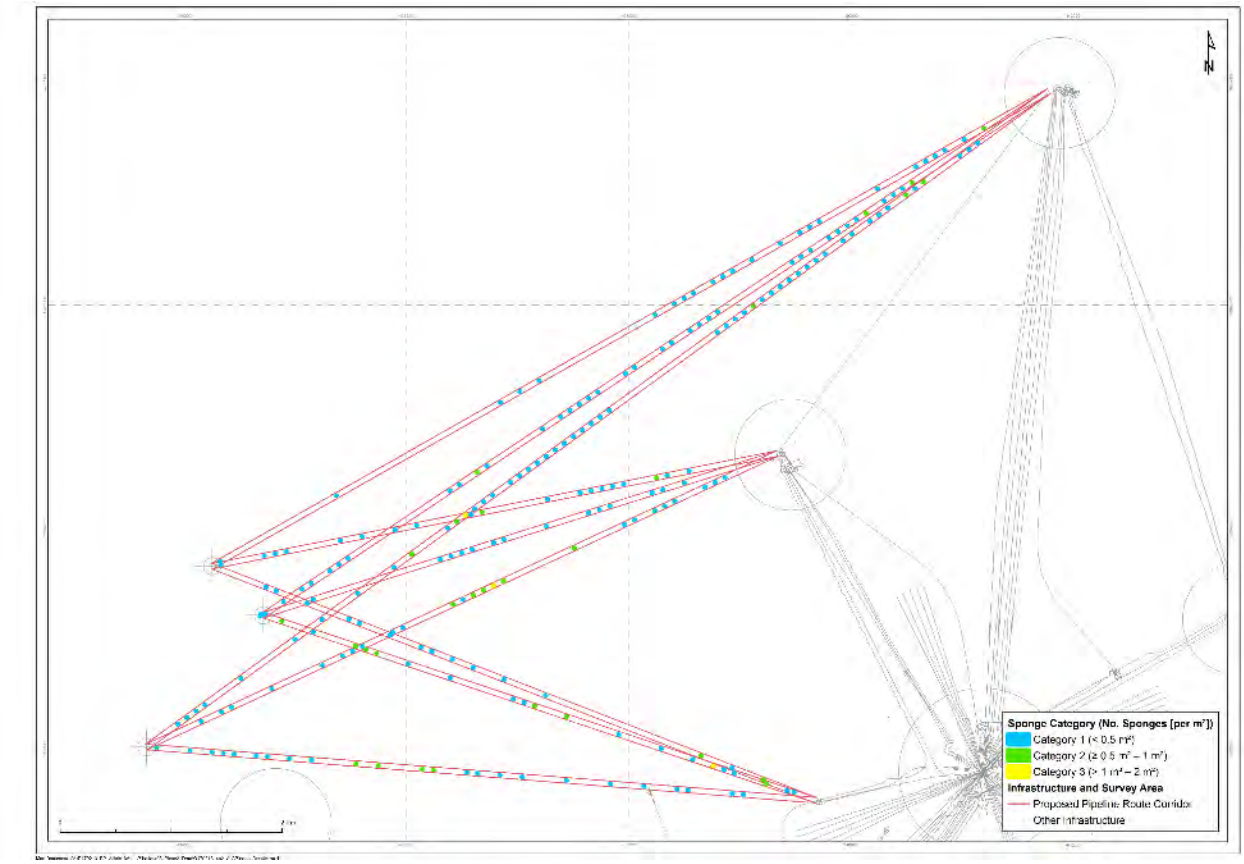

Figure 3-9: Surveyed pipeline route corridors showing the sponge density categories 1, 2 and 3 (Fugro, 2017 draft report).

Analysis of the data found that 32 of the 578 mosaics (equating to 4.17% of the total area reviewed) comprised sponges with a density more than 0.5 m^2 (defined as potential deep-sea sponge habitat). Within the majority of the mosaics in the 'No Category', small amounts of sponges were observed but the area over which they were seen was < 25 m^2, and therefore too small to be considered a deep-sea sponge aggregation. A large number of mosaics did not have any observations of sponges at all. The sponges associated with the Faroe-Shetland Sponge Belt, such as *Geodia* spp. were not observed in the 578 mosaics reviewed, instead, the sponges appeared to be dominated by the open, flattened/lamellate forms, expected to be *Phakellia* sp.

Overall, it is concluded that the potential area of deep-sea sponge habitat identified (where sponge density > 0.5 m^2) is small and scattered across the nine survey transects. There is no consolidated area of higher

sponge density and while the presence of sponges is ubiquitous, it is patchy with low densities overall. The deep-sea sponge grounds commencing around 60 nautical miles (111 km) to the north-east of the survey area (and *c*. 120 km north-east of the proposed drilling location) are thought to represent the boreal 'ostur' habitat variant which tend to be the main focus of habitat protection in the Faroe-Shetland Sponge Belt NCMPA (Fugro, 2017 draft report).

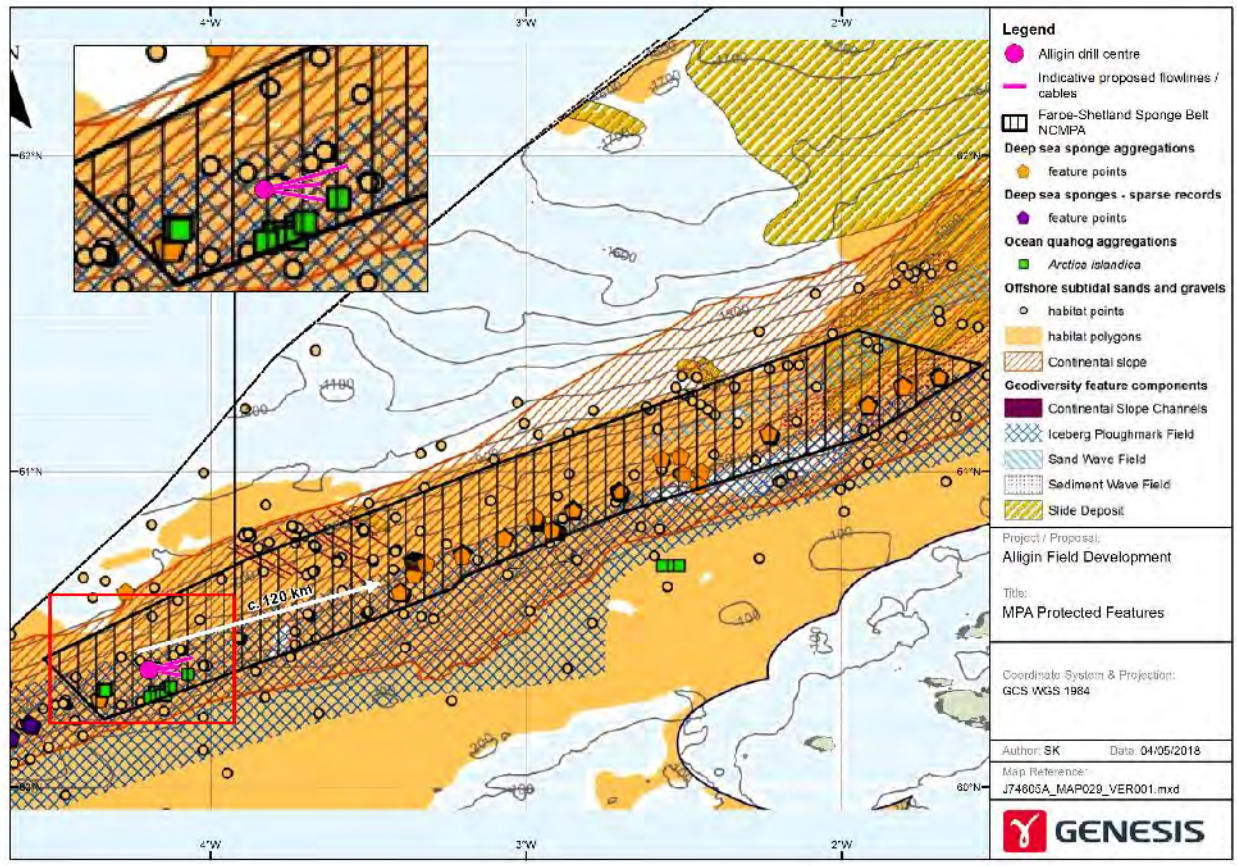

Figure 3-10: Location of the proposed Alligin drill centre in relation to the boreal 'ostur' habitat variant.

3.4.2.2 Arctica Islandica

From Figure 3-10 it can be seen that the proposed project is located in close proximity to an area associated with *Arctica Islandica* (ocean quahog) aggregations. These *A. islandica* aggregations are one of the designating features of the Faroe-Shetland Sponge Belt NCMPA (the Faroe-Shetland Sponge Belt NCMPA is discussed further in Section 3.5.3.1). *A. Islandica* is found buried in sandy and muddy sediments from the low intertidal zone down to 400 m. Therefore, at water depths of *c*. 460 - 480 m (Fugro, 2017 draft report), it is unlikely that aggregations of this species will occur at the drill centre location, however as can be seen from Figure 3-10 it is possible the pipeline routes could pass through an area containing this species (note water depths at Schiehallion and Loyal range from 350 m to 500 m; BP, 2010).

A. islandica is a long-lived species with a very slow growth rate. Populations of 40-80 year old specimens with a substantial proportion over 100 years old have been observed. It is among the longest-lived and slowest growing marine bivalves. It can grow to a length of *c*. 100 mm and a height of *c*. 85 mm.

The main threat to *A. islandica* stems from disturbances to the seabed, e.g. physical change to the seabed, physical removal of the substratum, or high levels if siltation. Further information on *A. islandica* is provided in Section 3.5.4.

Reefs

Reefs are one of the habitats of conservation significance listed under Annex I of the EU Habitats Directive for protection within SACs. European interpretation of the habitat includes bedrock, stony and biogenic reefs.

At West Schiehallion, recently acquired still images and video snapshots identified a 'low resemblance' to stony reef when evaluating the seafloor composition. It was concluded that there was no evidence of the presence of Annex I habitats (Gardline, 2017b).

The recent Alligin survey (Fugro, 2017 draft report) identified areas of coarse sediments comprising gravels, pebbles and cobbles along the pipeline route and around the proposed drill locations. It was determined that the cobles and boulders evident from the AUV footage did not constitute an Annex I habitat geogenic reef.

3.4.3 Finfish and Shellfish

More than 330 fish species are thought to inhabit the shelf seas of the UKCS (DECC, 2016). Pelagic species (e.g. herring, mackerel, blue whiting, and sprat (*Sprattus sprattus*) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g. cod, haddock (*Melanogrammus aeglefinus*), sandeels (*Ammodytes tobianus*), sole (*Solea solea*) and whiting live on or near the seabed and similar to pelagic species, many are known to passively move (e.g. drifting eggs and larvae) and / or actively migrate (e.g. juveniles and adults) between areas during their lifecycle.

The highest richness of northerly fish species is found in waters off the north-east of Scotland, including Orkney and Shetland (Daan, 2006). The WoS is largely characterised as an offshore, deep water region which observes fish assemblages which are quite different compared to those from other regions. The Faroe-Shetland Channel is separated from the deep shelf edge waters to the west of Scotland by the Wyville Thomson Ridge, which rises to a depth of approximately 500m. This separation means that the fish communities on either side of it are quite distinct, particularly below 500m (Gordon 2001).

Fish occupying areas in close proximity to offshore oil and gas installations will be exposed to aqueous discharges and may accumulate hydrocarbons and other contaminating chemicals in their body tissues. The most vulnerable stages of the life cycle of fish, to general disturbances such as disruption to sediments and oil pollution, are the egg and larval stages. Hence, recognition of spawning and nursery times and areas within a development area is important when considering potential disturbance caused by drilling and installation activities and when responding to accidental releases during operations.

The Alligin Field lies within ICES rectangle 49E5 (see Section 3.6.1 for description of ICES rectangles). Table 3-3 and Figure 3-11 show the approximate spawning times and nursery grounds of some commercial fish species occurring in 49E5. It should be noted that spawning and nursery areas tend to be transient and therefore cannot be defined with absolute accuracy (Coull *et al.,* 1998; Ellis *et al.,* 2012).

Table 3-3: Summary of spawning and nursery activity for some commercial fish species in ICES rectangle 49/E5 (Coull *et al.*, 1998[1]; Ellis *et al.*, 2012[2]).

Species	J	F	M	A	M	J	J	A	S	O	N	D	Nursery
Blue whiting[1,2]				*	*								Yes
Norway Pout[1]		*	*										Yes
Sandeel[1]													Yes
Mackerel[1,2]					*	*							Yes
Key	Species Present (*Peak Spawning)							Species not recorded					

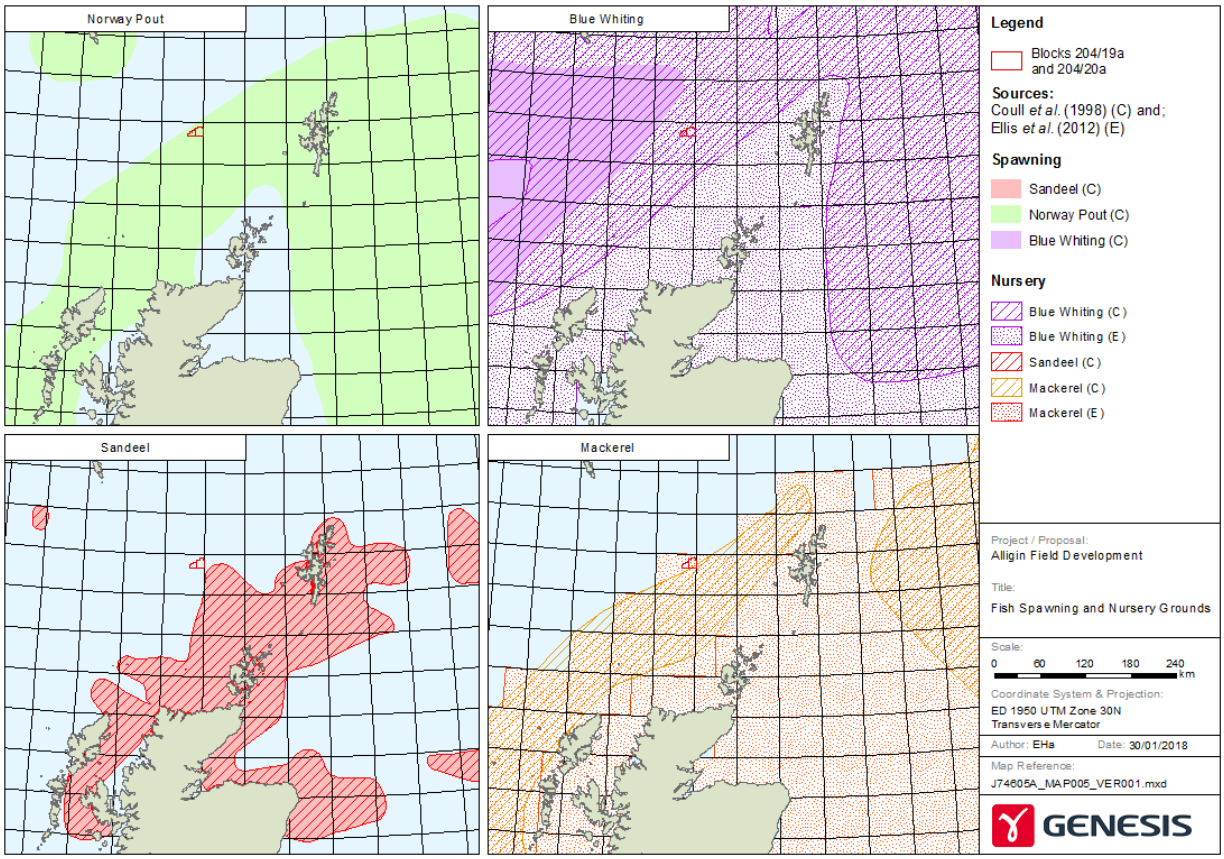

Figure 3-11: Fish spawning and nursery grounds within close proximity to the proposed development (Coull *et al.*, 1998; Ellis *et al.*, 2012).

All of the species that are identified within this area are represented on the Priority Marine Feature (PMF) list (see Section 3.5.5) and are subject to appropriate protection and conservation measures (Tyler-Walters *et al.,* 2016). Marine Scotland have not identified any 'period of concern' for seismic surveys within Blocks 204/19a and 204/20a due to fish spawning (OGA, 2017a).

Data generated by Marine Scotland (Aires *et al.*, 2014) uses Species Distribution Modelling (SDM) to predict where aggregations of 0-group fish (fish in the first year of their life) may be found based on environmental information and catch records. The data indicates that low levels of juveniles are present in the area for the majority of commercial fish species (Figure 3-12). However, these maps do not include all commercially important species and need to be considered alongside earlier data from Coull *et al.,* (1998) and Ellis *et al.,* (2012) in order to gain a full understanding (Figure 3-11).

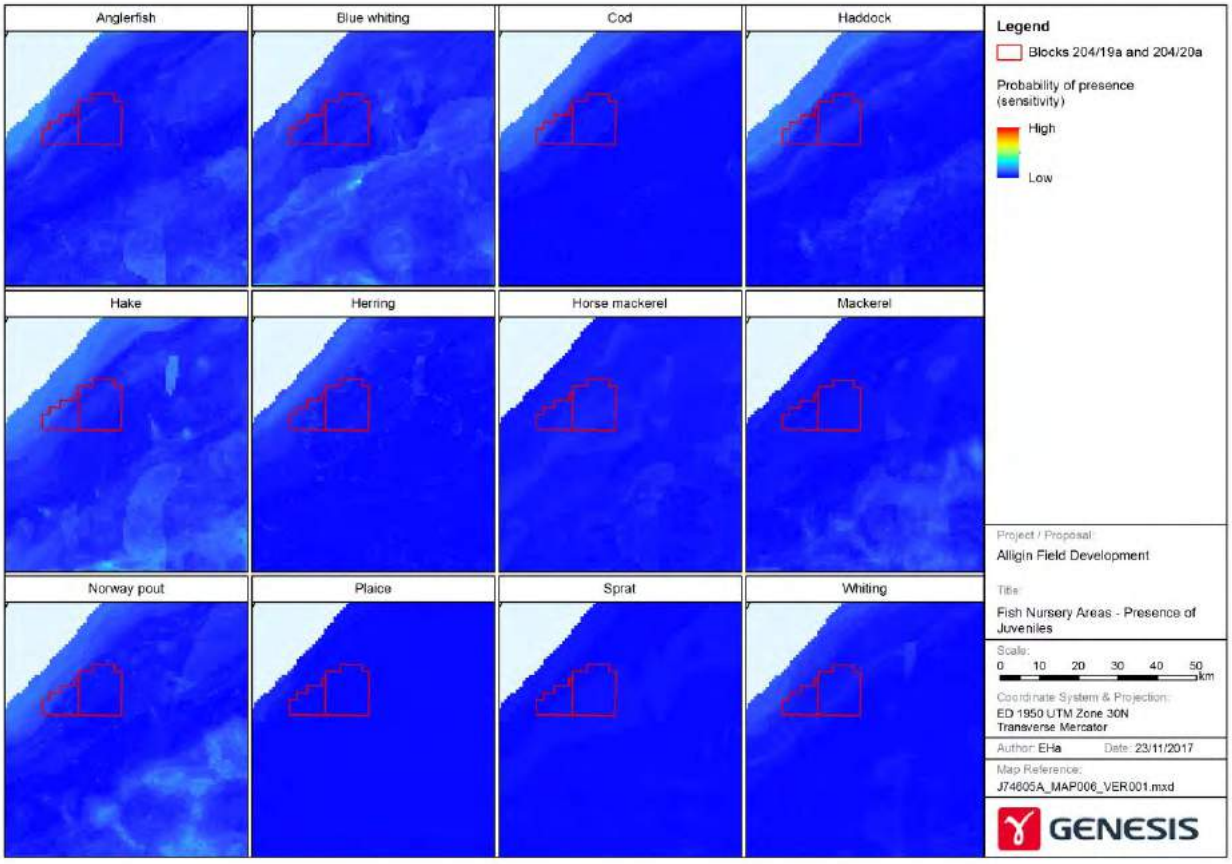

Figure 3-12: probability of juvenile fish presence (Aires *et al.* 2014)

Individuals of cod (*Gadus morhua*) were observed during the seabed imagery and video analysis of a recent environmental survey at Schiehallion central in 2017. This species is a PMF which is listed as vulnerable (VU) on the IUCN Red List as well as the Scottish Biodiversity List (IUCN, 2017; Scottish Biodiversity List, 2013).

One individual of the rabbitfish genus *Chimaera sp*. and four individuals of the species *Chimaera monstrosa* were observed. *Chimaera monstrosa* is listed as near threatened (NT) on the IUCN Red List (IUCN, 2017). The Ling *Molva* was observed at all transects and is listed as a UK Biodiversity Action Plan (BAP) priority marine species across Scotland (Scottish Biodiversity List, 2013). Figure 3-13 shows example species identified from a recent environmental survey at central Schiehallion which include photographic evidence of protected fish species abundance, as described above.

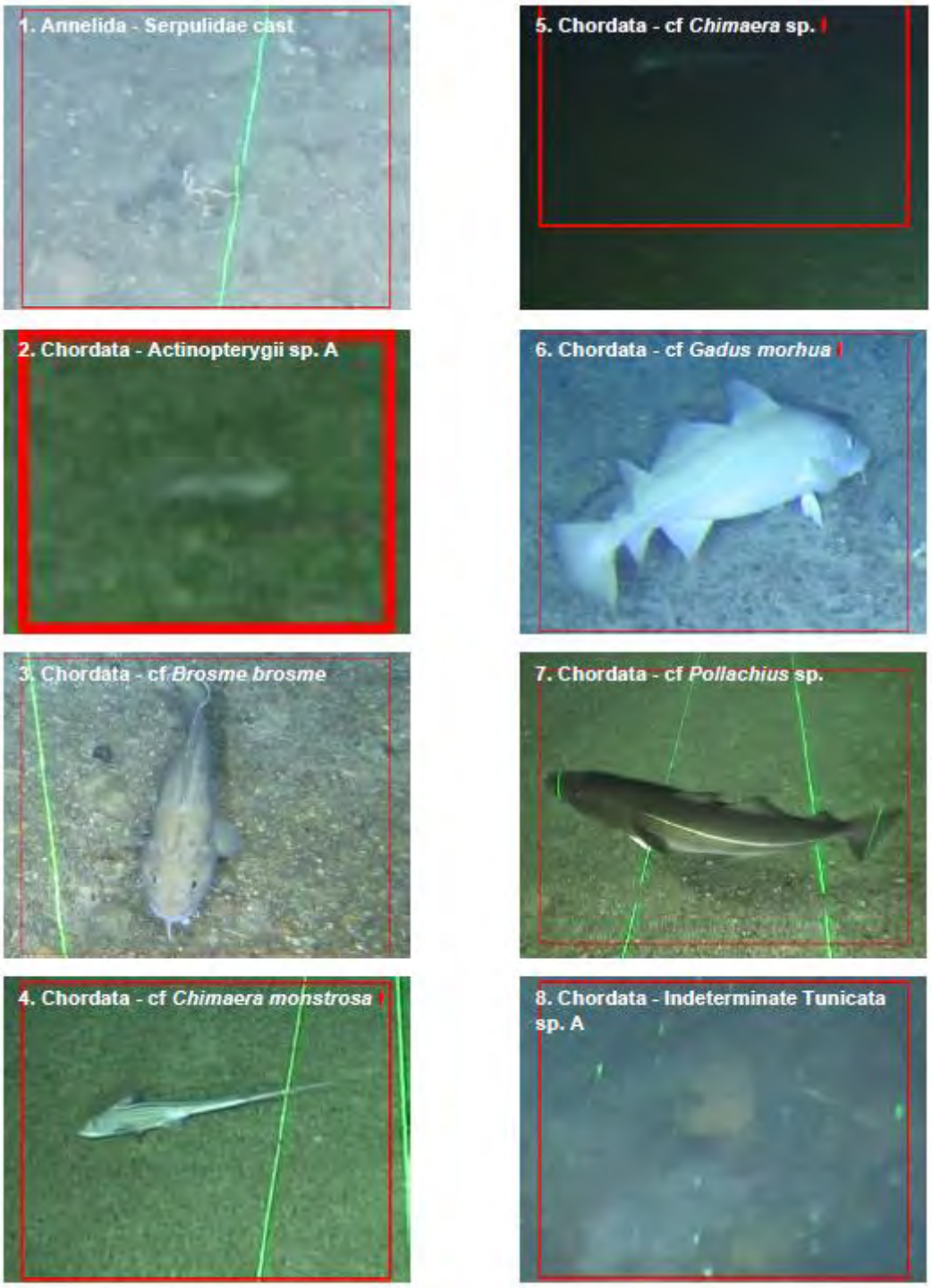

Figure 3-13: Example species (including *G. morhua* and *C. monstrosa*) identified in environmental survey Gardline, 2017a)

3.4.3.1 Sharks, Skates and Rays

Due to their slow growth rates and hence delayed maturity and relatively low reproductive rates, sharks, rays and skates (all members of the class *Chondrichthyes*) tend to be vulnerable to anthropogenic activities. Historically, Chondrichthyan species have been targeted by commercial fisheries (specifically common skate (*Dipturus batis*), long-nose skate (*Dipturus oxyrinchus*) and angel shark (*Squatina squatina*). Overfishing has

significantly depleted their numbers in the UK waters. These species tend to be taken as bycatch to such an extent that the stocks are still being depleted in UK waters. Work is underway to develop National Plans of Action for the conservation and management of the Chondrichthyes. Those species identified as being in need of immediate protection are the angel shark, common skate, longnose skate (*Raja rhina*), Norwegian skate (*Dipturus nidarosiensis*) and white skate (*Rostroraja alba*). It has been proposed to protect these species in UK waters in the same way as the basking shark is protected, under the Wildlife and Countryside Act (1981) (JNCC, 2017d).

The distribution of Chondrichthyes in the UKCS is not extensively documented. However available literature (Ellis *et al*., 2004) suggests that at least six species regularly occur in the northern North Sea:

- Spiny dogfish / spurdog (*Squalus acanthias*);
- Tope shark (*Galeorhinus galeus*);
- Thorny skate / starry ray (*Amblyraja radiata*);
- Cuckoo ray (*Leucoraja naevus*);
- Lesser spotted dogfish (*Scyliorhinus canicula*); and
- Thornback Ray (*Raja clavata*).

Total numbers recorded for each of these species are low (Ellis *et al*., 2004).

The Arctic skate is a key feature of the assemblage in the Faroe-Shetland Channel. There is also a greater abundance of elasmobranchs to the west of Scotland than in the Faroe Shetland Channel with deep water sharks such as the leaf-scale gulper shark (*Centrophorus squamosus*) and the blackmouth dogfish (*Galeus melastomus*) present (Gordon *et al.* 1994). The velvet belly (*Etmopterus spinax*), a lantern shark that uses light producing cells in its stomach as camouflage against the ocean surface, is sometimes caught in demersal hauls in the deep waters of the Rockall Plateau (Ellis and Heessen 2015).

Mesopelgic species can also be found within this region, however little is known about these species. Some Mesopelagic species can be very abundant and it is thought that the dominant fish species to the west of the UK are the light-emitting lantern-fish (*Notoscopelus kroyeri*) and the pearlside (*Maurolicus muelleri*) (Pinnegar *et al.* 2010; Kloppmann and Ellis 2015).

3.4.4 Seabirds

The UK and its surrounding seas are very important for seabirds. The extensive network of cliffs, sheltered bays, coastal wetlands, and estuarine areas, provide breeding and wintering grounds for nationally and internationally important bird species and assemblages (DECC, 2016). Approximately 26 species of seabird regularly breed in the UK and Ireland as do a number of other waterbird and wader species (DECC, 2016).

Predicted maximum monthly abundance of seabirds in the Alligin area is based on an analysis of the European Seabirds at Sea (ESAS) data collected over 30 years (Kober *et al.,* 2010). Continuous seabird density surface maps were generated using the spatial interpolation technique ‘Poisson kriging’ and fifty-seven seabird density surface maps were created to show particular species distribution in specific areas. Data from the relevant maps has been summarised for the Alligin area in Table 3-4.

Distibution and abundance of these bird species vary seasonally and annually. Seabird densities such as Atlantic puffin are generally higher in the breeding season (April – July), whereas other species such as the Northern fulmar have higher densities in the winter season (August - February) (Table 3-4). Of the species expected to occur in the area, guillemot (*Uria aalge*) and the European storm petrel (*Hydrobates pelagicus*) are afforded protection by the EC Birds Directive (Annex I).

Table 3-4: Predicted seabird surface density (maximum number of individuals/km^2) (Kober *et al.*, 2010).

Species	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern gannet	Breeding												
	Winter												
Great skua	Breeding												
	Winter												
Arctic Skua	Breeding												
Northern fulmar	Breeding												
	Winter												
Black legged kittiwake	Breeding												
	Winter												
European storm petrel	Breeding												
Sooty shearwater	Summer												
Great black-backed gull	Winter												
Glaucous gull	Winter												
Guillemot	Breeding												
	Additional												
	Winter												
Atlantic Puffin	Breeding												
	Winter												
ALL species combined	**Breeding**												
	Summer												
	Winter												

Key	Not recorded	≤1.0	1.0 – 5.0	5.0 – 10.0	10.0 - 20.0	20.0 ->30.0

Seabirds are generally not at risk from routine offshore oil and gas production operations. However, they may be vulnerable to pollution from less regular offshore activities such as well testing and flaring, when hydrocarbon dropout to the sea surface can occasionally occur, or from unplanned events such as accidental oil or diesel spills. Marine Scotland have not identified any 'period of concern' for drilling activities within Blocks 204/19a and 204/20a (OGA, 2017a).

The vulnerability of seabirds in the blocks and surrounding areas has been assessed according to JNCC Seabird Oil Sensitivity Index (SOSI). Oil and Gas UK commissioned HiDef (a digital aerial video and image specialist consultancy) to develop the SOSI tool and the results are available on the JNCC website (JNCC, 2017d). This model index supersedes JNCC's Oil Vulnerability Index (OVI) (JNCC, 1999). The purpose of this index is to identify areas where seabirds are likely to be most sensitive to oil pollution by considering factors that make a species more or less sensitive to oil-related impacts.

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

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

The combined seabird data and species sensitivity index values were then subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. The mean sensitivity SOSI data for the area is shown in Table 3-5. For blocks with 'no data', an indirect assessment has been made (where possible) using JNCC guidance (JNCC, 2017d). The sensitivity of birds to surface oil pollution is shown in Figure 3-14. The sensitivity of birds to surface oil pollution is generally low throughout the year within Blocks 204/19a and 204/20a, with the exception of November when seabird sensitivity is regarded as very high in both blocks. In the months February, April, May and June the seabird sensitivity is regarded as medium (JNCC, 2017d).

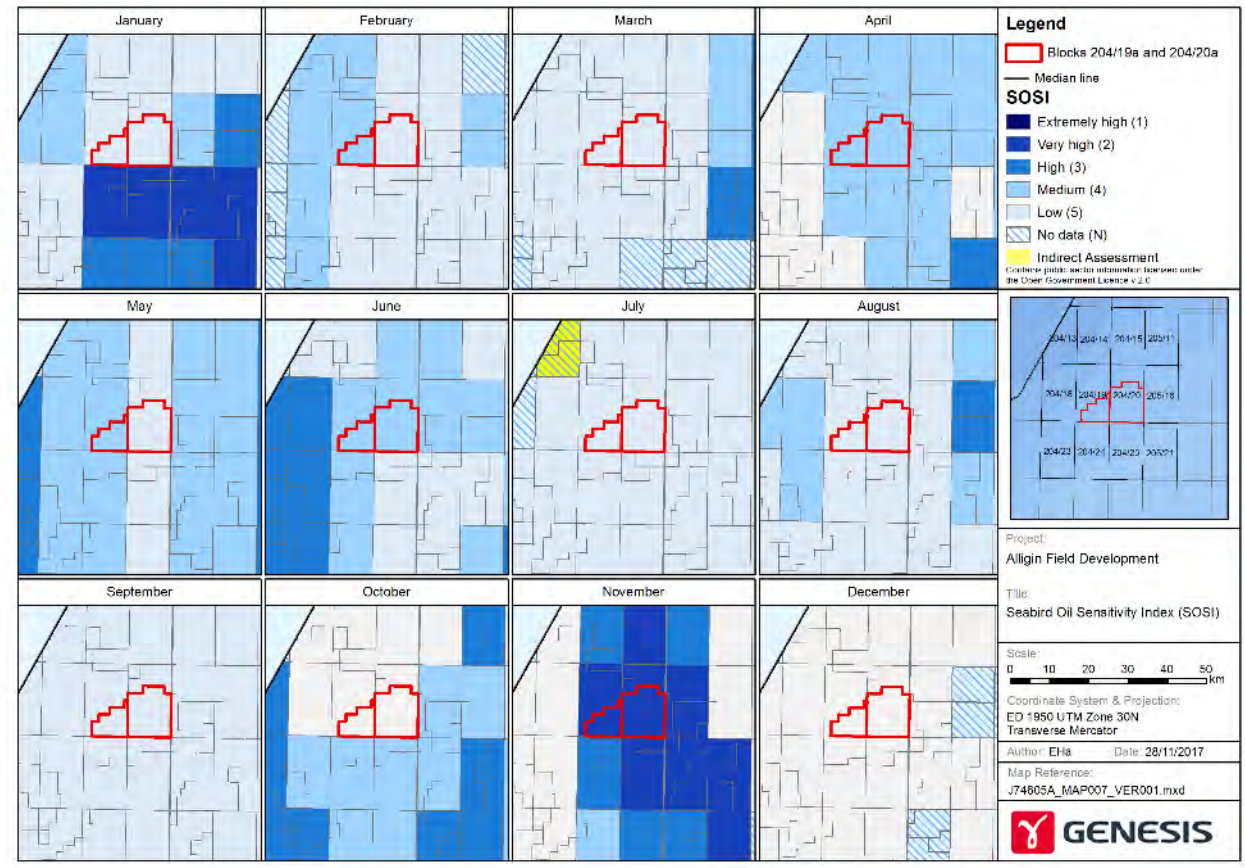

Figure 3-14: SOSI and indirect assessment for Blocks 204/19a and 204/20 and adjacent blocks (JNCC, 2017d).

Table 3-5: SOSI and indirect assessment for Blocks 204/19a and 204/20a (inc. adjacent blocks) (JNCC, 2017d).

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
204/13	4	4	5	4	4	5	5*	5	5	5	5	5
204/14	5	4	5	4	4	5	5	5	5	5	3	5
204/15	5	5	5	4	5	4	5	5	5	5	2	5
205/11	5	5	5	4	4	4	5	5	5	5	3	5
204/18	4	4	5	5	4	3	5	4	5	5	5	5
204/19	**5**	**4**	**5**	**4**	**4**	**4**	**5**	**5**	**5**	**5**	**2**	**5**
204/20	**5**	**5**	**5**	**4**	**5**	**4**	**5**	**5**	**5**	**5**	**2**	**5**
205/16	4	5	5	4	4	4	5	5	5	4	2	5
204/23	5	4	5	5	4	3	5	4	5	4	5	5
204/24	2	5	5	4	4	4	5	5	5	4	3	5
204/25	2	5	5	4	5	5	5	5	5	4	2	5
205/21	2	5	5	4	4	5	5	5	5	4	2	5
Key	1 Extremely High		2 Very High			3 High		4 Medium			5 Low	
	Indirect Assessment – data gaps have been populated following guidance provided by the JNCC (JNCC, 2017d). ** Data gap filled gap filled using data from the same block in adjacent months.*											

3.4.5 Marine Mammals

Marine mammals include mustelids (otters), pinnipeds (seals) and cetaceans (whales, dolphins and porpoises). Marine mammals are vulnerable to the direct effects of oil and gas activities such as noise, contaminants and oil spills. They may also be affected indirectly by activities that affect prey availability.

3.4.5.1 Mustelids

The European otter (*Lutra lutra*) is found across the UK and European waters, including North Scotland, Orkney and Shetland. Though not strictly a marine mammal, coastal populations are chiefly marine, though they must return to freshwater.

The Shetland otter population is one of the largest in Europe and is of national and international significance: In 2003, the total Scottish population was estimated at around 8,000 (SNH, 2015) and Shetland supports 12% of the UK population (Shetland Otters, 2016). The Scottish population unusually comprises a particularly high proportion (*c.* ≥ 50%) of coastal-dwelling individuals that feed almost exclusively at sea. The Yell Sound Coast Special Area of Conservation (SAC), on the south coast of Yell in Shetland has been designated for the otter. The SAC supports approximately 180 otters at higher densities than found anywhere else in Britain.

Otters in Shetland are morphologically and genetically distinct from those on the mainland (JNCC, 2016) making them particularly important in terms of conservation. Although numerous, otters in Shetland are isolated and as such are vulnerable. Otters live in shelters called holts (tunnel systems regularly used by otters for shelter) and in Shetland these are predominately located in peat around rocky coasts. Holts where cubs are born are called 'natal holts' (Chanin, 2003). In Shetland, otter cubs are reported to be born in May and June (Chanin, 2003).

The European otter is classed as a European Protected Species (EPS) and is fully protected by UK law through ratification of the Appendix II of the Bern Convention; Annexes II and IV of the Habitats Directive;

inclusion in Schedule 5 of the Wildlife and Countryside Act (1981) (as amended) and Schedule 2 of the Conservation Regulations 1994. Under this legislation, it is an offence to intentionally or recklessly kill, injure or disturb otters, and/or intentionally or recklessly obstruct, damage or destroy otter holts or couches. The otter is a priority species in the UK Biodiversity Action Plan (BAP) (see Section 3.5.4). As an EPS, otters are further protected by the designation of SACs in areas identified as being of particular importance for them. The otter is also listed on Appendix I of the Convention on International Trade of Endangered Species (CITES) and is a priority species in the UK BAP.

Routine activities at the proposed project location will not affect these mammals due to the distance from the coast. However, in cases of extreme oil spills, such that the oil is washed ashore, the effects could be detrimental to some local populations on the coast and in estuaries. Impacts from oil include gastrointestinal haemorrhaging or hypothermia resulting from the otters' fur being covered in oil and no longer being able to function as a thermal layer.

3.4.5.2 Pinnipeds

Five species of seal have been identified in the North Sea and surrounding locations; these include the grey seal *Halichoerus grypus*, harbour seal *Phoca vitulina*, harp seal *Phoca groenlandica*, hooded seal *Cystophora cristata* and ringed seal *Pusa hispida*. Of these, grey and harbour seals are found regularly in the WoS. Hooded seals can also be observed in this area as they have been recorded in deep waters over the Faroe-Shetland Channel, breeding and moulting on the packed ice of Arctic waters. Grey and harbour seal are protected under Annex II of the EU Directive.

Grey and harbour seals will feed both in inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and annually. Both species tend to be concentrated close to shore, particularly during the pupping and moulting season. Seal tracking studies from the Moray Firth have indicated that the foraging movements of harbour seals are generally restricted to within a 40 – 50 km range of their haul-out sites (SCOS, 2013). The movements of grey seals can involve larger distances than those of the harbour seal, and trips of several hundred kilometres from one haul-out to another have been recorded (SMRU, 2011).

The population of grey seals in the UK has steadily increased since the 1960s but has remained constant in recent years, the exception being at the Isle of May and Berwickshire and Northumberland SAC where the population increased by 21% between 2008 and 2009 (Sparling *et al.,* 2012). Along the east coast of Scotland, harbour seals occur mostly in the Moray Firth and Firth of Tay (SMRU, 2012). Since 1997, the population of harbour seals has decreased with a significant reduction in numbers recorded at most haul out sites.

Distribution maps based on telemetry data (1991 - 2012) and count data (1988 – 2012) indicate that grey seals and harbour seals are unlikely to occur in the vicinity of the proposed project (Figure 3-15).

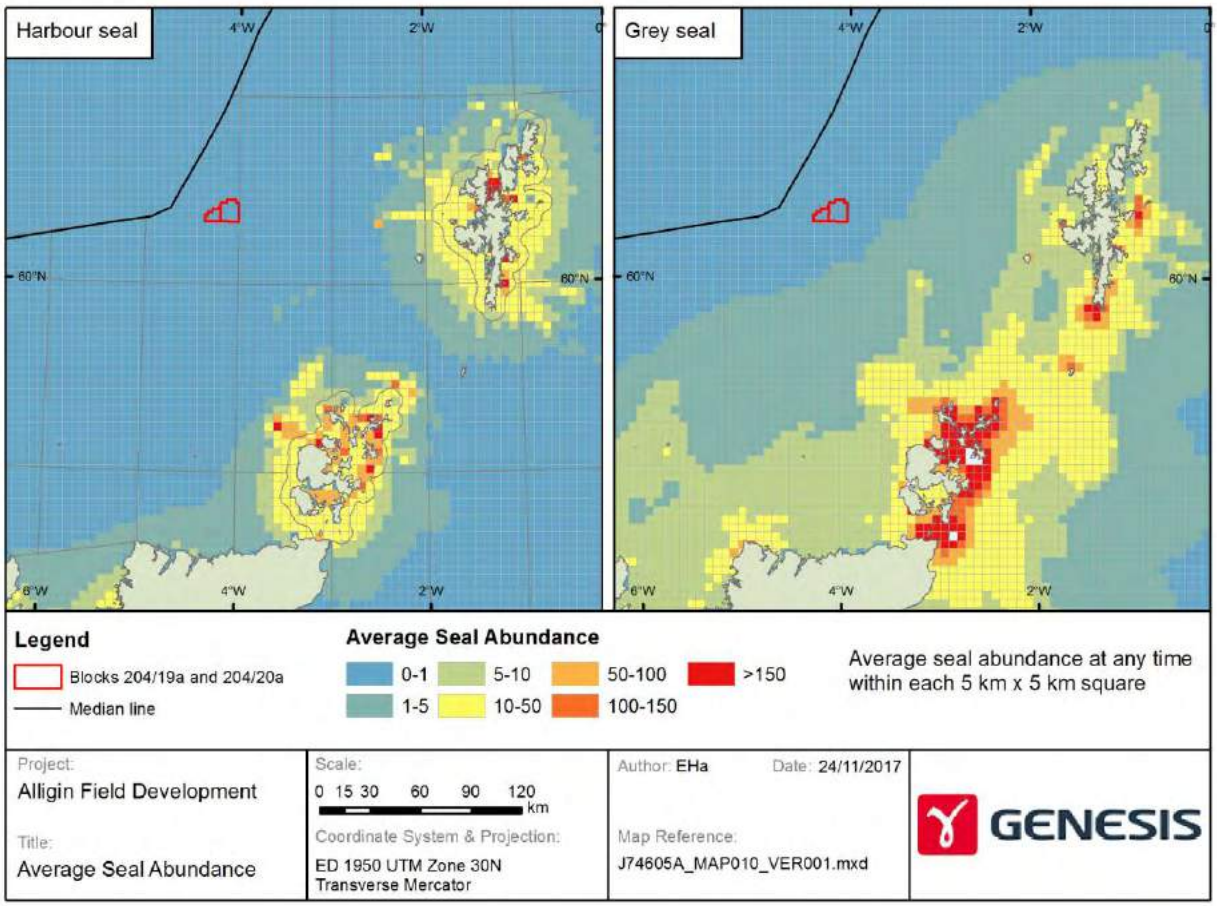

Figure 3-15: Harbour and grey seal distribution in the WoS (SMRU, 2012; Jones *et al.,* 2013)

3.4.5.3 Cetaceans

Many activities associated with the offshore oil and gas industry have the potential to impact on cetaceans by causing physical injury, disturbance or changes in behaviour. Activities with the potential to cause disturbance or behavioural effects include: drilling, seismic surveys, vessel movements, construction work and decommissioning (JNCC, 2008).

Twenty-seven species of cetacean have been recorded in UK waters, 16 of which are known to be present in the area to the west of Shetland. The most abundant cetacean in the deeper water beyond the shelf area to the west of Shetland is the Atlantic white-sided dolphin. The Faroe-Shetland Channel contains a number of species that are rare or endangered including the blue whale and right whale. Macleod *et al*., (2003) noted that of three regions surveyed: west of the Outer Hebrides, west of the Shetland Islands and the central Faroe-Shetland Channel, the Faroe-Shetland Channel had the greatest relative abundance of large whales and dolphins. Table 3-6 provides the seasonal occurrence of cetacean species in the WoS region. Some of the species listed here can also be observed in the Small Cetacean Abundance in the North Sea (SCANS-III) data provided in Table 3-7.

Table 3-6: Seasonal occurrence of cetaceans in the water west of Shetland (Pollock *et al*., 2000; Hammond *et al*., 2017; Reid *et al*., 2003; Stone, 2003a; 2003b; Macleod *et al*., 2003).

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

The JNCC has compiled an Atlas of Cetacean Distribution in Northwest European Waters (Reid *et al.,* 2003) which gives an indication of the annual distribution and abundance of cetacean species in the North Sea. Figure 3-16 shows the annual abundance and distribution of cetacean species most likely to occur in the area.

Data suggests that densities of harbour porpoise, white-sided dolphin, long-finned pilot whales and Risso's dolphin have been recorded within ICES rectangle 49E5 (Reid *et al.,* 2003). These species of cetacean are all listed as mobile species on the PMF list; and are subject to appropriate protection and conservation measures (Tyler-Walters *et al*., 2016).

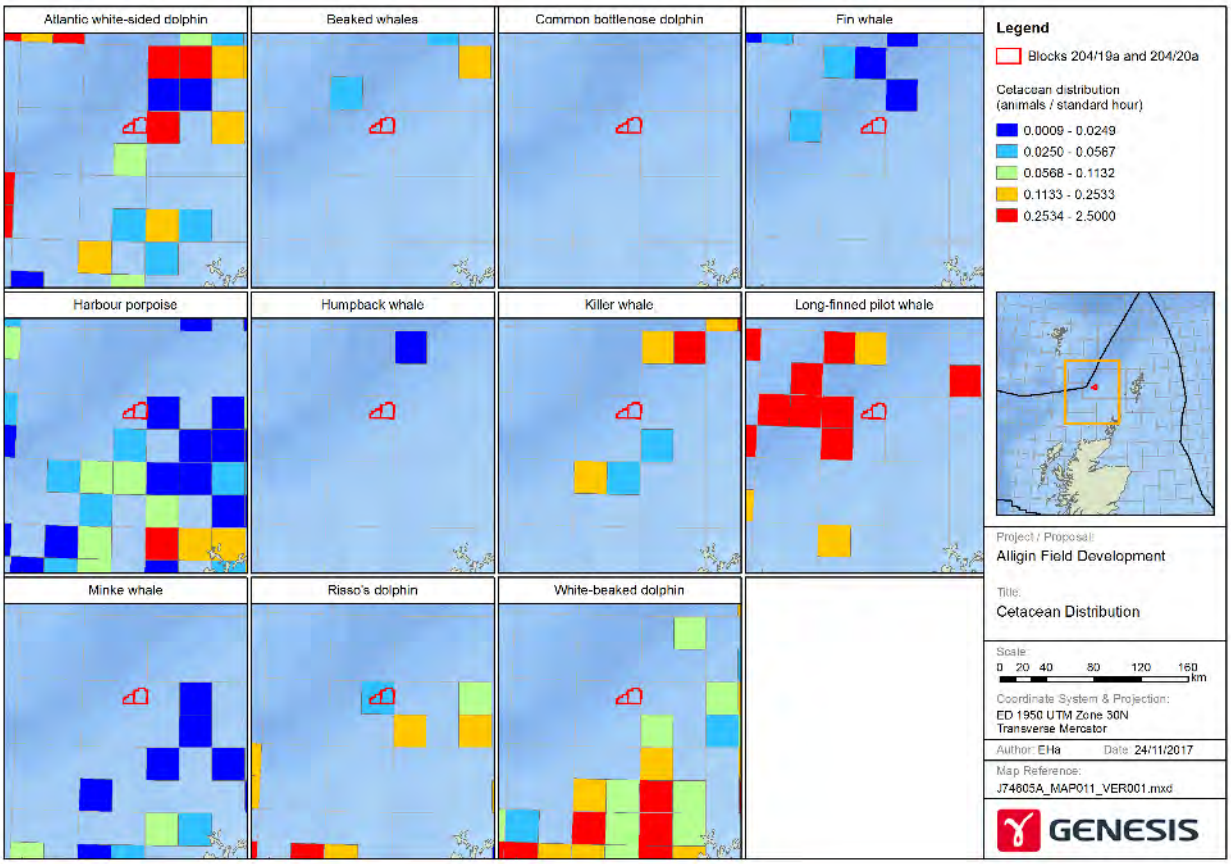

Figure 3-16: Distribution of cetacean species in the WoS (Reid *et al.,* 2003).

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys have been conducted to obtain an estimate of cetacean abundance in North Sea and adjacent waters, the most recent results are SCANS-III are presented in Hammond *et al.,* (2017). Aeriel and shipboard surveys were carried out during the summer of 2016 to collect data on the abundance of harbour porpoise, bottlenose dolphin, Risso's dolphin, white-beaked dolphin, white-sided dolphin, common dolphin, striped dolphin, pilot whale, all beaked whale species combined, sperm whale, minke whale and fin whale.

The blocks are located within SCANS-III survey areas "K" and "S". Aeriel survey estimates of animal abundance and densities (animals per km^2) within this area are provided in Table 3-7.

Table 3-7: Cetacean abundance in SCANS-III Survey blocks "K" and "S" (Hammond *et al.*, 2017).

Survey Block	Species	Animal Abundance (MU)[2]	Density (animals/km^2)[1]
K	Harbour porpoise	9,999	0.308
	Minke whales	295	0.009
	Beaked whale	211	0.006
	Risso's	44	0.014
	White-beaked dolphin	7,055	0.217
	Pilot whale	1,733	0.053
	Striped dolphin	142	0.004
S	Harbour porpoise	6,147	0.152
	White-beaked dolphin	868	0.021
	Minke whale	383	0.010
	Bottlenose dolphin	151	0.004

The JNCC have published the 'regional' population estimates for the seven most common species of cetacean occurring in UK waters (Inter-Agency Marine Mammal Working Group IAMMWG, 2015). Divided into Management Units (MUs), the estimated abundance of animals in these MUs are currently considered the reference populations for cetacean species in the North and Celtic Seas. Phase III of the Joint Cetacean Protocol (JCP) provides abundance estimates (adjusted average summer density surfaces from 2007-2010) which can be used to scale the MU populations to provide a reference population estimate for any given area (Paxton *et al.,* 2016). These abundance estimates provide an indication of the spatial scale and the relevant populations at which impacts should be assessed. The relevant populations are presented in Table 3-8.

Table 3-8: MU cetacean abundance scaled to relevant area (IAMMWG, 2015; Paxton *et al.*, 2016).

Species	MU Population	Shetlands	
		% area of relevant MU	Scaled abundance to relevant area
Harbour porpoise	21,462	0.3	682
White-beaked dolphin	15,895	0.2	32
White-sided dolphin	69,293	0.2	139
Minke whale	23,528	0.2	47

3.5 Conservation of Habitats and Species

The EU Habitats Directive (92/43/EEC) and the EU Birds Directive (2009/147/EC) are the main driving forces for safeguarding biodiversity in Europe. Through the establishment of a network of protected sites, these directives provide protection for animal and plant species of European importance and the habitats that support them. Protected areas in the vicinity of the Alligin Field Development are shown in Figure 3-17. The proposed activities are only expected to impact on the Faroe-Shetland Sponge Belt NCMPA, however an overview is provided on other designated areas that could be impacted in the event of a major hydrocarbon release such as a well blowout.

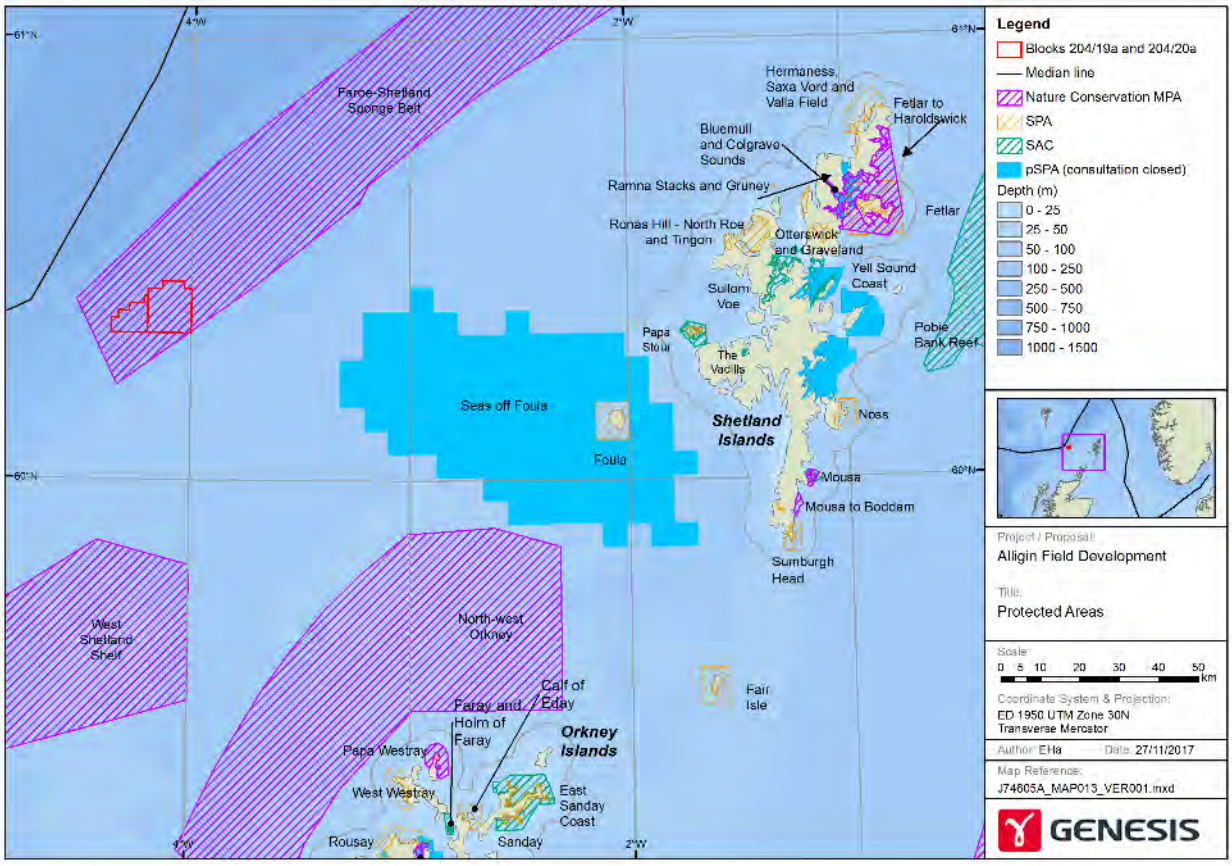

Figure 3-17: Protected areas in the region.

3.5.1 Special Areas of Conservation (SACs)

The Habitats Directive lists those habitats and species (Annex I and II respectively) whose conservation requires the designation of protected areas. These habitats and species are protected by the creation of a series of SACs and other safeguard measures such as Sites of Community Importance (SCIs) for particular species (Table 3-9).

Table 3-9: Definition of UK SAC/SCI Sites.

Site	Description
SAC	SACs are sites that have been adopted by the European Commission (EC) and formally designated by the government of each country in whose territory that site lies.
Site of Community Importance (SCIs)	SCIs are sites that have been adopted by the EC but not yet formally designated by the government of each country.
Candidate SAC (cSAC)	Candidate SACs (cSACs) are sites that have been submitted to the EC and not formally adopted.
Possible SAC (pSAC)	Possible SACs (pSACs) are sites that have been formally advised to UK Government, but not yet submitted to the EC.
Draft SAC (dSAC)	Draft SACs (dSACs) are areas that have been formally advised to UK government but not yet approved by it.

BEIS considers all types of SAC (cSAC, pSAC or dSAC) in the same way, such that any activity likely to have a significant effect on any type of SAC must be appropriately assessed.

Of the Annex I habitat types listed as requiring protection in the Habitats Directive, three potentially occur in the UK offshore waters (EC, 2013):

- Sandbanks which are slightly covered by seawater at all times;
- Reefs:
  - Bedrock reefs – made from continuous outcroppings of bedrock which may be of various topographical shapes (e.g. pinnacles and offshore banks);
  - Stony reefs- aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces;
  - Biogenic reefs – formed by e.g. cold water corals (e.g. *Lophelia pertusa*), polychaete worm *Sabellaria spinulosa*, horse mussel *Modiolus modiolus;*
- Submarine structures made by leaking gases.

No SACs feature within 40 km of the proposed development (OGA, 2017c) and no recent surveys identified the presence of any Annex I habitats (Gardline, 2017a; Gardline 2017b). Those SCAs of closest proximity to the Alligin Field and their designating features are listed in Table 3-10 (JNCC, 2017b).

Table 3-10: SACs/SCIs in closest proximity to the field development (JNCC, 2017b).

Area	Qualifying Features	Approximate distance from Alligin (km)
Papa Stour	**Annex I habitats**: reefs and submerged or partially submerged sea caves	120
Sanday	**Annex I habitats**: reefs, sandbanks which are slightly covered by seawater all the time and mudflats and sandflats not covered by seawater at low tide. **Annex II species**: harbour seal (*Phica vitulina*)	138
The Vadills	**Annex I habitats**: coastal lagoons	140
Faray and Holm of Faray	**Annex II species**: grey seal (*Halichoerus grypus*)	140
Sullom Voe	**Annex I habitats**: large shallow inlets and bays, coastal lagoons and reefs	144
Yell Sound and Coast	**Annex II species:** Otter (*lutra lutra*)	152
Pobie Bank Reef	**Annex I habitat:** reefs	186

3.5.2 Special Protection Areas (SPAs)

The Birds Directive requires member states to identify and nominate sites as Special Protection Areas (SPAs) for the protection of birds listed in Annex I of the Directive or sites that hold significant populations of regularly occurring migratory species. Unlike the SAC designation process, there are only two stages in designation of SPAs: potential (p)SPA for sites approved by Government that are currently in the process of being classified and SPA for classified sites. SPAs are also designated as Sites of Special Scientific Interest (SSSI).

There are no SPAs within 40 km of the blocks (OGA, 2017c). However, there are a number of SPAs along the coastal regions of the Shetland and Orkney isles (see Table 3-11).

Table 3-11: SPAs/pSPA in closest proximity to the field development site (JNCC, 2017c).

Area	Qualifying Features	Approximate distance from blocks (km)
Foula	**Breeding species:** Arctic tern; Leach's storm-petrel; red-throated Diver. **Breeding migratory species:** great skua; guillemot; puffin; shag *Phalacrocorax aristotelis.* **Assemblage qualification of international importance:** during the breeding season the area supports 250,000 seabirds.	105
West of Westray	**Breeding species**: Arctic tern **Breeding migratory species**: guillemot **Assemblage qualification of international importance:** during the breeding season the area supports 120,000 seabirds.	122
Papa Stour	**Breeding species**: Arctic tern **Breeding migratory species:** ringed plover *Charadrius hiaticula*	124
Rousay	**Breeding species**: Arctic tern **Assemblage qualification of international importance:** during the breeding season the area supports 30,000 seabirds.	134
Calf of Eday	**Assemblage qualification of international importance:** during the breeding season the area supports 30,000 seabirds.	138
Ronas Hill – North Roe and Tingon	**Breeding species**: merlin *Falco columbarius;* red-throat diver.	139
Ramna Stacks and Gruney	**Breeding species**: Leach's storm-petrel.	140
Fair Isle	**Breeding species**: Arctic tern; Fair Isle Wren *Troglodytes troglodytes fridariensis.* **Breeding migratory species:** guillemot **Assemblage qualification of international importance:** during the breeding season the area supports 180,000 seabirds.	155
Otterswick and Graveland	**Breeding species**: Red-throat diver	157
Sumburgh Head	**Breeding species**: Arctic tern **Assemblage qualification of international importance:** during the breeding season the area supports 35,000 seabirds.	159
Noss	**Breeding migratory species:** Gannet *Morus bassanus;* Great Skua; Guillemot **Assemblage qualification of international importance:** during the breeding season the area supports 100,000 seabirds.	165
Fetlar	**Breeding species**: Arctic Tern; Red-necked Phalarope *Phalaropus lobatus.* **Breeding migratory species:** Dunlin *Calidris alpina schinzii;* Great Skua *Catharacta skua;* Whimbrel *Numenius phaeopus* **Assemblage qualification of international importance:** during the breeding season the area supports 22,000 seabirds.	168
Hermaness, Saxa Vord and Valla Field	**Breeding species:** Red-throated Diver. **Breeding migratory species:** Gannet *Morus bassanus;* Great Skua; Puffin **Assemblage qualification of international importance:** during the breeding season the area supports 152,000 seabirds.	170

3.5.3 Nature Conservation Marine Protected Areas (NCMPAs)

Under the Marine (Scotland) Act and the UK Marine and Coastal Access Act (2009) the Scottish MPA Project led by Marine Scotland in partnership with Scottish Natural Heritage (SNH), the JNCC and others, designated 30 NCMPAs in July 2014. These NCMPAs were chosen based on:

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

Table 3-12 describes the closest NCMPAs to the Alligin Field and their qualifying features. Only the Faroe-Shetland Sponge Belt NCMPA is expected to be impacted by the proposed project.

Table 3-12: NCMPAs/pMPA in close proximity to the proposed project (JNCC, 2015b; JNCC, 2017e).

Area	Qualifying Features	Approximate distance from blocks (km)
Faroe-Shetland Sponge Belt	See Section 3.5.3.1.	Development lies within site
West of Shetland Shelf	Offshore subtidal sands and gravel.	52
North-West Orkney	Sandeels, sandbanks, save wave fields representative of the Fair Isle Strait Marine Process Bedforms Key Geodiversity Area.	75
Papa Westray	Important site for supporting black guillemots and important example of a shelf carbonate system, supplying sands to beaches.	120
Mousa to Boddam	Sandeels, reefs, seacaves and harbour seals.	160
Fetlar to Haroldswick	Beds of maerl (coralline seaweed), horse mussels, black guillemot populations, kelp habitats.	165

3.5.3.1 Faroe-Shetland Sponge Belt NCMPA

The Faroe-Shetland Sponge Belt NCMPA covers an area of 5,278 km^2 and is designated for a number of features:

- Deep-sea sponge aggregations;
- *A. islandica* aggregations;
- Offshore subtidal sands and gravels;
- Continental slope;
- Continental slope channels, iceberg plough marks, prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity area;
- Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area.

The overall conservation objective of each of these features is to conserve them in a favourable condition.

Deep-sea sponge aggregations have been discussed previously in Section 3.4.2.1 whilst *A. islandica* is discussed in Section 3.4.2.2 and Section 3.5.5.

There are two distinct sedimentary communities within the NCMPA which are representative of offshore subtidal sands and gravels; one is found between 300 and 600 m and is characterised by a greater proportion

of cobbles and boulders; the second is found below 600 m, and is characterised by finer sands and muddy sands (JNCC, 2015b). As discussed previously in Section 3.3.3 the proposed Alligin Field Development project occurs in an area comprising gravel and sand with varying pebbles, cobbles and small to medium sized boulders which has been found to be typical of the Greater Schiehallion Area (Fugro, 2017 draft report). The proposed activities are not expected to impact on the finer sands and muddy sands found below 600 m.

The NCMPA also includes an area of continental slope. It is thought that the Faroe-Shetland Channel continental slope is important for maintaining the health and biodiversity of Scotland's Seas.

Five geodiversity features are included in the NCMPA which are representative of the West Shetland Margin palaeo-depositional system and the West Shetland Margin contourite deposits Key Geodiversity Areas. The sand and sediment wave fields in the West Shetland Margin contourite deposits were formed during interglacial periods and are unique to UK waters. Geodiversity features in the West Shetland Margin palaeo-depositional system were created in the last glacial period. During the last ice age, icebergs scoured the seabed leaving iceberg ploughmarks that remain on the sea floor. These iceberg ploughmark fields are associated with cobbles and boulders, which are ideal settlement points for deep-sea sponge aggregations.

Based on the information presented in Figure 3-10, the Greater Schiehallion Area (encompassing the proposed Alligin Field Development location) occurs within an area of iceberg plough marks. This is confirmed with observations made during the environmental surveys carried out at Schiehallion and Foinaven (see Section 3.3.3.1).

3.5.4 Species

The designation of fish species requiring special protection in UK waters is receiving increasing attention with particular consideration being paid to large slow growing species such as sharks and rays. A number of international laws, conventions and regulations as well as national legislative Acts have been implemented which provide for the protection of these species. They include:

- **The UK BAP** priority fish species (JNCC, accessed 2017a);
- **The OSPAR List of Threatened and/or Declining Species & Habitats** (OSPAR, accessed 2017);
- **The IUCN (International Union for Conservation of Nature) Red List of Threatened Species** (IUCN, accessed 2017).
- **The Wildlife and Countryside Act 1981** (which consolidates and amends existing national legislation to implement the Convention on the Conservation of European Wildlife and Natural Habitats **(Bern Convention)** and the Birds Directive in Great Britain) (JNCC, accessed 2017d). The

Wildlife and Countryside Act makes it an offence to intentionally kill, injure, possess or trade any animal listed in Schedule 5 and to interfere with places used by such animals for shelter or protection.

- **The EC Habitats Directive** (transposed into UK law through the Conservation of Habitats and Species Regulations 2010 in England and Wales and also the 1994 Regulations in Scotland).

Those species of fish that could potentially occur in the area of the Alligin Field are listed under the protection measures shown in Table 3-13.

Table 3-13: designation of fish species potentially occuring in the vicinity of the Alligin Field.

Species	UK BAP	OSPAR	IUCN	Bern Convention	Habitats Regulations
Allis shad (*Alosa alosa*)	✓	✓	Least Concern	✓	×
Twaite shad (*Alosa fallax*)	✓	×	Least Concern	✓	×
Angel shark (*Squatina squatina*)	✓	✓	Critically Endangered	✓ [1]	×
Atlantic salmon (*Salmo salar*)	✓	✓	Least Concern	✓ [2]	×
Common skate (*Dipturus batis*)	✓	✓	Critically Endangered	×	×
Basking shark (*Cetorhinus* maximus)	✓	×	Vulnerable	✓	×
Porbeagle shark (*Lamna nasus)*	✓	✓	Vulnerable	✓	×
Atlantic cod (*Gadus morhua*)	×	✓	Vulnerable	×	×

[1] = Applies in the Mediterranean only.
[2] = Does not apply in sea waters.

In addition, four marine mammal species listed under Annex II of the Habitats Directive occur in relatively large numbers in UK offshore waters:

- Grey seal (*Halichoerus grypus*);
- Harbour seal (*Phoca vitulina*);
- Bottlenose dolphin (*Tursiops truncatus*); and
- Harbour porpoise (*Phocoena phocoena*).

The bottlenose dolphin and harbour porpoise, like all the cetacean species found in UK waters, also have EPS status, along with several other marine mammals found in UK waters. Developers must therefore consider the requirement to apply for the necessary licences if there is a risk of causing any potential disturbance / injury to EPS.

Under the Habitats Regulations, it is an offence to deliberately disturb any European Protected Species (EPS), e.g. cetaceans, or to capture, injure or kill an EPS at any time. New projects / developments must demonstrate that they will not significantly disturb an EPS in a way that will affect:

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

3.5.5 Priority Marine Features (PMFs)

In addition to the list of features of nature conservation importance for which it is deemed appropriate to use area-based mechanisms (Marine Protected Areas) as a means of affording protection, as part of the Scottish MPA Project, SNH and JNCC have compiled a separate list of 80 habitats and species, termed PMFs which are considered to be of particular importance in Scotland's seas. The purpose of this list is to guide policy decisions regarding conservation in Scottish waters. The following PMFs species are potentially of highest relevance to the proposed Alligin Field Development (Tyler-Walters, 2016):

Mobile Species (fish)

- Blue whiting
- Norway pout
- Sandeel
- Mackerel

Mobile Species (cetaceans)

- Atlantic white-sided dolphin
- Harbour porpoise
- White-beaked dolphin
- Minke whale
- Risso's dolphin

Low or limited mobility species (benthos)

- *A. islandica*

A. islandica is identified within Block 204/20a (Defra, 2010) and has been discussed previously in Section 3.4.2.2. It is associated with the presence of small boulders and cobbles creating a suitable substrate for settlement. Sediment of this nature is identified in recent seabed surveys of the site (see Section 3.3.3). It is listed on the OSPAR list of threatened and/or declining species and habitats as under threat and/or in decline in the Greater North Sea and is a PMF (SNH, 2014; OSPAR 2017). The European range extends from Norway to the Bay of Biscay. Known locations of *A. islandica* are shown in Figure 3-18.

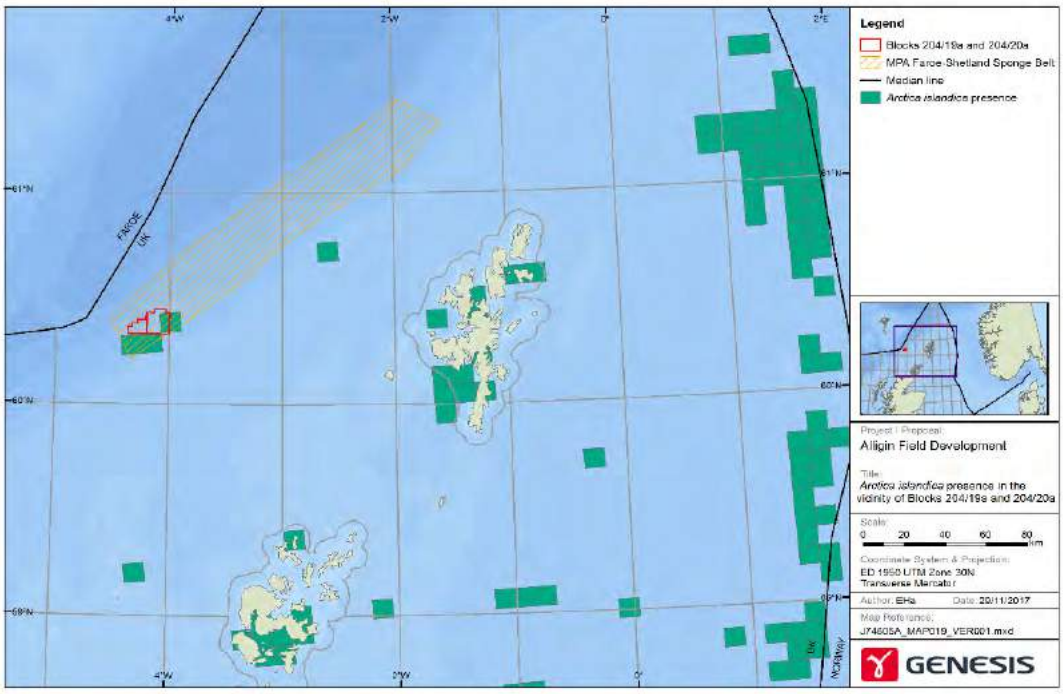

Figure 3-18: *A. islandica* presence in the vicinity of Blocks 204/19a and 204/20a (Defra, 2010).

3.6 Socio-Economic Environment

The need for a socio-economic assessment comes directly from the EIA regulations that require all new projects to consider both positive and negative socio-economic impacts in terms of benefits to the local communities and the country, along with the potential interface with existing industries and communities.

3.6.1 Social Impacts

Socially the impacts of the Alligin Field Development will be minor as it is a project super-imposed on a social system that is already adapted to the oil and gas industry. However, there are both short term and long term positive social benefits in relation to the continuation and creation of skilled jobs in the construction yards, on the offshore installation vessels, on the Glen Lyon FPSO, and within associated industries (road haulage, materials etc.). There will also be a need for project staff onshore to support the project. The project will help maintain employment in local services and supply industries and provide valuable monies into the economy.

3.6.2 Economic Impacts

First hydrocarbon from the Alligin Field Development are expected in Q1 of 2020. The field is anticipated to produce significant hydrocarbon reserves with the option to expand into the northern part of the field in the future. The positive impacts of this will be: the reduction in the UK's need to import hydrocarbons (making the UK less reliant on foreign oil and gas); the provision of increased revenue to the Exchequer; the provision of employment opportunities; and positive supply chain impacts.

3.6.3 Commercial Fisheries

Offshore structures have the potential to interfere with fishing activities as their physical presence may obstruct access to fishing grounds. Knowledge of fishing activities and the location of the major fishing grounds is therefore an important consideration when evaluating any potential impacts from offshore developments.

The International Council for the Exploration of the Sea (ICES) divides the north-east Atlantic into a number of rectangles measuring 30 nm by 30 nm. Each ICES rectangle covers approximately one half of one quadrant i.e. 15 license blocks. The importance of an area to the fishing industry is assessed by measuring the fishing effort which may be defined as the number of days (time) x fleet capacity (tonnage and engine power). It should be noted that fishing activity may not be uniformly distributed over the area of the ICES rectangle.

The proposed project area is located within ICES rectangle 49E5. Based on UK annual fishing effort for vessels > 10 m the UK annual fishing effort in these ICES rectangles can be considered low. The total fishing effort in 49E5 was 270 days in 2016 which constitutes 0.20% of the overall UK fishing effort in days[1] (Scottish Government, 2017). Figure 3-19 shows the average fishing intensity between 2012 and 2016. A more detailed breakdown of effort in days within ICES rectangle 49E5 and, more broadly, the UK total is given in Table 3-14.

[1] Note this value is based on landing values reported for ICES rectangles within which more than five UK vessels measuring 10 m were active. In those ICES rectangles where < 5 vessels were active the information is considered disclosive and is therefore not available.

Figure 3-19: Fishing effort in the WoS over five years (2012-2016) in the vicinity of the proposed project (Scottish Government, 2017).

Table 3-14: Annual fishing effort in ICES rectangle 49E5 (Scottish Government, 2017).

Year	UK Total Effort (days)	Effort (days) in 49E5	% of UK total
2012	185,182	411	0.22
2013	183,413	216	0.12
2014	129,850	234	0.18
2015	126,406	271	0.21
2016	133,319	270	0.20
Average	151,634	280	0.19

'Within year' fishing effort is detailed in Table 3-15. Generally, the majority of fishing effort takes place in the summer months between April and July. Data from 2012 – 2015 shows hook and line and trawls were the only gear types used in 49E5. In 2016 trawls were the main gear type used followed by hook and lines. Seine

nets were also used however the data is classified as disclosive and are not available (i.e. less than five vessels (>10 m) undertook fishing activity) (Scottish Government, 2017).

Table 3-15: 'Within year' fishing effort (2012 – 2016) (Scottish Government, 2017).

Year	J	F	M	A	M	J	J	A	S	O	N	D
2012	35	10	34	61	37	32	51	25	13	30	20	D
2013	D	13	12	17	25	24	19	16	14	39	23	D
2014	D	8	18	24	18	26	24	24	35	28	21	6
2015	21	D	9	16	27	43	26	19	13	18	36	40
2016	17	8	25	20	46	45	19	D	16	29	13	25
KEY:	**Disclosive data***		**≤ 20 days**		**21 – 30 days**		**31 – 40 days**		**41 – 50 days**		**>51 days**	

**If less than five vessels over 10 metres undertook fishing activity in the ICES rectangle the data is considered to be disclosive (D) and therefore not shown.*
***Note:** In Table 3-14 the total number of effort days for ICES rectangle 49E5 includes the months with disclosive data and the total therefore may not equal the number of days shown here.*

Figure 3-20 shows the annual landings between 2012 – 2016 of demersal, pelagic and shellfish species in ICES rectangle 49E5. Landings within this area were dominated by demersal fish species in terms of weight and value in all years (2012 – 2016) with exception to 2013 where live weight was dominated by pelagic species (Table 3-16)[2]. On average in 2016, the total landings of demersal fish contributed to 99.8% of the total value and 99.9% of the total weight in 49E5.

Table 3-16: Fishing landings from ICES rectangle 49E5 (Scottish Governement, 2017).

Species Type	2012		2013		2014		2015		2016	
	Value (£)	Live Weigh t (te)	Value (£)	Live Weigh t (te)	Value (£)	Live Weigh t (te)	Value (£)	Live Weig ht (te)	Value (£)	Live Weigh t (te)
Demersal	4,836,806	3,329	3,672,536	2,397	4,096,525	2,714	4,519,000	2,725	5,520,601	3,005
Pelagic	122	0.4	3,044,533	2,843	241,814	893	-	-	679	2
Shellfish	9,756	2	17,634	5	10,863	4	9,937	5	8,153	2
Total	4,846,684	3,331	6,734,702	5,245	4,349,202	3,612	4,528,938	2,730	5,529,432	3,009

[2] As for fishing effort data, reporting landing data provided refers to landings data by UK vessels over 10 m into UK ports where > 5 m vessels have been active.

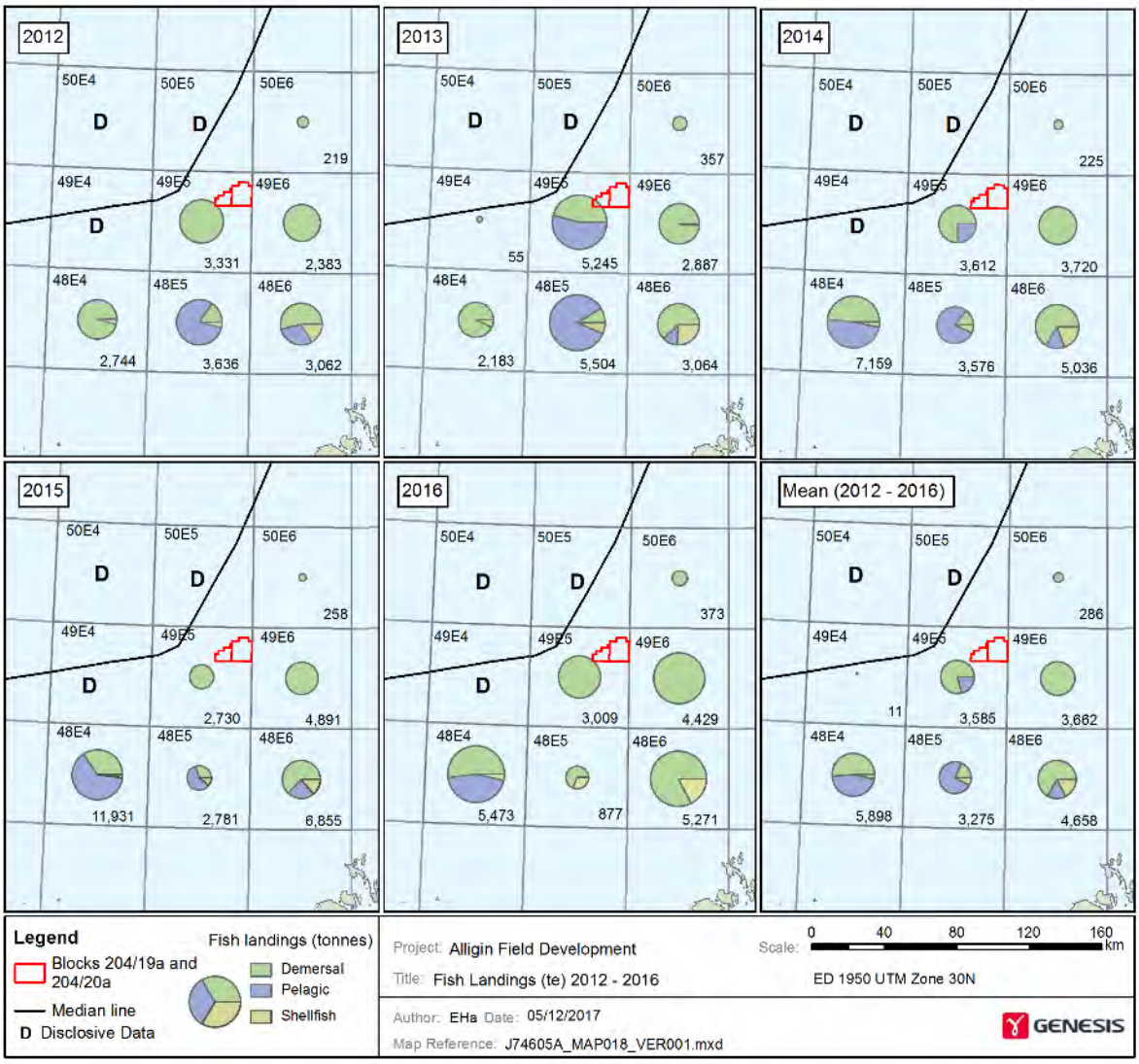

Figure 3-20: UK reported landings by quantity (te) within the Alligin region (2012 – 2016) (Scottish Government, 2017).

Amalgamated Vessel Monitoring Systems (VMS) data (2009 – 2013) for vessels ≥ 15 m within the Scottish zone of the UK Fishing limits (200 nm) has been combined with landings data to develop GIS layers describing the spatial patterns of landings by the Scottish fleet. The data shows the position, time at a position, and course and speed of fishing vessels (Kafas *et al*., 2012).

Figure 3-21 shows the fishing intensity by fishing vessels ≥15 m in length using different types of fishing gear (therefore targeting different species) in the North Sea using VMS data. It can be seen that the most intense fishing effort is concentrated in different areas dependent on the fishing gear used. Demersal mobile gear was the most intensely used within Block 204/19a and 204/20a whereas *Nephrops* fishing did not feature within close proximity to the proposed project.

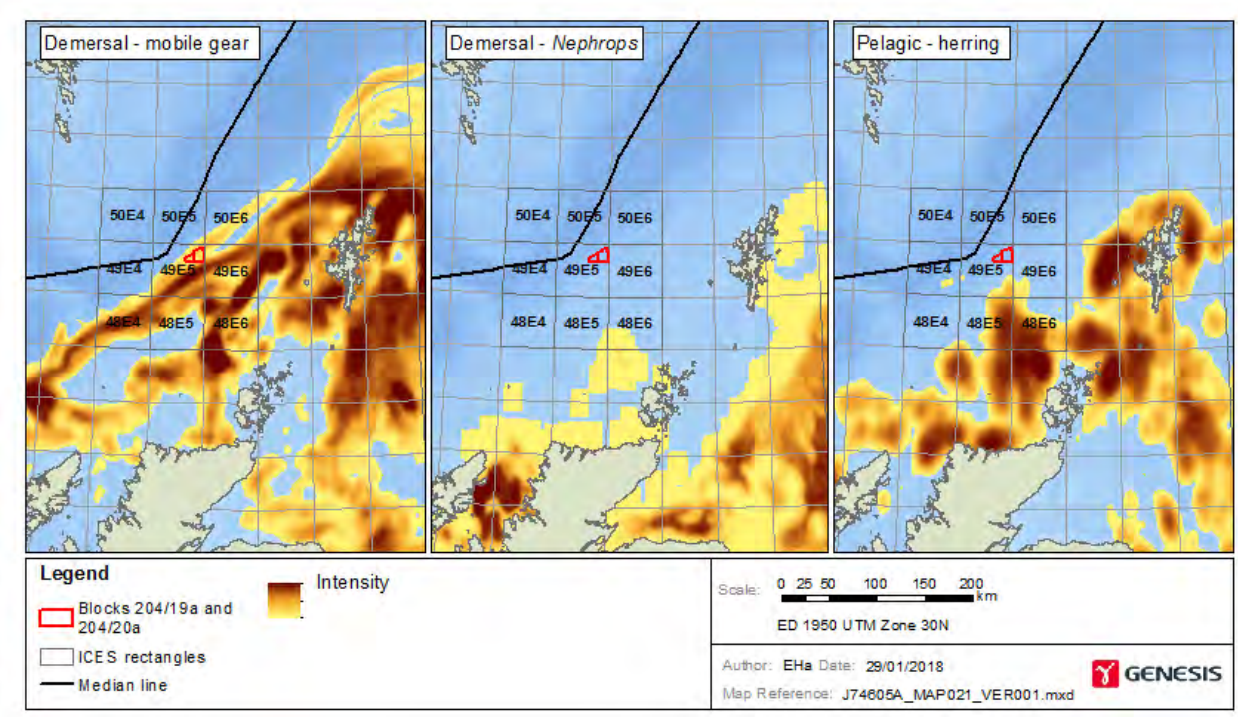

Figure 3-21: VMS combined data from 2009 – 2013 showing the fishing intensity of fishing vessels > 15 m in length off the WoS using demersal mobile gears, *Nephrops* mobile gears and pelagic herring gears (Kafas *et al.*, 2012).

Recent information on the activity of foreign fishing vessels in ICES rectangle 49E5 is not available, however, overflight surveillance sightings data assessed as part of the Quad204 development indicate significant levels of foreign vessel activity in the West of Shetland. The five most active countries (in addition to the UK) are Spain, Norway, France, Germany and the Faroes, with otter trawl being the most commonly used gear (SFF/Brown and May, 2010).

3.6.4 Aquaculture

The worldwide decline of ocean fisheries stocks has provided impetus for the rapid growth of aquaculture. For example, between 1987 and 1997 global production of farmed fish and shellfish more than doubled in weight and value (Naylor *et al*. 2000). The aquaculture industry is important to Scotland's economic growth, and is supported by the Aquaculture and Fisheries (Scotland) Act 2013 which aims to ensure that the interactions between farmed and wild fisheries are managed effectively to maximise their contribution to supporting sustainable economic growth.

The nearest finfish and shellfish farms to the proposed development are over 140 km away (Figure 3-22), around the coastlines of Shetland and Orkney which produce primarily salmon and mussels. They are not expected to be impacted by the routine operations, however the sites may be at risk in the event of an accidental spill.

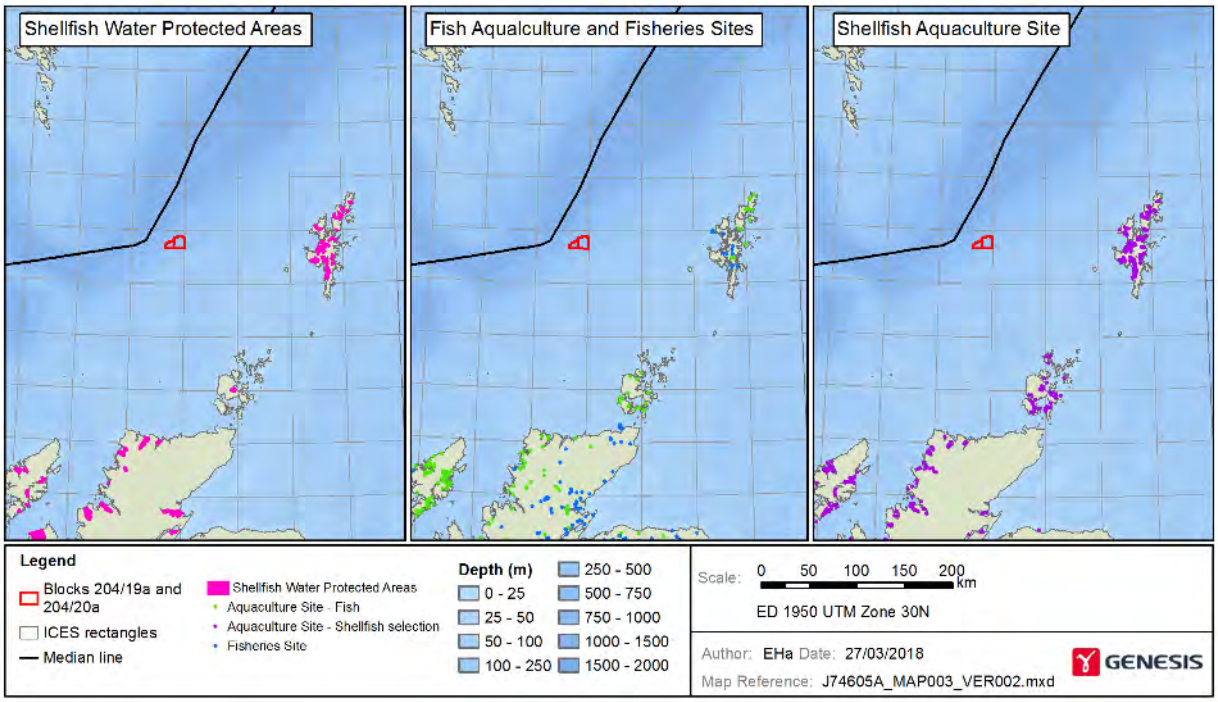

Figure 3-22: Location of Shellfish Water Protection Sites, finfish and shellfish aquaculture sites in relation to the Alligin Field.

3.6.5 Shellfish Water Protection Sites

The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013 provides for the protection of water bodies in Scotland for a number of special purposes, including shellfish harvesting. This recognises the need for clean water in shellfish production areas to ensure a good quality product which is safe for human consumption. A number of sites have been designated on the Shetland and Orkney Islands (Figure 3-22). Water bodies can be impacted by pollution from various sources, such as run-off from agricultural land or discharges from sewage treatment works. These sites are not expected to be impacted by the routine operations, however they may be at risk in the event of an accidental spill.

3.6.6 Shipping

The North Sea contains some of the busiest shipping routes in the world, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic. Shipping activities in the North Sea / WoS are categorised by OGA (2017b) to have either: very low; low; moderate; high; or very high shipping density. The shipping activity within Blocks 204/19a and 204/20a is considered to be low to very low as shown in Figure 3-23 (OGA, 2017b).

In support of the Consent to Locate application for Alligin, Anatec were commissioned to carry out a vessel traffic study to assess the impact of the proposed development on shipping. The study presents details of all shipping routes passing within 10 nm of the Alligin drill centre. The study found that the highest trafficked areas are to the south east of Alligin (highest density) with the planned location being shielded from passing traffic by the existing oil facilities at Schiehallion (Anatec, 2018).

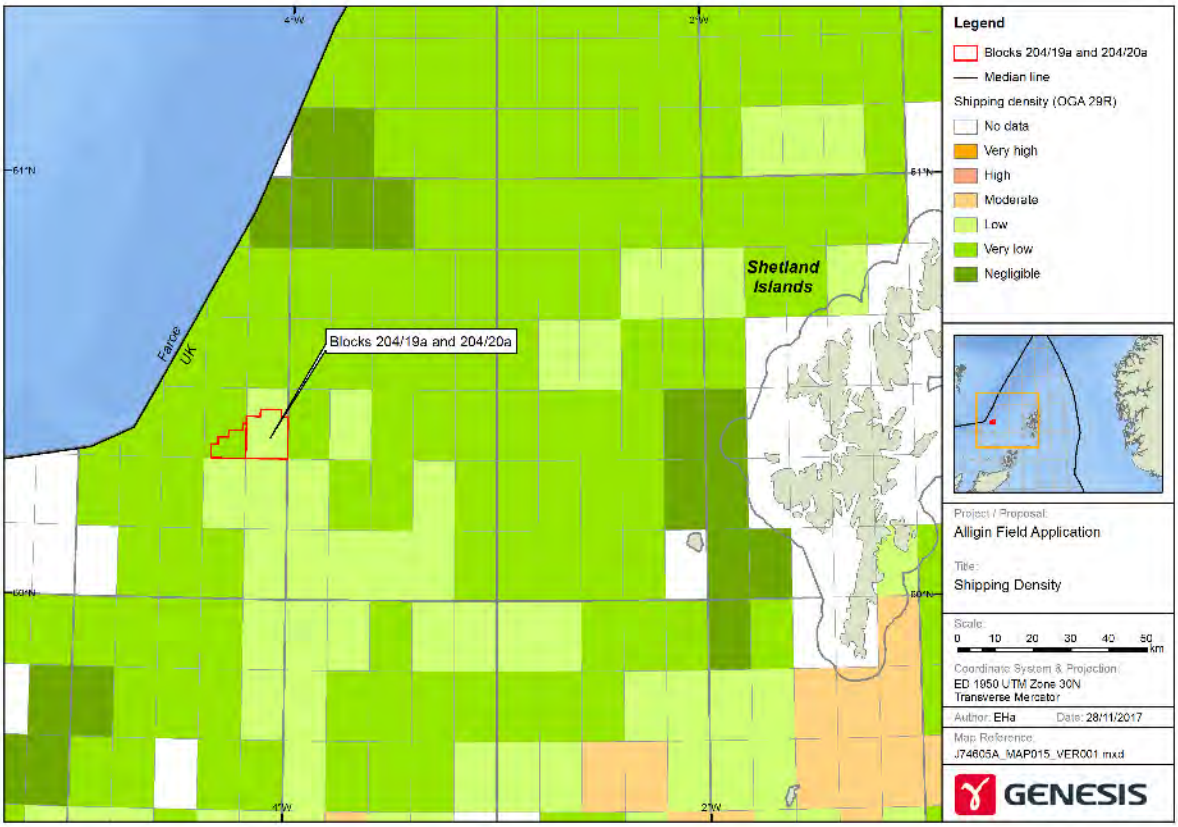

Figure 3-23: Shipping density as categorised by OGA (OGA, 2017b).

3.6.7 Submarine Cables

Every year, around 100-150 cases of cable damage are reported worldwide. Although some damage is from natural causes, most is caused by human interactions and can result in disruption of international communications (Shapiro *et al.,* 1997). There are no telecommunications cables within the Alligin Field. The closest active submarine telecommunications cable is located *c.* 5 km east of the blocks shown in Figure 3-24 (Scottish Government NMPi, 2017).

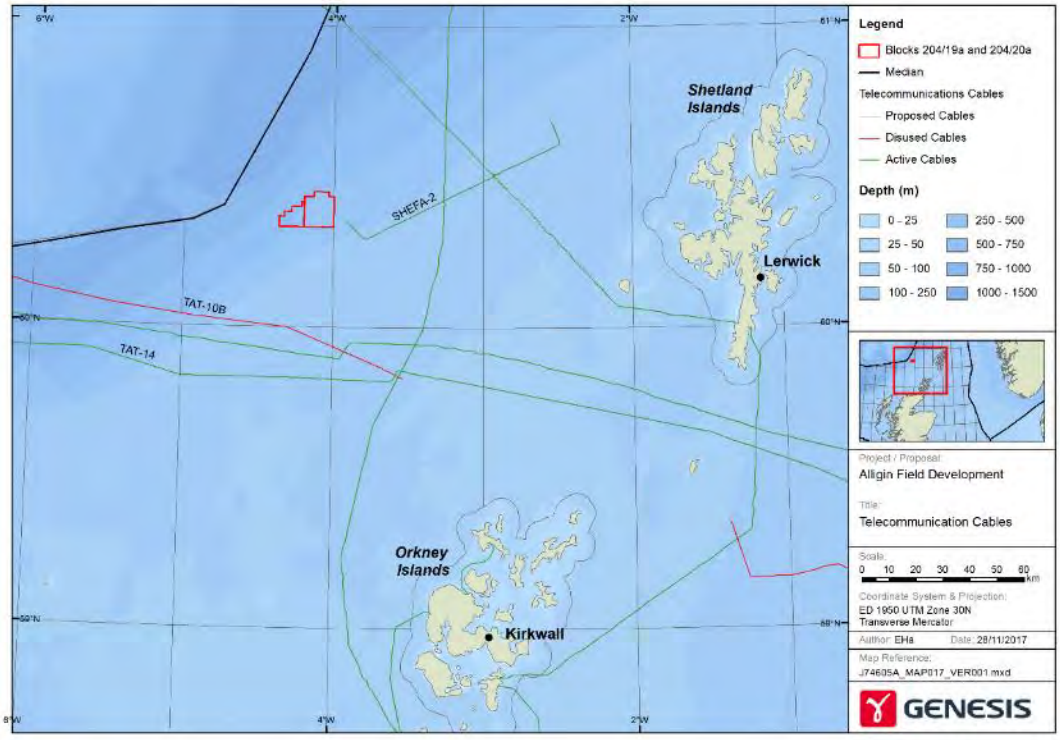

Figure 3-24: Telecommunication cables in the WoS (Scottish Government NMPi, 2017).

3.6.8 Oil and Gas Exploration

The Alligin Field lies within an area featuring some oil and gas infrastructure and activity. The closest surface installations to the project location is the Foinaven FPSO *c.* 5 km away. Other infrastructure locations are shown in Figure 3-25 and the corresponding distances in Table 3-17.

Anthropogenic activities can impact the seabed, the surrounding environment and species. Evidence of seabed scarring was observed in the majority of transects taken in an Environmental Survey at Schiehallion Central (*c.* < 2 km away from Alligin) (Gardline, 2017a). Anthropogenic debris (plastic rings, sheeting and gloves) were observed in two still images and four video snapshots. Pipelines could also be identified in six still images and six video snapshots.

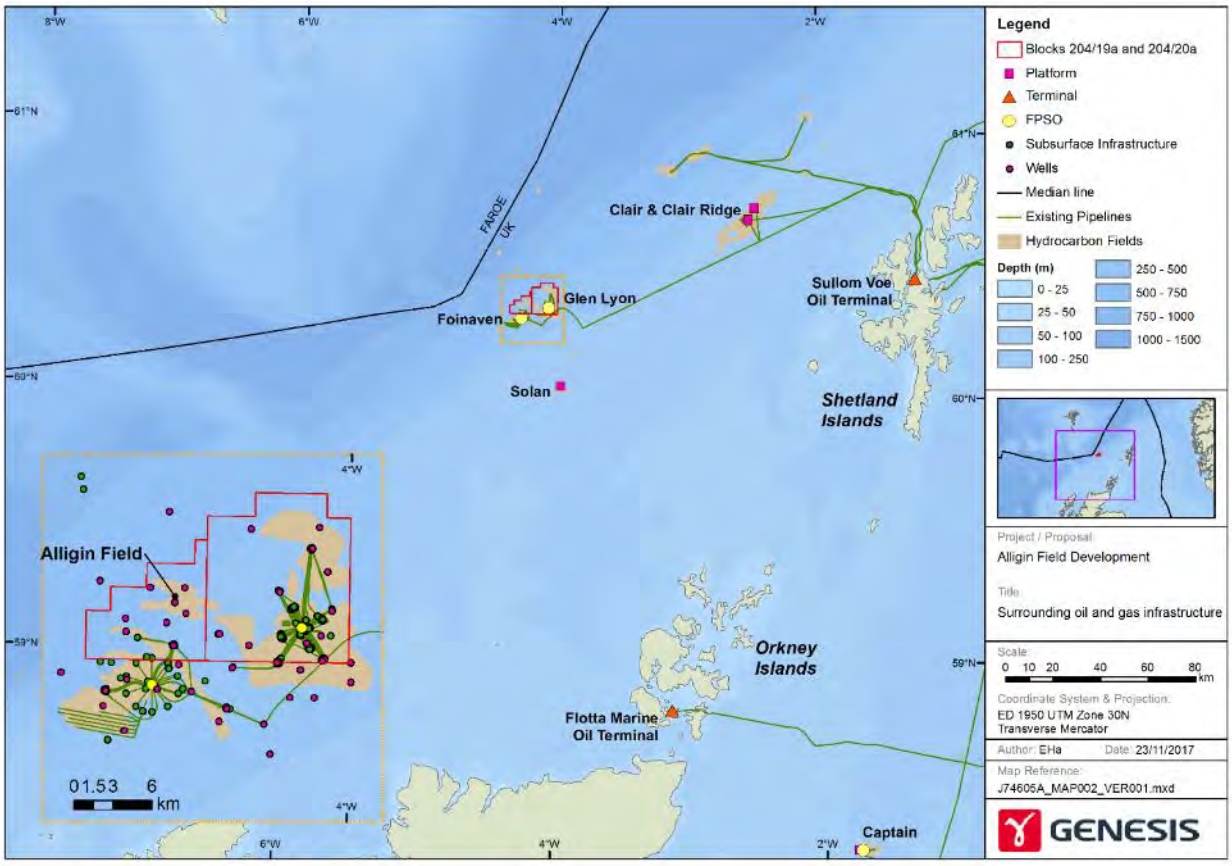

Figure 3-25: Existing oil and gas installations within the vicinity.

Table 3-17: Approximate distance of neighbouring installations to the development.

Installation	Approximate Distance (km)
Foinaven FPSO	5
Glen Lyon FPSO	6
Solan Platform	32
Clair Platform	96

3.6.9 Military Activities

There are no military exercise areas within Blocks 204/19a and 204/20a (Scottish Government NMPi, 2017).

4. ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1 Introduction

In order to determine the impact that the proposed Alligin Field Development may have on the environment an ENVironmental and socio-economic Impact IDentification (ENVIID) workshop was undertaken following a structured methodology. The purpose of the ENVIID was to identify the significance of the environmental and social risks associated with the planned activities and any possible unplanned events and to identify appropriate mitigation measures, controls and safeguards to minimise this risk.

During the workshop a number of aspects were considered for each activity:

- Physical presence;
- Emissions to air;
- Discharges to sea;
- Seabed disturbance;
- Noise and visual impact;
- Waste;
- Use of resources; and
- Unplanned events.

For each of the planned activities an environmental and/or social significance of risk is assigned for the relevant aspects by taking into account the duration of the activities (Section 4.2.1) and the severity of the impact (Section 4.2.2).

For unplanned events the environmental and/or social significance of risk ranking also takes into account the severity of the impact, however, rather than considering the duration of the event it takes account of the likelihood of the unplanned event occurring (Section 4.2.1).

4.2 BPEOC Environmental Risk Assessment Matrix

This section describes the risk assessment matrix used to determine the significance of the environment and social risks associated with the proposed project. A qualitative risk ranking method was generally applied to assess the risk based on the severity of the impact and the duration (planned activities) or likelihood (unplanned events) of its occurrence. However, where possible, estimates of some quantitative data such as atmospheric emissions and area of disturbed seabed are considered.

4.2.1 Activity Duration or Likelihood

The duration or likelihood of the occurrence of each potential effect was given a score between one and four (Table 4-1). The duration of planned activities is defined in Column 2; whilst the likelihood of an accidental event is defined in Column 3. A low score means that the duration (planned) of the activity is relatively short or that the likelihood (unplanned) of the event occurring is relatively low.

Table 4-1 Duration of a planned activity and likelihood of an unplanned event.

Duration / Likelihood Category	Duration of planned activity	Likelihood of an unplanned event
1	**Very short duration** • Cumulative events of duration less than 12 hours a year. • Single event with duration less than an hour.	**Unlikely** • Never heard of in the industry though potential to occur exists.
2	**Short duration** • Cumulative event of duration up to 3 days a year. • Single event with duration of up to a day.	**Low probability** • Incident has occurred in the industry such that there is definite potential for it to occur.
3	**Medium duration** • Cumulative events of duration up to 3 months a year. • Single event with duration of up to a month.	**Moderate probability** • Strong possibility of occurrence and incident has / is expected to occur in BP.
4	**Long duration** • Cumulative or single events of duration up to continuous/ongoing.	**High probability** • Incident is almost certain to occur and has / is expected to occur several times per year in work location.

4.2.2 Severity of Impacts

The severity of each potential environmental / social impact was also rated on a scale of 1 to 4, four being the most severe (Table 4-2). Where severity appeared to fall within two categories, the higher category was selected to provide a worst case scenario for the purposes of this assessment.

Table 4-2 Severity of Impacts.

Impact Severity	Environmental	Social
4	• Irreparable, widespread damage to the environment. • Widespread and long-term damage to the regional marine ecosystem. • Major contribution to a known global or regional air pollution issue. • Major degradation of local air quality, prejudicial to human health.	• Long term or widespread damage to fisheries industry. • Physical resettlement of a community. • Workers exposed to modern slavery practices (e.g., passport retention, paying exorbitant recruitment fees, no contracts). • Destruction of, or severe damage to, iconic international cultural heritage such as World Heritage Site, or iconic national heritage.
3	• Significant elevation in ambient pollutant levels relative to air quality guidelines. • Significant damage or impact to local environment and / or protected species or habitat, reparable over the longer term. • Significant contribution to a known global or regional air pollution issue. • Significant impact to local air quality.	• Damage to fishing area, resulting in medium term suspension of fishing activity. • Large scale land acquisition programme leads to lost income for many land owners and users. • Serious deficiencies in labour rights e.g. salaries delayed and below minimum wage, non-compliances with working hours and leave, no workforce grievance mechanism.
2	• Detectable degradation of the environment, reparable over the longer term. • Small contribution to global or regional air pollution issue and/ or elevation in pollutant levels relative to air quality guidelines.	• Localised damage to fisheries industry causing negligible impact to fishing activities. • Localised impact to community safety, e.g. vessel routing/ traffic. • Some inadequate employment practices, poor quality of some worker accommodation and sanitation, inadequate workforce grievance mechanism. • Damage to important national or regional cultural heritage.
1	• Undetectable or limited local degradation of the environment, rapidly returning to original state by natural action. • No significant contribution to global or regional air pollution problem. • Minor elevation in ambient pollutant levels within air quality guidelines.	• Small levels of community disturbance impact e.g. noise, vibration, lighting from vessels. • Limited impact to fishing industries. • Limited/ no long term impact or damage to locally recognised cultural heritage

4.2.3 Combining Duration/Likelihood and Severity of Impact to Establish Risk

The significance of the environmental / social risk is determined by combining the duration (planned activity) / likelihood (unplanned event) and the severity of the impact using the matrix in Table 4-3.

Table 4-3: Risk significance matrix.

		Duration (planned activity) / Likelihood (unplanned event)			
		1	2	3	4
Severity of Impact	4				
	3				
	2				
	1				

Definition of categories of risk significance	
Negligible significance	Risks are acceptable when managed within the scope of existing controls and mitigation measures as described.
Minor significance	Risks are acceptable when managed within the additional controls and mitigation measures as described.
Moderate significance	Risks are acceptable provided the risks are reduced to ALARP, and managed under the additional controls and mitigation measures as described.
Major significance	For planned activities, risk of impact cannot be justified under the given criteria. For unplanned events, frequency of event must represent a tolerable level of likelihood, in addition to being reduced to ALARP and managed under the additional controls and mitigation measures as described.

4.3 Assessment of Significance of Environmental and Social Risks

Using the information provided in Sections 2 and 3 and the criteria set out above, Appendix C identifies all activities associated with the proposed Alligin Field Development and their potential environmental risk.

Appendix C is split into five sections:

- Vessel use during drilling, installation and commissioning activities;
- Drilling operations;
- Subsea installation and commissioning;
- Topside modifications; and
- Production.

Table 4-4 identifies those aspects / activities found to have a moderate or major significance of risk after mitigation measures /safeguards have been applied.

Table 4-4: Activities identified to have a moderate or major significance of risk.

Aspect	Activity	Significance of risk following mitigation
Seabed disturbance	Installation of subsea infrastructure e.g. manifolds, FTA, pipelines, umbilicals, jumpers, stabilisation features etc.	Moderate
Seabed Disturbance	Discharge of drill cuttings and associated WBMs.	Moderate
Unplanned / accidental events	Release of hydrocarbons / chemicals to sea (e.g. from drains, bunkering operations etc.).	Moderate
	Major release to sea of drilling rig fuel hydrocarbon inventory in the result of a vessel collision.	Moderate
	Well blowout (uncontrolled hydrocarbon release in the event of loss of well control).	Major
	Alligin flowline rupture and subsequent release of hydrocarbons to sea.	Moderate

The assessment showed that with the application of industry standard mitigation measures the majority of the planned activities are anticipated to have a negligible or minor environmental/social significance risk. Only two of the planned activities are considered to have an environmental risk of moderate significance, whilst none are considered to be of major significance.

As with the planned activities the significance of risk associated with the majority of the unplanned events identified were found to be negligible or minor following the application of mitigation measures/safeguards which reduced the likelihood of the events occurring. Three were found to be of potential moderate significance and one was considered to lead to an environmental risk considered to be of major significance (see Table 4-4).

Sections 5 – 10 further assess the impacts of the aspects/activities that:

- Are subject to regulatory control;
- Were found to pose a moderate or major risk significance to the environment;
- Were raised during the consultation phase; or
- Were identified as areas of public concern.

Section 11 presents the results of modelling carried out to determine the impact of a major hydrocarbon loss.

5. PHYSICAL PRESENCE

This section discusses the potential impacts associated with the physical presence of:

- the vessels and drilling rig associated with the proposed Alligin Field Development Project; and
- all subsea infrastructure

on other sea users and animals (other than the benthic species) using the risk assessment methodology presented in Section 4. The impacts on the seabed and the local benthic communities are discussed in Section 8 'Seabed Disturbance'.

5.1 Presence of Vessels and the Drilling Rig

The vessels required for the drilling, installation and commissioning activities associated with the proposed subsea tie-back development are expected to include: AHVs, survey vessels, construction support vessels, a rock dump vessel and supply vessels (see Tables 2-8 and 2-11). The Deepsea Aberdeen drilling rig will be on location for *c.* 200 days and an ERRV will patrol the area while the drilling rig is on location. The physical presence of the vessels and drilling rig could potentially result in navigational hazards, a restriction of fishing operations, and disturbance to marine mammals and seabirds.

During routine production operations (after drilling, installation and commissioning activities) the number of vessels present in the Schiehallion area will not significantly increase as a result of the proposed Alligin tie-back.

5.1.1 Impact of Vessels and Drilling Rig on Other Sea Users

When compared to shipping levels throughout the North Sea, shipping levels in the area are considered to be low or very low (see Section 3.6.6). A vessel traffic survey produced in Q1 2018 (Anatec, 2018) found that 14 shipping routes passed within 10 nautical miles (nm) of the proposed Alligin drill centre equating to less than two vessels per day. Of these 14 shipping routes, none were found to occur within 2 nm of the proposed drill centre location.

As the proposed project is located in close proximity to a well-developed oil and gas area, the increase in vessel traffic required for the drilling and installation activities is not anticipated to result in a significant change to existing levels.

To minimise navigation hazards, all vessels engaged in the project operations will have markings and lightings as per the International Regulations for the Prevention of Collisions at Sea (COLREGS) (International Maritime Organisation (IMO), 1972) and vessel use will be optimised where possible.

The Deepsea Aberdeen is equipped with marine navigational aids and an aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations (Health and Safety Executive (HSE), 2009), to warn ships and aircraft of their position. The systems comprise:

- Marine navigation lights;
- Fog-lights
- Aviation obstruction lights;
- Helideck beacons (helideck status light system)
- Fog-horns;
- Fog detector;
- Helideck lighting;
- Radar beacons.

As required by HSE Operations Notice 6 (HSE, 2014), a rig warning communication will be issued at least 48 hours before any rig movement. Notice of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the drilling rig will be sent to the Northern Lighthouse Board (NLB). The drilling rig routes will be selected in consultation with other users of the sea, with the aim of minimising interference to other vessels and the risk of collision. Prior to commencement of offshore activities, BPEOC will apply for a 500 m exclusion zone at the drilling location to mitigate any collision risk and an ERRV will patrol the Greater Schiehallion Area. In addition, a CtL permit application will be submitted to BEIS.

The proposed Alligin Field Development will be located within ICES rectangle 49E5. The information presented in Section 3.6.3 suggests that fishing effort within this rectangle is relatively low. BPEOC have been in consultation with SFF regarding the proposed project (see Section 1.9) and will continue to consult with the SFF throughout the project to discuss any potential concerns from the fishing industry.

The proposed Alligin Field Development Project will be located within an Offshore Development Area[1] which encompasses the Schiehallion, Loyal and Foinaven Fields (Figure 5-1). This Offshore Development Area has previously been submitted to the Hydrographic Office, Kingfisher (information service provider to sea users and is therefore charted) and the MoD and warns other sea users of increased vessel activity and potential seabed obstructions. The chart (Kingfisher) notes that surface vessels, subsea craft and divers may engage in operations within the area but that other vessels are strongly advised to keep outside the charted limits.

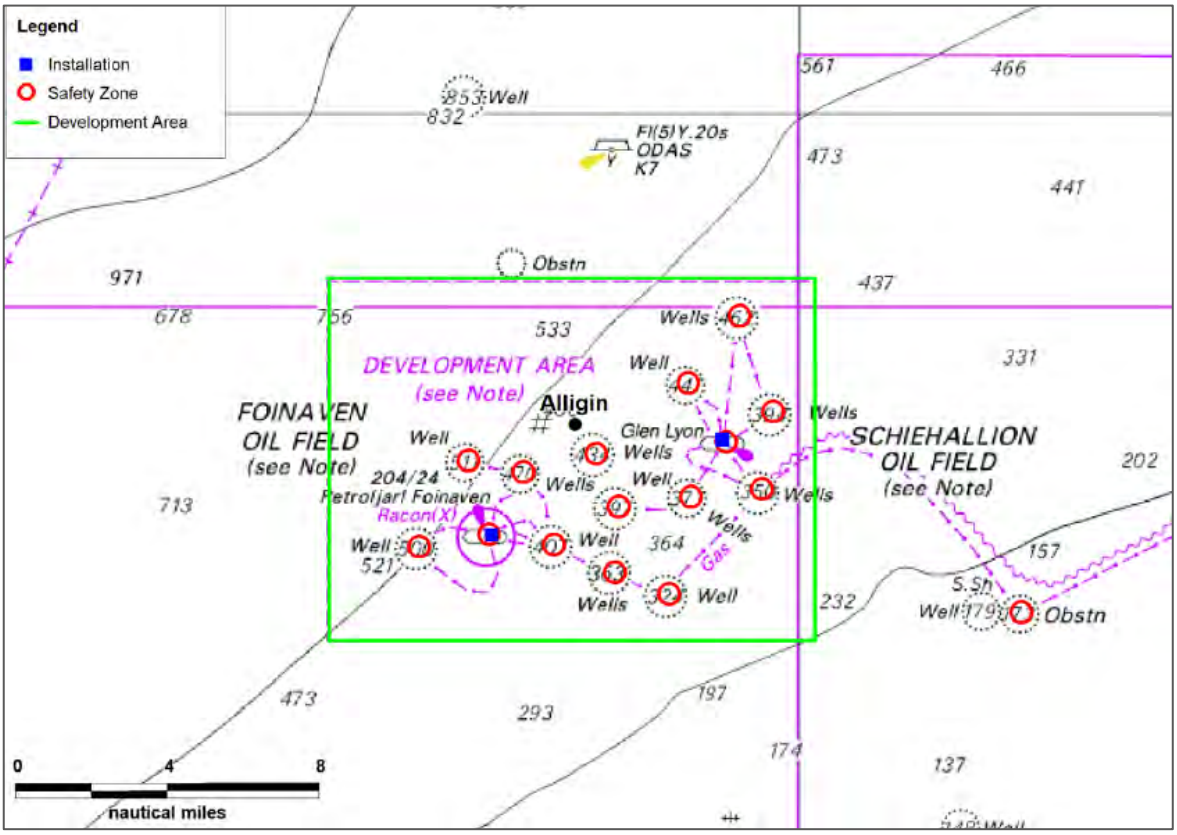

Figure 5-1: Location of the Offshore Development Area (green box).

[1] Offshore Development Areas were introduced in 1980 as a means of advising mariners not to enter particular areas because of the high levels of activity associated with the establishment of offshore installations.

Given the relative low shipping and fishing activity within the area; the use of navigational aids; the application of a 500 m zone at the drilling location; the submission of a CtL and BPEOC's commitment to keeping the NLB up to date on any drilling rig moves and potential schedule changes; the close proximity to a well-developed oil and gas area; BPEOC's commitment to only using vessels adhering to the COLREGS, and the restriction of activities to within an existing Offshore Development Area, the social impact of the presence of the vessels and drilling rig is considered to be (1), however the environmental risk is considered to be minor due to the duration (ranked as 4) of the activities.

5.1.2 Impact of Vessels and Drilling Rig on Marine Mammals

Note the impact of underwater noise associated with vessels and drilling activities are discussed in Section 9. This section discusses the physical presence of the vessel and rig. From Section 3.4.5 it can be seen that a number of marine mammals occur in the area which could be disturbed by the increase in vessel traffic. In addition, there could be an increased risk of injury to marine mammals through vessel strikes.

As the proposed project is within a well-developed oil and gas area, it is likely that marine mammals have been habituated to vessel activity in the area. In addition, the evidence for lethal injury from boat collisions with marine mammals suggests that collisions with vessels are very rare (Cetacean Stranding Investigation Programme (CSIP), 2011). Out of 478 post mortem examinations of harbour porpoise in the UK carried out between 2005 and 2010, only four (0.8 %) were attributed to boat collisions.

It is likely that the noise generated by the vessels will deter marine mammals from the immediate vicinity and therefore collisions with vessels are unlikely such that the environmental impact associated with potential marine mammal and vessel collisions is considered to be (1) however the environmental risk is considered to be minor due to the duration (ranked as 4) of the drilling activities.

Marine mammals may be attracted to installations due to increased prey abundance (Todd *et al*. 2009); however, no evidence of impacts of installations on marine mammals on the UKCS have been reported.

Cetaceans are anticipated to quickly adapt to the presence of the drilling rig, which will occupy a very small proportion of their overall available habitat such that the environmental impact of the presence of the drilling rig is considered to be (1), however the environmental risk is considered to be minor due to the duration (ranked as 4) of the drilling activities.

5.1.3 Impact of Vessels and Drilling Rig on Birds

As described in Section 3.4.4 a number of bird species are found in the Alligin Field area. Many of these birds will travel to the area from the SPAs that are found along the coastal regions of the Shetland and Orkney Islands (see Section 3.5.2).

The vessels and drilling rig have the potential to cause displacement of seabirds from foraging habitat and may cause flying birds to detour from their flight routes. For example, auk species (e.g. guillemot, little auk) are believed to avoid vessels by up to 200 to 300 m but gull species (e.g. kittiwake, herring gull and great black-backed gull) are attracted to the presence of them (Furness and Wade, 2012). Seabird densities in the North Sea are reported to be seven times greater within 500 m of a platform. Lights are known to attract seabirds, however increased food availability at the installation and the availability of roost sites may also be a factor (Weise *et al*. 2001).

Though evidence suggests that the presence of the vessels and the Deepsea Aberdeen could cause some bird species to be displaced from their foraging area, the very small proportion of their overall available habitat that will be occupied by the vessels and drilling rig means the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area, and the relatively close proximity to the Glen Lyon and Foinhaven FPSOs it is expected that the impact of the vessels and drilling

rig on bird migration routes is not expected to be significant. Therefore, the environmental impact of the presence of the vessels and drilling rig on birds is considered to be (1) whilst the environmental risk is considered to be minor due to the duration (ranked as 4) of the drilling activities.

5.2 Presence of Subsea Infrastructure

All subsea infrastructure including the wellheads, Xmas trees, pipelines, control umbilical and pipeline protection materials (concrete mattresses, grout and/or sand bags, rockdump) have the potential to impact fishing operations and wildlife as a result of their physical presence.

5.2.1 Impact of Subsea Infrastructure on Other Sea Users

The majority of the fish caught in ICES rectangle 49E5 by UK vessels are demersal species (see Section 3.6.3). Many of the fishing gears used to catch these species are towed along the seabed such that they may impact on any subsea structures that they come into contact with.

As discussed in Section 2.3.3 the option to surface lay the pipelines and umbilical was selected for a number of reasons including the fact that it aligns with the existing Greater Schiehallion Area pipe lay philosophy. The 16" pipeline trawl gear loading will be assessed in accordance with DNVGL-RP-F111 and the pipeline will be designed to Safebuck III guidelines for buckling. The 10/16" OD production pipe-in-pipe system will be designed to meet the requirements for potential impact loads such as those associated with trawl gear interference. With respect to the smaller diameter flexible flowlines and umbilical it is expected that the reduced diameter and relatively low submerged weight means that snagged fishing gear will displace the flowline, both laterally and vertically. This increases the likelihood of the fishing gear releasing and thus not causing serious damage to the flowlines or the gear.

As discussed in Section 2.7.2 where subject to fishing interaction, the Alligin structural design shall adopt the same approach as the Greater Schiehallion Area such that the manifold and trees are designed using the loads / energies specified in NORSOK U-001 and are designed to be fishing friendly i.e. non-snaggable but not over-trawlable. The designs will allow removal of snagged fishing gear by simple reversal or 'backing-up' of the fishing gear.

As mentioned the Alligin Development Project is located within an Offshore Development Area which, in addition to warning other sea users of increased vessel activity, also warns them of potential seabed obstructions and strongly advises that vessels other than surface vessels, subsea craft and divers keep outside the charted limits.

A 500 m exclusion zone will also be in place at the Alligin drill centre. The FTA and splitter manifold on the production flowline will be installed within the existing Loyal 500 m zone. Installation of these structures within the 500 m exclusion zone will prevent fishing gear interaction.

As described in Section 2.7.4 mattresses and 25 kg grout bags will be used to protect the tie-in jumpers, FTPs and EFLs. In addition, they will be laid to protect existing infrastructure at the Loyal, North West and DUTA D30 drill centres, over which the Alligin infrastructure will be laid. In addition, it is possible that some spot rock cover may be required to mitigate spans. Use of stabilisation features will be minimised and any rock cover required will be laid accordance with industry practice which is also the preferred SFF best practice.

Prior to installing the subsea infrastructure, the project will apply for a Pipeline Works Authorisation (PWA), including a Deposit of Materials; and the development will comply with any notification requirements associated with the PWA approval. This will include the positions of any pipelines and control tie-backs. The project will submit a CtL application to BEIS including the results of an up to date vessel traffic survey and

collision risk assessment. The location of all infrastructure to be installed will be submitted for inclusion on the admiralty charts.

Given that the proposed project occurs within an existing Offshore Development Area and that the pipelines, umbilical and subsea structures will be designed to industry standards to minimise snagging by fishing gear, the social impact of the proposed development is considered to be (1), however given the length of time the infrastructure will be in place (ranked as 4) the environmental risk is considered to be minor.

5.2.2 Impact of Subsea Infrastructure on Marine Mammals and Fish

Marine mammals and fish in the area are anticipated to adapt to the presence of the subsea infrastructure, which will occupy a very small proportion of their overall available habitat. The environmental impact associated with the physical presence of the subsea infrastructure on animals other than the benthic communities in the area is therefore considered to be (1) however given the length of time the infrastructure will be in place (ranked as 4) the environmental risk is considered to be minor.

Note, the impact on the benthic communities is discussed separately in Section 8 ‘Seabed Disturbance’.

5.3 Decommissioning Phase

At CoP the Alligin infrastructure will be decommissioned as part of a Decommissioning Programme incorporating Alligin along with the Schiehallion and Loyal fields. At the commencement of the decommissioning activities, vessel activity in the area will increase relative to the number of vessels typically present in the area of the development during the production phase. All decommissioning activities will occur within the Offshore Development Area such that they are not expected to significantly impact shipping and fishing activities in the area at the time.

Subject to a Comparative Assessment and Decommissioning Programme it will be technically feasible to recover the Xmas trees, PLEM, splitter manifold, FTA, UETs tie-in jumpers, FTPs and EFLs. Where feasible the mattresses and grout bags will also be recovered. It is likely that the surface flowlines and umbilicals will also be recovered at end of field life, however in line with current BEIS draft guidance (BEIS, 2017: note guidance was still in draft at the time of submission of the ES), a Comparative Assessment will be carried out to determine the optimal approach.

Following decommissioning, over trawl trials or surveys (e.g. side scan sonar) will carried out along the pipeline and umbilical routes and within the Alligin 500 m exclusion zone to ensure a clear seabed. Following decommissioning, and subject to legislation and guidance in force at that time, the Alligin Field Development tie-back will surrender the exclusion zone.

5.4 Cumulative and Transboundary Effects

The Alligin project activities will occur in proximity to a well-developed oil and gas area and will result in a modest increase in activity as a result of additional vessel movements. Given that these activities will occur within a well-established area for oil and gas activity and will be short term in nature, cumulative impacts are not expected.

The proposed Alligin Field Development will be located *c.* 20 km from the UK/Faroe median line and therefore no transboundary impacts associated with the physical presence of the drilling rig or vessels are expected.

5.5 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with the physical presence of the vessels, semi-submersible drilling rig, and subsea infrastructure associated with the proposed Alligin development.

Proposed Mitigation Measures

- Ongoing consultation with SFF;
- Notice to Mariners will be circulated prior to rig mobilisation;
- Notice will be sent to the NLB of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the semi-submersible drilling rig;
- The Deepsea Aberdeen drilling rig will abide by CtL conditions;
- A Collision Risk Management Plan will be produced if determined to be required;
- All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.;
- The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations;
- Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site;
- Flowlines will be designed in accordance with industry standards to minimise buckling and to minimise interactions with fishing gear;
- All infrastructure will be laid within an existing charted Offshore Area Development;
- A 500 m safety zone will be applied for at the Alligin drill centre whilst the infrastructure at Loyal will be laid within the existing 500 m exclusion zone at that drill centre; and
- The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with industry SFF best practice.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the physical presence of the vessels, drilling rig and subsea infrastructure associated with the proposed development is considered to be of a minor social risk. In addition, the environmental risk in relation to marine mammals, birds and fish is considered minor (the environmental risk in relation to benthic species in considered separately in Section 8). The environmental and social risks are therefore considered acceptable when managed within the additional controls and mitigation measures described.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

6. EMISSIONS TO AIR

Gaseous emissions can contribute to global atmospheric concentrations of greenhouse gases, regional acid loads, poor air quality and ozone depletion with the main pollutants of concern being carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), methane (CH_4) and volatile organic compounds (VOCs). These pollutants, associated with fuel use, will all be produced during the drilling, installation, commissioning and operational phases of the proposed Alligin Field Development Project. This section describes and quantifies the sources of emissions during each phase of the proposed development. Using the risk assessment methodology presented in Section 4, the environmental risk of the anticipated project emissions is determined.

6.1 Drilling Phase

6.1.1 Exhaust Emissions from the Drilling Rig and Support Vessels

This section discusses the potential environmental impacts associated with the emissions associated with the drilling rig and support vessels.

Table 2-8 presents the anticipated maximum number of days that the Deepsea Aberdeen and supporting vessels will be on location. Table 6-1 summarises the predicted emissions from the drilling rig. It can be seen from the table that the emissions from diesel use by the drilling rig represent *c.* 0.98 % of the CO_2 emissions associated with diesel use by drill ships, semi-submersibles and Heavy Duty Jack-Up (HDJU) drilling rigs in 2015. Relative to other UKCS emissions associated with drill rigs, the environmental impact associated with these emissions is considered to be (1); however, given the duration of the activities (ranked as 4) the environmental risk is considered minor.

Table 6-1: Estimated emissions associated with diesel consumption of drilling rig.

	Total fuel use (Te)	Te						
		CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Emissions associated with the drilling rig (estimated at 200 days)	2,000	6,400	119	0.44	8	31.40	0.36	4
Emissions from diesel use on drill ships, semi-submersibles and HDJU on the UKCS in 2015[1]		656,181	12,064	66	724	3,140	45	700
Rig emissions as a % of the 2015 total		0.98	0.99	0.67	1.10	1.00	0.80	0.57

[1]EEMS data 2015.

Table 2-8 summarises the fuel use associated with the drilling support vessels whilst Table 6-2 provides an estimate of the associated emissions. It can be seen from the Table 6-2 that emissions from diesel use by the drilling support vessels represents approximately 0.06 % of the CO_2 emissions associated with domestic and international shipping in 2014. Relative to other UKCS emissions associated with vessels the environmental impact associated with these emissions is considered to be (1). However, given the duration of the activities (ranked as 4) the environmental risk is considered minor. Relative to other UKCS emissions associated with flaring, the environmental impact associated with these emissions considered to be (1); however, whilst the environmental risk is considered negligible given the relatively short duration of the activities (ranked as 2).

Table 6-2: Estimated emissions associated with the drilling support vessels.

	Total fuel use (Te)	Te						
		CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Total emissions associated with drilling support vessels	1,935	6,196	115	0.43	8	30	0.35	4
Approximate shipping emissions in UK waters (domestic and international) 2014[1]		9,900,000	-	-	-	-	-	-
Annual emissions from drilling support vessels as a % of shipping emissions in UK waters		0.06	-	-	-	-	-	-
[1]Committee on Climate Change (2015)								

6.2 Installation Phase

Table 2-11 describes the vessels required for the installation of the subsea infrastructure associated with the proposed development. The anticipated emissions associated with these vessels are shown in Table 6-3. The predicted CO_2 emissions associated with these vessels is *c.* 11,872 te. To put these CO_2 emissions into context, they are presented as a percentage of the overall CO_2 emissions from shipping emissions in UK waters and are anticipated to represent *c.* 0.12 % of CO_2 emissions from shipping such that the environmental impact associated with these emissions considered to be (1). However, given the duration of the activities (ranked as 4) the environmental risk is considered minor.

Table 6-3 Estimated vessel emissions associated with the subsea installation activities.

	Total fuel use (te)	Te						
		CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Subsea installation vessels	3,710	11,872	220	0.82	15	58	0.67	7
Shipping emissions in UK waters (domestic and international) 2014[1]		9,900,000	-	-	-	-	-	-
Installation support vessel emissions as a % of shipping emissions in UK waters		0.12	-	-	-	-	-	-
[1] Committee on Climate Change (2015)								

6.3 Start-up and Production Phase

6.3.1 Start-Up

When the production well is brought on line there is the potential for an increase in flaring at the Glen Lyon FPSO due to unstable operating conditions (as a result of the tie-back) leading to a process trip and subsequent depressurisation. As a worst case this ES assumes two process trips (1.5 days each) with a total flared volume of 4,463 te. As can be seen from Table 6-4 *c.* 12,496 te of CO_2 emissions would result from this flaring which represents *c.* 0.39% of UKCS flaring emissions.

Table 6-4: Emissions at the Glen Lyon FPSO at well start-up.

	Total flared (Te)	Te						
		CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Gas flared at start up	4,463	12,496	5.36	0.36	0.06	30	201	22
2015 UKCS totals for well clean-up and testing		3,176,722	1,526	94	260	8,174	14,279	14,076
Emissions as a % of 2015 UKCS flaring emissions		0.39	0.35	0.38	0.02	0.37	1.41	0.16

6.3.2 Production

Emissions from the production phase can primarily be divided into emissions associated with power generation, flaring and direct emissions (including gas venting, emissions from during offloading etc.). The Alligin tie-back will not require any changes to the power generation equipment on the Glen Lyon FPSO.

The Alligin tie-back will not require any changes to the current flaring and venting systems at the Glen Loyal FPSO. Energy demands associated with gas compression will see a slight increase however the volume of gas is within the capacity of the existing gas processing and compression system.

Though no significant changes to the Glen Lyon FPSO's fuel forecast are expected; the existing Glen Lyon Offshore Combustion Installations Permit (PPC) permit will be reviewed and any changes to the fuel forecast as a result of the Alligin tie-back will be detailed in a permit variation.

During production, emissions at the Glen Lyon FPSO will not differ significantly from current levels following tie-back of the proposed Alligin Field Development and therefore they are not considered further here.

6.4 Decommissioning Phase

Decommissioning activities at the end of Field Life will require an increase in vessel numbers relative to those present during the production phase. A drilling rig will be brought on site to plug and permanently abandon the wells in accordance with OGUK Guidelines for the Abandonment of Wells (OGUK, 2015) (or applicable guidance at that time).

In addition, vessels will be involved in recovery activities associated with the wellheads, Xmas trees, tie-in jumpers etc.

At the time of decommissioning the operator will likely carry out an energy balance assessment based on the Institute of Petroleum 'Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures' (Institute of Petroleum, 2000) (or applicable guidance at the time). The assessment will include identification of all end points associated with decommissioning each structure, where end points are defined as the final states of the materials at the cessation of the decommissioning operations, including the presence of material in landfill sites or on the seabed. For each end point, energy use and resultant atmospheric emissions resulting from vessels, onshore transport to smelting yards, smelting activities etc. will be assessed and their environmental impacts determined. Emissions associated with decommissioning activities are not assessed further at this time.

6.5 Cumulative and Transboundary Effects

It is not expected that emissions from the drilling and installation activities will have a significant detrimental impact on air quality in the vicinity of the installation. Similarly given the distance (*c.* 20 km) from the UK / Faroe median line no transboundary impacts associated with the emissions are expected.

6.6 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with emissions to air resulting from the proposed development.

Proposed Mitigation Measures

- The drilling rig will be subject to audits ensuring compliance with UK legislation;
- The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity;
- During drilling there will be adherence to good operating practices and maintenance programmes;

Emissions from combustion equipment are regulated through EU ETS and PPC Regulations. As part of the PPC permit the following measures will be in place:

- During production there will be adherence to good operating practices, maintenance programmes and optimisation of quantities of gas flared during emergency shut-downs;
- The emissions from the combustion equipment will be monitored;
- Plant and equipment will be subject to an inspection and energy maintenance strategy;
- UK and EU air quality standards are not exceeded;
- Fuel gas usage will be monitored; and
- Energy assessments will be carried out as required.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the atmospheric emissions resulting from the drilling and installation activities are considered to be of a minor environmental risk and are therefore considered acceptable when managed within the additional controls and mitigation measures described.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

7. DISCHARGES TO SEA

This section assesses the planned and permitted marine discharges from the proposed Alligin Field Development Project using the risk assessment methodology presented in Section 4, and discusses the management and mitigation measures employed in order to adhere to legislation and to minimise environmental impact. All phases will involve the discharge of sewage and food waste from vessels; however, these discharges will be in line with MARPOL requirements and the environmental risks are considered negligible. They are therefore not assessed further.

7.1 Drilling Phase

Planned and permitted discharges to sea during drilling operations include drill cuttings, associated fluids (WBM including seawater and viscous bentonite sweeps), cement and associated chemicals. As discussed in Section 2.5.5, the LTOBM contaminated cuttings will be skipped and shipped to shore for treatment and subsequent disposal.

7.1.1 Discharge of Drilling Fluids and Drill Cuttings

The proposed project involves the drilling of one production well and one WI well. Section 2.6.5 describes and estimates the maximum quantities of drill cuttings that will be produced as a result of the drilling programme (Table 2-7).

The cuttings from the top sections (those drilled with seawater and bentonite sweeps) will be discharged around 1 m above the seabed. The volume of cuttings associated with the top hole sections has been estimated at *c*. 322 te, some of which will disperse within the water column. However, it is expected that in the immediate vicinity of the well, solids will accumulate in a cuttings pile.

It is estimated that *c*. 664 te of cuttings will be returned to the drilling rig from the lower sections during the drilling of each well. This includes WBM contaminated cuttings and LTOBM contaminated cuttings (see Table 2-6). Of these 664 te, *c*. 486 te will be from well sections drilled with WBM and will therefore be discharged over board. Upon discharge (*c*. 13.5 m above surface) the particles are expected to occupy the full extent of the water column within 200 to 300 m of the discharge point before sinking into the lower part of the water column and settling out over the seabed.

Pineda *et al.* (2017) showed that some sponge species exposed to high Suspended Sediment Concentrations (SSC) i.e. ≥23 mg/l for extended periods (28 days) have lower survival, increased necrosis and depletion of energy reserves. In contrast, SSC of ≤10 mg/l caused few, if any, negative effects and is thus suggested as a prudent sub-lethal threshold for sponges.

The discharges of WBM cuttings from the rig remain mainly in the upper water column where currents are much faster and benefit from a greater degree of initial dilution. Although coarser cuttings are predicted to descend to the seabed, at no point is a water column concentration of suspended solids predicted to be above 10 mg/l, so significant effects on sponges from suspended solids are not predicted (modelling of the discharge of cuttings is presented in Appendix E). A potential risk from the bentonite and barite associated with the cuttings has been identified, however given the short term exposure in a small area in the upper water column it is not considered to cause a significant impact (Appendix E Section E.3.1).

Where avoidance by fish is not possible the sensitivity to suspended sediments varies greatly between species and their life history stages, and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe and Jensen, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to, and affected by, suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink 1999; Clarke and Wilber 2000). This effect is greatest for juvenile fish as they

have a higher oxygen demand and small gills at higher risk of clogging (FeBEC 2010). Given the temporary nature of the sediments in the water column the discharge of cuttings is not considered to have a significant impact on fish in the area.

The impacts associated with the deposition of drill cuttings on the sea floor (either directly or through settling) are discussed in Section 8, Seabed Disturbance.

7.1.2 Cement and Cementing Chemicals

As described in Section 2.6.6, when drilling a well, cement is used to secure the steel conductor and casings in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry. The discharges associated with these cementing operations are described briefly here and will be detailed in the drilling permit applications submitted to BEIS prior to commencement of drilling. These include:

- Discharge of residual mixed cement from the rig following a cementing operation
- Discharge of cement as a result of an aborted cementing job
- Discharge onto the seabed of excess cement pumped down the well.

7.1.2.1 Residual mixed cement and aborted cement jobs

Prior to carrying out the cementing job, dry cement is mixed in a cement unit on board the drilling rig. Once the cement job is completed the cement unit is washed, to remove any residual chemical additives and / or cement slurry from the lines as any cement slurry left in the lines will set and block the line rendering the cement unit incapable of performing the next job until this blockage is removed. The water and residual cement are discharged overboard.

The need to abort a cement job could arise for a number of reasons including a total failure of the pumping equipment, a blockage (either on surface or down the wellbore) in the pipes through which the cement is pumped, or due to changing downhole well conditions (i.e., wellbore collapse, losses, or well control scenarios). In these instances, the consequences of not discharging mixed cement would be severe with the potential for cement to settle in the pumps, pits and lines on the rig, rendering the equipment unusable until the hardened cement is removed from surface equipment. This could in turn result in major workscopes associated with disconnecting, removing and cleaning the lines before reconnecting them in order to return the equipment to operational status.

The cement discharges associated with the planned flushing operations of the cement unit or those associated with an aborted cement job are expected to disperse rapidly in the upper water column. Using data from Stark and Mueller (2003) it is concluded that at North Sea temperatures, cement particles that have been diluted will not increase significantly in particle size due to their hydration reaction, and will remain in the range 10-30 microns or smaller which is controlled by their manufacture and specification. Such particles will take many days to settle through the water column and will be in an inert reacted state once at the seabed, with negligible impact. The initial discharge may affect plankton in the localised area of the plume, with rapid recovery expected similar to a discharge of drilling solids.

Over a period of hours, it is expected that the cement discharged following the washing of the cement unit or as a result of an aborted cement job will be indistinguishable from background suspended solids concentrations such that the environmental impact of these discharges are considered to be (1) whilst the environmental risk is considered negligible due to the short duration of discharges (ranked as 2).

7.1.2.2 Excess cement pumped down the well

Once injected, it is anticipated that the majority of the cementing material will remain down hole with discharge to the environment only occurring when the casings are cemented back to the seabed. Any cement returns will be discharged in the immediate vicinity of the wellhead and will likely impact on an area already impacted by the drill cuttings.

The cement mixture is designed to set rapidly and the majority of the slurry will set into masses of inert solid cement, smothering a small area of seabed near to the casing, and ultimately will behave similarly to rocks of the same size. Discharges to the seabed are at a density of around 1.9 t/m^3 in a semi-cohesive state and as mentioned are expected to flow onto the area already disturbed by cuttings from drilling the tophole sections, with some dispersion into the water column. The majority of the slurry will set into a thin diluted crust of weakened, inert solid cement and smother a small area of seabed near to the casing, and ultimately will behave as an inert hard substrate.

Large cement deposits on the seabed are not expected and have not been observed during drilling at the Greater Schiehallion Area to date. Should they occur, they will be addressed in the mandatory debris survey at the decommissioning stage at the end of field life. It is not expected any deposits would be capable of posing a hazard to towed fishing gear in the area, however if any large deposits are identified during the decommissioning stage, relevant measures will be taken to mitigate any potential dangers in the area before the removal of the drill centre 500 m safety zones. Any increase in turbidity of the water column as a result of cement returns would be localised and short-lived. In order to address the cumulative impacts of the project the impacts of these cementing discharges on the seabed and associated ecosystem are discussed in Section 8, Seabed Disturbance.

7.2 Subsea Installation and Commissioning Phase

Depending on detailed design it is possible that the pipeline testing and commissioning operations would require a discharge to sea of the pipeline preservation fluids (Section 2.6.5).

These discharges could contain chemicals including oxygen scavengers and biocides to mitigate the risks of corrosion or bacterial growth whilst an ultraviolet-fluorescent dye may be added to assist in leak detection.

BPEOC aims to minimise the effect of the chemicals used/discharged during its operations and as such, wherever possible, chemicals will be chosen which are PLONOR or are of a Hazard Quotient (HQ) <1. All CHARMable chemicals discharged will be further assessed by calculating a RQ. Where chemical use and discharge results in a RQ value >1, thus indicating a possible risk of the discharge causing harm to the marine environment, further investigation of the product will be carried out to determine if there is an alternative product that can be used which produces a lower RQ or if the discharge can be diluted in order to reduce its RQ.

All chemicals used during pipeline testing and commissioning will be risk assessed within the Pipeline Operation MAT applications. The testing will be carried out over a short timescale and the amount of chemicals discharged to the marine environment will be minimised.

Marine flora and fauna may be affected on a localised level but given BPEOC's commitment to prioritise the use of chemicals which are PLONOR, or are of a HQ <1, the rapid dilution that will occur on discharge the environmental impact is considered to be (1) with the environmental risk considered to be minor given the duration of the activities (ranked as 3).

7.3 Production Phase

There will be some discharges to sea of cooling water and drainage water during production whilst the primary discharges will be associated with produced water.

Discharges of cooling water and drainage water at the Glen Lyon FPSO are not anticipated to change as a result of the Alligin tie-in and are therefore not discussed further.

7.3.1 Produced Water Discharges

Formation water is naturally trapped in oil and gas reservoirs and despite efforts to produce the hydrocarbons selectively, a fraction of this water is brought to the surface mixed with oil and gas. This PW may comprise dispersed oil, metals and organic compounds such as dissolved hydrocarbons, organic acids and phenols.

The PWRI system in place on the Glen Lyon FPSO is designed such that from 2019 it will enable up to 90 % of PW to be injected. The PW is treated to keep the Oil in Produced Water (OiPW) quantity in line with the regulatory requirement of < 30 mg/l such that any PW is suitable for discharge under the Oil Discharge Permit. However, it should be noted that the Glen Lyon FPSO PW treatment system is forecasted to reach OiPW concentrations of 20mg/l from 2019.

Produced water at Alligin is expected to peak in 2037 at a rate of 6,568 te/day (see Table 2-15). Assuming 10 % discharge per annum (i.e. 90 % PWRI availability), this equates to a discharge rate of *c*. 657 te/day in 2037 When combined with the forecasted PW volumes from the Schiehallion and Loyal Fields, total PW production at the Glen Lyon FPSO in 2037 (year of maximum PW production at Alligin) is 34,547 te/day. This is *c*. 20% less than the maximum anticipated PW volumes at Glen Lyon FPSO (43,145 te/day in 2036).

7.3.1.1 Oil Associated with Produced Water

As a worst case this ES assumes that 10% of PW will be discharged per annum whilst Alligin is producing. Table 7-1 provides estimated peak oil discharges (based on an OiPW concentration of 30 mg/l) associated with the year of maximum water production at the Alligin Field (2037). According to DECC (2016) a total of 2,283 te of oil was discharged in PW from UK installations in 2015. Based on the regulatory 30 mg/l OiPW concentration and peak water volumes, Alligin will result in a maximum of *c*. 7.32 te/year, equating to *c*. 0.3 % of the UK total.

In 2037, maximum OiPW discharges from Glen Lyon FPSO are estimated at *c*. 38 te with Alligin contributing *c*. 20 % of that total. Whilst Alligin is producing, maximum cumulative PW volumes at the Glen Lyon FPSO are expected in 2036 at a rate of 43,145 te /day resulting in *c*. 48 te/year of oil being discharged (assuming that 10% of PW is discharged).

As mentioned, the PW treatment system on board the Glyn Lyon FPSO is forecasted to reach OiPW concentrations of 20mg/l from 2019. Assuming 90% uptime of the system, the quantities of oil discharged per annum based on this concentration are less (Table 7-1) with the maximum OiPW associated with the Alligin Field representing 0.2 % of the UK total.

Table 7-1: Estimated Peak Oil Discharges.

	Alligin peak water production (2037)	Total peak PW rate at Glen Lyon FPSO in 2037	Total peak PW rate at Glen Lyon FPSO in 2036
Produced water	6,568 te/day	34,547 te/day	43,145 te/day
Maximum PW discharged (10%)	657 te/day	3,455 te/day	4,315 te/day
2015 UK OiPW discharge total*	2,283 te/yr		
Discharged OiPW assuming OiPW concentration of 30 mg/l	7.32 te/year	38 te/year	48 te/year
% of UK total assuming OiPW concentration of 30 mg/l	0.3 %	1.7 %	2.1 %
Discharged OiPW assuming OiPW concentration of 20 mg/l	4.88 te/yr	26 te/yr	32 te/yr
% of UK total assuming OiPW concentration of 20 mg/l	0.2 %	1.1 %	1.4 %
* Source: DECC (2016) based on 92 installations discharging produced water on the UKCS			

7.3.1.2 Chemicals Associated with Produced Water

Chemical use and discharge during production is regulated under the Offshore Chemicals Regulations. Chemicals discharged into the marine environment have the potential for acute or long term effects on marine organisms. Whether these effects are realised depends on a number of factors such as the inherent toxicity of the product, the quantities discharged and resulting concentrations in the water column, the length of time biota are exposed to that concentration and the sensitivity of the organisms to the particular chemical. Chemicals discharged from offshore operations are immediately diluted in the sea. The amount of dilution depends on the water depth and water currents but is estimated to be a dilution of *c.* 1,000 at a distance of 500 m from the discharge point. This dilution tends to reduce concentrations to levels which are not acutely toxic to marine organisms (OGUK, 2016).

Details (e.g. type / volume) of all production chemicals are provided in the existing Glen Lyon FPSO Production Operation MAT application. Chemicals to be used during the processing of the Alligin hydrocarbons have yet to be confirmed, though are expected to be similar to those currently used at the Glen Lyon FPSO. Chemicals which are PLONOR or of lowest toxicity will be prioritised where technically feasible. Prior to coming on line the proposed Alligin chemicals will be added to the Glen Lyon FPSO chemical permit.

7.3.1.3 Impacts Associated with Produced Water Discharges

The discharge of PW to sea is one of the largest discharges associated with offshore oil and gas developments. As discussed PW contains residues of reservoir hydrocarbons, as well as chemicals added during the production process and dissolved organic and inorganic compounds (metals) that were present in the geological formation.

Following its discharge to sea, PW undergoes several weathering processes, partly influenced by the behaviour of the discharge plume which may be dense and sink towards the seabed or buoyant and rise to the surface. The effluent dilutes rapidly upon discharge to well-mixed seawater. Low molecular weight organic compounds will either volatilise into the air or be degraded by micro-organisms present in seawater. Many constituents will precipitate on discharge (e.g. certain metals). Higher molecular weight organic particles adsorb onto suspended solids and sediment. Individually or collectively, these processes tend to reduce concentrations of PW compounds in the receiving environment and thereby decrease their potential toxicity and bioavailability to marine organisms (OGP, 2005).

Research into the effects of PW discharges has focused on components that could result in chronic biological effects, in particular Polycyclic Aromatic Hydrocarbons (PAHs) and high molecular weight phenols. PAHs are known to have mutagenic, carcinogenic and teratogenic properties. However, many marine organisms have the ability to metabolise and detoxify PAHs at the concentrations found in the receiving environment. In the laboratory, high molecular weight phenols can be shown to exhibit endocrine disruption (Bakke *et al.*, 2013 and references therein). Such components may disturb reproductive functions, and affect several chemical, biochemical and genetic biomarkers.

Bakke *et al.*, (2013) have reviewed a number of studies carried out to determine the impact of PW discharges. They concluded that these discharges do not have a significant impact on plankton or fish species as harmful exposure to PW is not sufficiently widescale or the population influence from locally affected individuals is not large enough. They also found that most studies supported the conclusion that significant impacts on benthic animals will be limited to within 1 km of the discharge.

Given the base case of total reinjection; a PW treatment system designed to reduced OiPW concentrations to below OPPC requirements for discharge; and BPEOC's commitment to choosing PLONOR or lowest toxicity chemicals available where possible, the environmental impact associated with PW discharges is considered to be (1) however given the duration of the activities (ranked as 3) the environmental risk is considered minor.

7.3.2 Produced Sand Discharges

There is potential for low volumes of sand to be produced from the Alligin reservoir. As described in Section 2.6.1 the production tree will be installed with acoustic sand detectors on the flow base which will allow immediate action to be taken to minimise sand entering the oil and gas systems. Removed sand will be sent to the sand washing package for cleaning in line with permit conditions (< 1% oil on sand) prior to overboard disposal below the water line via a spray nozzle. These discharges will involve far smaller quantities of particulate matter than the cuttings discharges described above and are unlikely to result in smothering or changes to grain size at the seabed. The environmental impact of these discharges are therefore considered to be (1), however due to the potential duration of the intermittent discharges over the life of the field (ranked as 4) the environmental risk is considered minor.

7.4 Decommissioning Phase

Some discharges to sea are likely to occur during the decommissioning of the Alligin facilities at the end of field life. These will / may include the following planned discharges:

- Routine MARPOL compliant discharges from vessels associated with the decommissioning activities;
- Discharges associated with well abandonment;
- Discharges resulting from the disconnection / cutting of the jumpers, pipelines, umbilical etc.; and
- Discharges resulting from disconnection and recovery of the jumpers.

Discharges to sea resulting from the decommissioning activities will be described in the EIA submitted in support of the Decommissioning Programme.

In addition to chemical discharges, there is potential for some discharge of scale and debris during well abandonment. All discharges that may be contaminated with hydrocarbons will be cleaned to below minimum levels required at the time of decommissioning or shipped to shore for treatment and disposal.

7.5 Cumulative and Transboundary Effects

The cumulative impact of drill cuttings and cement on the seabed are discussed in Section 8. In relation to all other discharges, given the proposed mitigation measures no significant cumulative impacts are anticipated.

The proposed Alligin Field Development will be located *c*. 20 km from the UK/Faroe median line such that no transboundary impacts are anticipated from the discharges associated with the proposed drilling, installation, commissioning, production or decommissioning activities.

7.6 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with the discharges to sea associated with the proposed Alligin Field Development Project.

Proposed Mitigation Measures

- Deepsea Aberdeen is audited under BPEOC's marine assurance standards and subject to rig recertification audits;
- All vessels used will be MARPOL compliant;
- Where technically feasible BPEOC will prioritise the selection of PLONOR, or chemicals with a lower RQ;
- The base case is for total reinjection of PW (reaching a minimum target of 95 % availability); and
- The discharges of PW and associated chemicals are regulated by the OPPC and OCR regulations and reported through the Environmental Emissions Monitoring Scheme (EEMS). As such, during abnormal operations, BPEOC will ensure that sampling, analysis and reporting are undertaken in line with the regulations and permit conditions.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the environmental risk associated with the discharges to sea (other than those associated with the accumulation of cutting or cement on the seabed which are discussed in Section 8: Seabed Disturbance) is considered minor. The environmental risks are therefore considered acceptable when managed within the additional controls and mitigation measures described.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

8. SEABED DISTURBANCE

A number of activities will be carried out during the proposed Alligin Field Development Project which have the potential to impact seabed habitats populated by the benthic communities in the area. This section describes and quantifies the level of seabed disturbance during each phase of the proposed project using the risk assessment methodology presented in Section 4.

The extent to which the benthic habitats will be impacted depends on the size of the area that will be affected and the temporal extent of the impact e.g. positioning of the mooring anchors associated with the semi-submersible drilling rig can have a temporary impact in the vicinity of anchors whilst the area of seabed beneath the infrastructure to be installed can be considered a permanent impact. In addition, species sensitivity and the habitat type in the area, and whether they are unique to the area or of significant conservation importance, are important in determining the overall impact of the proposed project. This section considers the impact of the different sources of seabed disturbance identified, quantifies the area of potential seabed disturbance and assesses the impact of the disturbance.

8.1 Drilling Phase

8.1.1 Drilling Rig

Having been towed to the site, the Deepsea Aberdeen will be held on location using 8 x *c*. 6,900 m chain anchors. Anchor dimensions of 2 m x 2 m are assumed. During positioning it is assumed each anchor will impact an area of 10 m x 10 m, whilst a maximum of 1,400 m of each anchor line is anticipated to come into contact with the seabed. The drilling rig will be skidded between wells such that it will not be required to be repositioned when moving from one well to the other. Table 8-1 summarises the anticipated maximum area of seabed to be impacted by the positioning the drilling rig.

Table 8-1: Anticipated area of seabed disturbance during positioning of the drilling rig.

Infrastructure	**Assumptions made**	**Area impacted (km^2)**
8 x semi-submersible anchors	Assumes the area of disturbance when positioning each anchor is 10 m x 10 m. (Note the area of impact beneath each anchor when positioned is *c*. 45.44 m^2).	0.0008
8 x semi-submersible anchor lines	Assumes a maximum of 1,400 m of each anchor line impacting on the seabed across a maximum corridor width of 10 m.	0.112
Total area initially impacted by positioning of the Deepsea Aberdeen		**0.113**

8.1.2 Drill Cuttings

As discussed in Section 2.5.5 and Section 7.1.1, drill cuttings and associated seawater and bentonite sweeps/WBMs will be discharged during the drilling operations. The cuttings and associated seawater and bentonite sweeps from the 46" and 26" sections will be discharged *c*. 1 m above the seabed whilst the cuttings and WBMs associated with the $17^1/_2$" and $8^1/_2$" sections will be discharged from the platform, *c*. 13.5 m above sea surface. Modelling was carried out to determine the environmental risk of these discharges. The Dose-related Risk and Effect Assessment Model (DREAM), which incorporates the ParTrack sub-model was used, details of which are provided in Appendix E.

It should be noted that the cuttings associated with the $8^1/_2$" section of the production well are expected to contain reservoir oil. In addition to capturing the main components of the different muds and the cuttings volumes, the reservoir oil associated with the cuttings from the $8^1/_2$" section have also been included in the model run. As described in Appendix E, the volume of oil accounted for in the model is 11.59 te (Section E.2.1.1) for each well whilst the oil type used in the model is considered very conservative in terms of its toxicity (Section E.2.1.2). Appendix E Section E.2.1.3 presents the methodology used for determining the oil content of the cuttings and describes how it represents a worst case where by the actual volume is expected to be 60-80% less for the production well and even less for the water injection well. BPEOC are in ongoing discussions with BEIS regarding the standard methodology for calculating the volumes of reservoir oil returned in the cuttings, and are investigating methods of refining the estimates. For the ES it was determined that for consistency the standard methodology currently being applied to the Greater Schiehallion wells would be used for the Alligin Field Development ES. The areas of impact considered in this ES is therefore considered very conservative such that the toxicity of the oil selected is 'worse' than what the toxicity of the Alligin oil is actually expected to be, the volume of oil released is over estimated and the areas at risk from oxidation in reality will be much smaller than presented.

8.1.2.1 Model Approach

The DREAM/ParTrack modelling approach was designed to express risk to the environment using a metric known as the Environmental Impact Factor (EIF). The methodology is based on a comparison of modelled concentrations of chemicals in the water column (termed the predicted environmental concentration (PEC)) and the highest theoretical concentration of the same compounds at which harmful effects are not expected to occur in marine organisms (termed the predicted no effect concentration, (PNEC)). In cases where the ratio PEC:PNEC exceeds 1 (i.e. where the PEC is greater than the PNEC), a risk to at least 5% of the most sensitive species occurs. An EIF of 1 in the water column is then defined to signify a volume of water encompassed by a cuboid of dimensions 100 m x 100 m x 10 m (i.e. 100,000 m^3) where a risk to PEC:PNEC exceeds 1. This methodology is used by the DREAM/ParTrack model to calculate the risk to the water column due to toxicity from chemicals in drill cuttings discharges.

The protocol for assessing risks from drill cuttings discharges was further developed by the Environmental Risk Management System (ERMS) joint industry project to include the assessment of risk to the seabed sediment, and was founded on well-established scientific studies such as those in Trannum (2004), Kjeilen-Eilertsen (2004) and Neff (2005). The assessment methodology for sediments is similar to that for the water column and is based on a combined risk approach. Similar to the methodology used to assess risk in the water column, risk to the seabed sediments is assessed using the EIF and PEC:PNEC approach. However, for sediments PEC should be understood as the Predicted Environmental Change (as opposed to Predicted Environmental Concentration used for water column), and PNEC should be understood as Predicted No Effect Change (as opposed to Predicted No Effect Concentration used for water column). Furthermore, for sediments, an EIF of 1 is defined to signify that an area encompassed by a square of dimensions 100 m x 100 m i.e. 10,000 m^2 where there is a risk to 5 % of the most sensitive species.

8.1.2.2 Results of Modelling Carried Out

Appendix E, Section E.2.1 details the data inputted to the model whilst Sections E.2.2 and E.2.3 detail the release parameters and thresholds of significance captured in the model.

The aims of the modelling are to understand:

- Where the cuttings are likely to travel;
- How the cuttings are likely to disperse over time (both on the seabed and in the water column);
- Where stressors could exceed certain thresholds in the water column and in sediments;
- The recovery of the seabed; and
- The significance of the potential environmental impacts.

Water Column Impacts

A snapshot of the water column concentrations during discharges of cuttings at the seabed and from the drilling rig are shown in Figure 8-1and Figure 8-2 respectively. These are relatively consistent during the duration of the model run and reflect the steady and strong currents to the northeast in this location. Since the mud components used are all solids the concentration key is equivalent to the concentration of suspended solids (note the reservoir oil associated with the cuttings from the $8^1/_2$" section is initially trapped within the rock particles and does not impact on the water column).

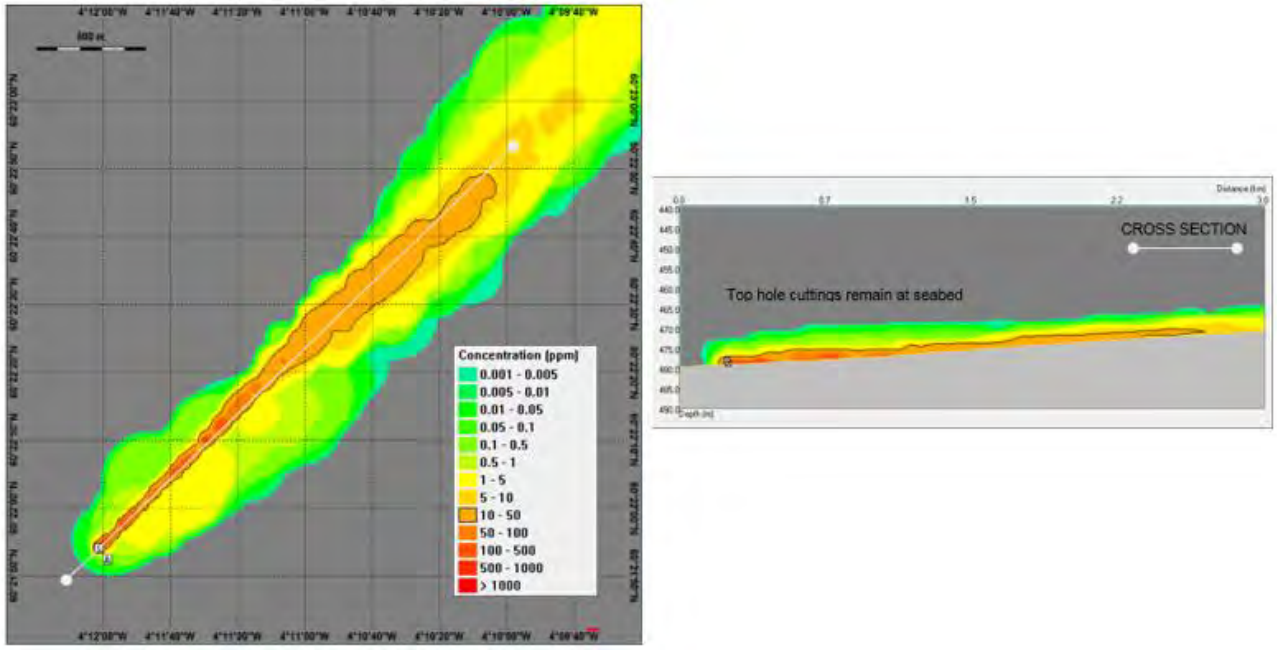

Figure 8-1: Typical water column concentrations of suspended solids during discharge of cuttings at the seabed.

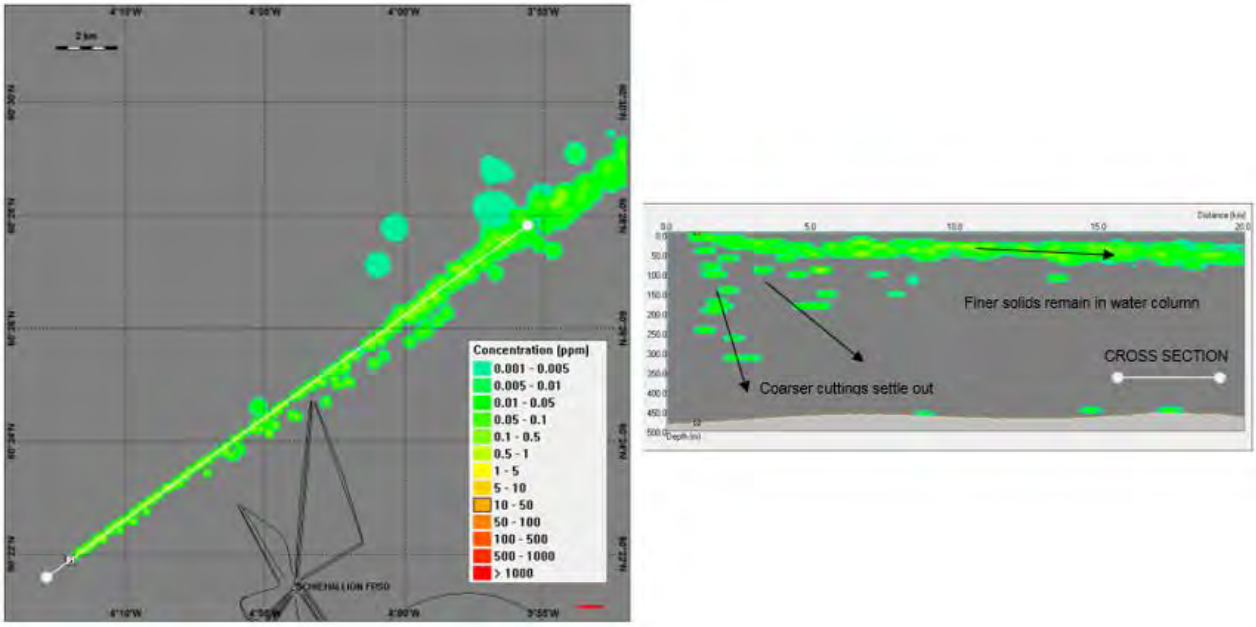

Figure 8-2: Typical water column concentrations of suspended solids during discharges of cuttings from the drilling rig.

The discharge of the cuttings (at the seabed) from the top hole sections gives rise to the highest seabed concentrations of suspended solids. These exceed 10 mg/l in a narrow area of *c*. 2.5 km long by 90 m wide for a number of hours while this operation takes place. The tophole discharge is not expected to occur for more than 18 hours continuous drilling per well. While it exceeds the precautionary level of 10 mg/l suspended solids, this threshold is based on observations where effects were observed over a 28-day exposure. In this respect it is unlikely to give rise to a significant impact in terms of sponge filter feeding activities. Concentrations also exceed the PNEC levels of 88 ppb for bentonite and 200 ppb for barite identified in the ERMS project (Smit *et al.*, 2006) which relates to a 5% risk of a random biota being exposed to a level above its PNEC, and this could extend in the order of 10 km from the well. The exposure is however very short term and stops almost immediately on cessation of drilling, and is not considered to cause a significant impact.

The discharges of WBM cuttings from the rig remain mainly in the upper water column where currents are much faster and benefit from a greater degree of initial dilution. Although coarser cuttings are predicted to descend to the seabed, including those containing residual reservoir oil, at no point is a water column concentration of suspended solids predicted to be above 10 mg/l, such that significant effects on sponges from suspended solids are not predicted. As described in Appendix E Section E.3.1, the modelling indicated that the concentrations of suspended solids exceed the PNEC levels for bentonite and for barite in a small area in the upper water column suggesting a 5% risk of a random biota being exposed to a level above its PNEC. The exposure is however very short term and not considered to cause a significant impact.

Seabed Impacts

The greatest accumulation of cuttings on the seabed is immediately to the northeast of the release point within 50 m of the wells (Figure 8-3). The peak thickness of deposition is *c*. 1.2 m and this is predicted to occur within 20 m of the release point. Thicknesses rapidly diminish with distance, such that at a distance of 500 m, the maximum depositional thickness is predicted to be 0.2 mm along the dominant current axis, and 0.1 mm at 500 m perpendicular to this axis.

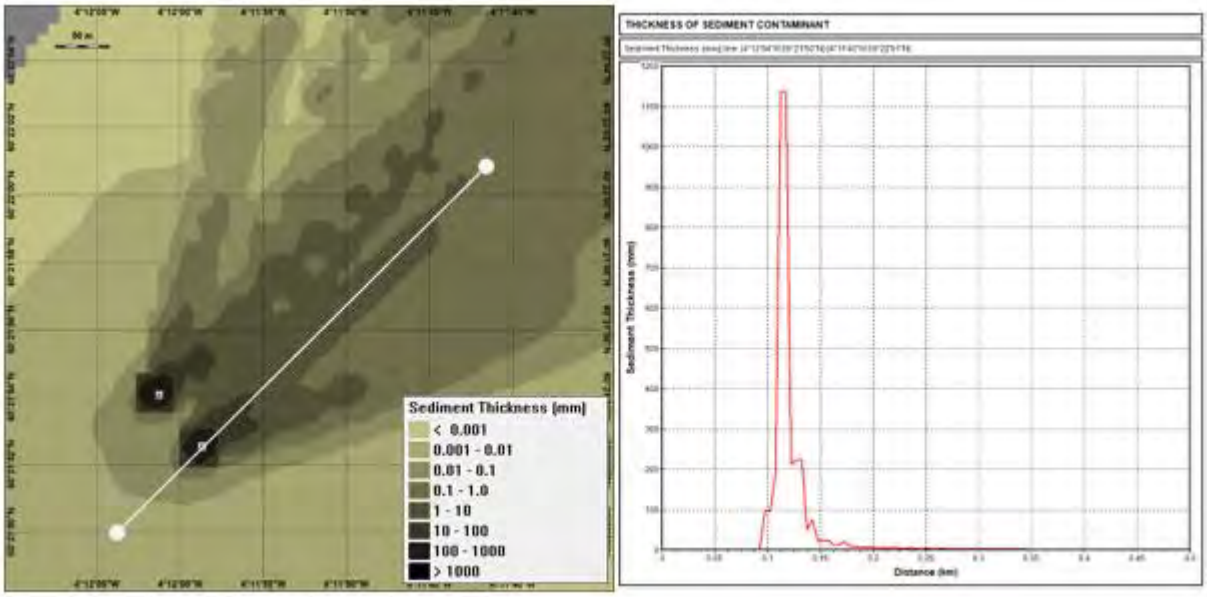

Figure 8-3: Depositional thickness of solids and cross section through pile.

The areas of very thin deposition reflect the presence of very fine solids which will travel much further than the majority of rock cuttings which will deposit near to the well (the particle size distribution used is described in Appendix E Section E.3.2).

Figure 8-4 shows the >5% environmental risk to the seabed based on a cumulative PEC:PNEC approach after cessation of drilling. As described in Appendix E (Section E.2.3) the cumulative PEC:PNEC considers grain size change, burial thickness, chemical toxicity and oxygen depletion (with oxygen depletion being the main stressor (Appendix E, Section E.3.3). Figure 8-5 shows the same cumulative impact 1 year, 5 years, 10 years and 20 years after cessation of drilling.

Following cessation of drilling the initial area of risk is small Figure 8-4and is primarily associated with changes in grain size and burial, close to the well location. The shape of the risk contours shown reflect the depositional pattern and it can be seen that areas where the cumulative risk is >5 % are contained within *c.* 200 m of the well following cessation of drilling.

However, over time the oil content in the sediments causes deoxygenation to occur, which results in the area of risk 'growing' (to a maximum of 0.72 km^2) in the first 12 months before it starts to decrease in area again (Figure 8-5). The low temperatures at the seabed and the toxicity of the oil inhibits microbial activity therefore slowing recovery such that a small area of risk >5 % is predicted to still remain after 20 years.

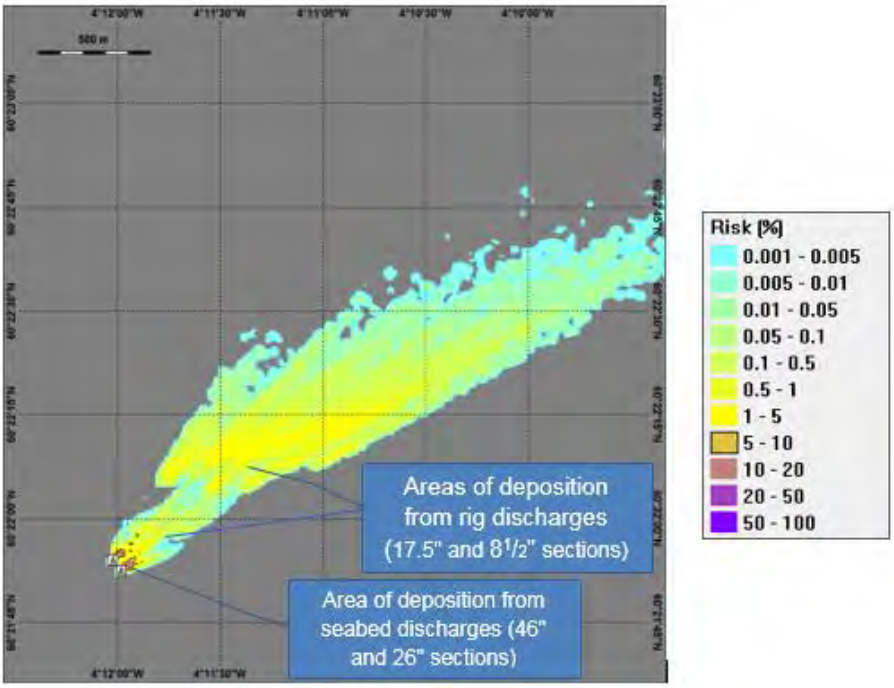

Figure 8-4: Sediment risk after cessation of drilling.

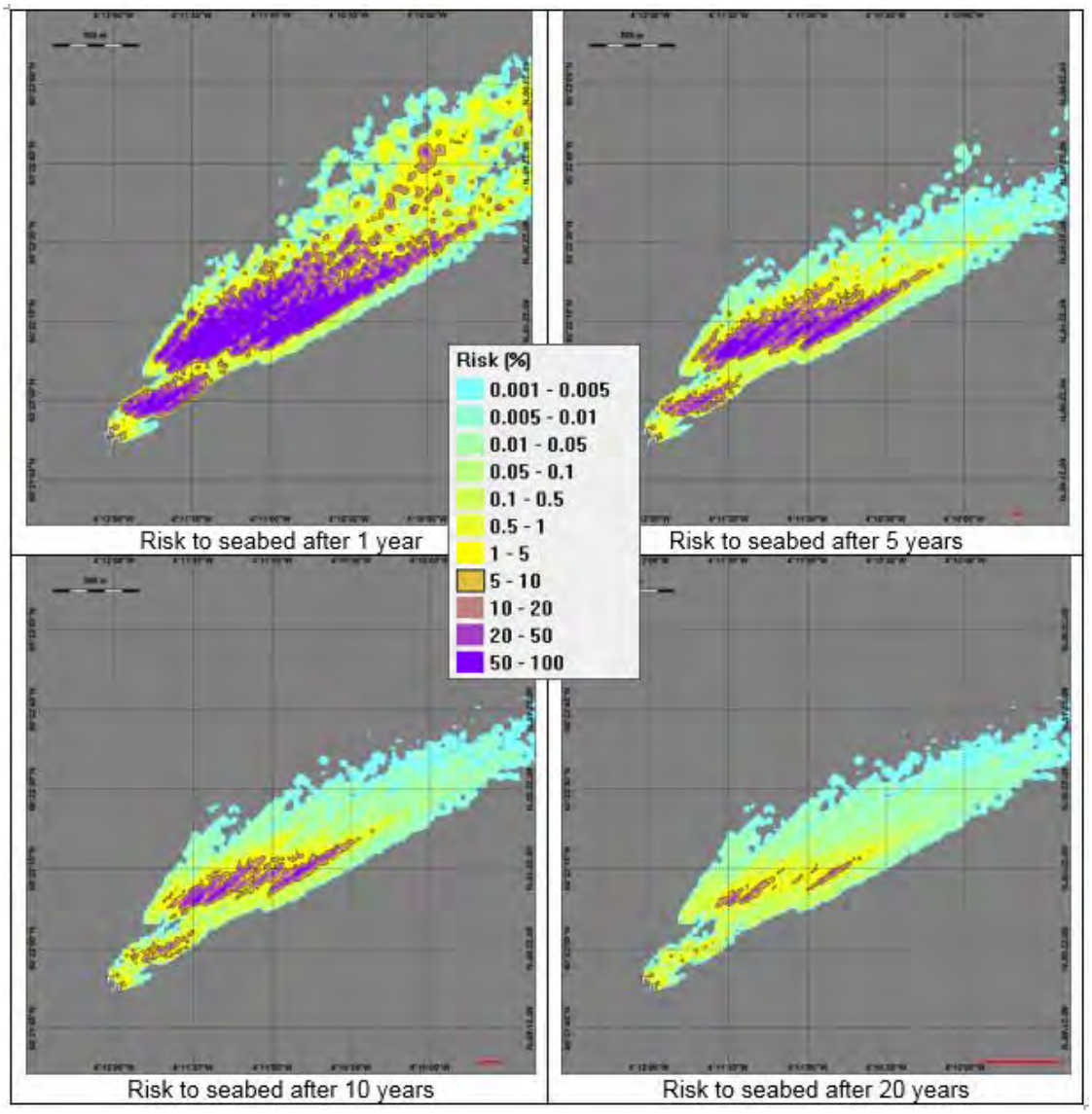

Figure 8-5: Time development of risks to the seabed.

The model was also used to predict the area of sediment within which the hydrocarbon threshold of 5 g/m^2 (i.e. 50 mg/kg) would be exceeded. This is the concentration of oil in sediment above which toxic effects on benthic fauna may begin to be discernible (further details in Appendix E, Section E.2.3). This concentration was exceeded across a total area of 0.00065 km^2 located *c.* 500 m from the wells (Appendix E, Figure E-12). Therefore, while the precautionary assessment of > 5% of biota being exposed to conditions above their PNEC suggests that an area of *c.* 0.72 km^2 is impacted, the area where harmful effects are actually expected, based on a threshold derived from experience, is far smaller at 0.00065 km^2. In addition, as discussed previously a very conservative oil type and volume has been included in the model such that the actual area of impact is considered to be even smaller.

8.1.3 Cement Deposits at the Well

As discussed in Section 7.1.2.2 it is possible that solid cement deposits could occur on the seabed at the top of each well. If they do occur these deposits are expected to impact on an area of less than 0.0002 km^2 (based on a 7.5 m radius) at each well. The impact of these deposits on the seabed and its associated ecosystem are discussed in Section 8.5.

8.2 Installation Phase

Table 2-9 and Table 2-10 summarise the subsea infrastructure and protection features to be installed as part of the proposed project. Table 8-2 summarises the total area anticipated to be initially impacted by the installation activities and the area anticipated to be permanently impacted. It should be noted the area of disturbance presented represents a worst case, for example the area impacted by the mattresses and a number for the tie-in spools, FTPs, ELFs will overlap. Similarly, much of the area impacted by the grout bags will likely also be impacted by the mattresses and infrastructure, whilst a worst case estimate of rock cover has been applied. It should also be noted that surface laying the pipelines and umbilical minimises the area of disturbance associated with the installation activities. The impacts of the anticipated disturbance on the seabed and its associated ecosystem are discussed in Section 8.5.

Table 8-2: Anticipated area of seabed impacted during installation of the subsea infrastructure.

Infrastructure	Assumptions	Area of seabed impacted during installation (km^2)	
		Temporarily & permanently impacted	Permanently impacted
9 km production pipeline	Anticipated that during installation a 2 m corridor will be impacted due to sediment disturbance. Permanent disturbance assumes a worst case of a corridor of 40 cm width beneath the pipeline / umbilical.	0.0180	0.0036
5.5 km injection water pipeline		0.0110	0.0022
5.5 km lift gas pipeline		0.0110	0.0022
5.7 km control umbilical		0.0114	0.0023
Spools, EFLs and FTPs tying into the Alligin wells.	(i) 95 m bundled production and lift gas spools between PLEM and production well. (ii) 210 m bundled EFLs from UET to production well. (iii) 210 m FTP from UET to production well. (iv) 100 m bundled EFLs from UET to WI well. (v) 100 m length FTP from UET to WI well. Anticipated that during installation a 1 m corridor will be impacted due to sediment disturbance along each of the items listed. Permanent disturbance assumes a worst case of a corridor of 40 cm width beneath the pipeline / umbilical.	0.0007	0.0003
Three spools tying new splitter manifold into existing manifolds.	Maximum length of each spool 170 m. Anticipated that during installation a 1 m corridor will be impacted along each tie-in spool route due to sediment disturbance. Permanent disturbance assumes a worst case of a corridor of 40 cm width beneath each tie-in.	0.0005	0.0002

Infrastructure	Assumptions	Area of seabed impacted during installation (km^2)	
		Temporarily & permanently impacted	Permanently impacted
EFLs and FTP between new UET and existing DUTAD30.	(i) 2 x 95 m ELF bundles of two (ii) 1 x 95 m EFL. Anticipated that during installation a 1 m corridor will be impacted due to sediment disturbance along each of the items listed. Permanent disturbance assumes a worst case of a corridor of 40 cm width beneath each tie-in.	0.0003	0.0001
PLEM at Alligin Drill Centre	Dimensions: 12 m (L) x 8 m (W) x 4 m (H) A worst case of temporary disturbance of 1 m on each side of the structure is assumed.	0.00014	0.0001
FTA) on production pipeline	Dimensions: 8 m (L) x 8 m (W) x 3 m (H) A worst case of temporary disturbance of 1 m on each side of the structure is assumed.	0.0001	0.00006
Splitter manifold at Loyal Drill Centre	Dimensions: 12 m (L) x 8 m (W) x 4 m (H) A worst case of temporary disturbance of 1 m on each side of the structure is assumed.	0.00014	0.0001
UET at Alligin Field	Dimensions: 6 m (L) x 4 m (W) x 5 m (H) A worst case of temporary disturbance of 1 m on each side of the structure is assumed.	0.00005	0.00002
UET at DUTA D30	Dimensions: 6 m (L) x 4 m (W) x 5 m (H) A worst case of temporary disturbance of 1 m on each side of the structure is assumed.	0.00005	0.00002
Two wellheads and associated Xmas trees and protective structures	Dimensions: 5 m (L) x 4 m (w). Includes protection structure. A worst case of temporary disturbance of 1 m on each side of each structure is assumed.	0.0008	0.00004
Rock cover	20,000 te of rock cover. Assumes a worst case whereby 1 te of rock cover permanently impacts on 1 m^2 and during laydown 1 te impacts on 2 m^2 as a result of sedimentation.	0.04	0.02
Mattresses	Anticipated up to 37 mattresses will be required (measuring 6 m (L) x 3 m (W)). As a worst case it is assumed that an additional area of 1 m on each side will be temporarily impacted during installation.	0.0015	0.0007
Grout bags	10 te of grout bags (400 x 25 kg) to be used. Assessment assumes 1 te of grout bags permanently impacts on 1 m^2 of seabed and temporarily impacts on an additional 1 m^2 during installation. It should be noted this is an over estimate as the grout bags will in many cases be impact on the same areas as accounted for by the mattresses.	0.00002	0.00001
Total		**0.0957**	**0.03195**

8.3 Production Phase

No additional seabed disturbance is anticipated to occur during routine production operations.

8.4 Decommissioning Phase

The decommissioning activities will result in some temporary disturbance to the seabed. Sources of disturbance could include:

- Seabed sampling for pre decommissioning survey work;
- Localised dredging or jetting to allow access for cutting;
- Recovery of subsea infrastructure;
- Potential temporary wet storage of items following disconnection and prior to recovery;
- Temporary positioning of baskets for recovery of tie-in spools etc.; and
- Anchoring of drilling rig.

Following discussion with BEIS and its consultees, BPEOC, as operator, will meet survey requirements prior to the commencement of decommissioning activities.

The Environmental Appraisal submitted in support of the Decommissioning Programme will capture the impacts associated with the disturbance of the seabed. The activities will be further detailed on the relevant MAT and associated SAT applications including a Marine Licence in line with advice received from BEIS at the time. It is anticipated that the area disturbed by the decommissioning activities will mostly be within the area disturbed by the installation activities.

8.5 Seabed Disturbance Impact Assessment

The Alligin environmental survey (Fugro, 2017) found evidence of sponges across the survey extent, however in most areas the small amounts of sponges observed were too small to be considered deep-sea sponge aggregations (see Section 3.3.3). No consolidated areas of higher sponge density were identified and while the presence of sponges in the project area is ubiquitous, it is patchy with low densities overall. The deep-sea sponge grounds thought to represent the boreal 'ostur' habitat variant which tend to be the main focus of habitat protection in the Faroe-Shetland Sponge Belt NCMPA are located around 111 km to the north-east of the survey area/project area (Fugro, 2017). Therefore, though the seabed impacts discussed in this section will occur within the Faroe-Shetland Sponge Belt NCMPA they are not expected to impact on the deep-sea sponge grounds considered to be the main focus of habitat protection.

Excluding the footprint associated with the discharged cuttings it is anticipated that a maximum seabed area of *c*. 0.209 km^2 will be impacted by the proposed project (Table 8-3). However, of this area at least 0.176 km^2 is expected to be temporarily impacted through installation activities whilst *c*. 0.032 km^2 is expected to be impacted permanently.

A number of worst case assumptions have been made to determine the maximum impact, for example it has been assumed that the area of seabed impacted by the infrastructure and stabilisation features to be installed do not overlap. In addition, a worst case volume of rockdump has been assumed.

Table 8-3: Summary of maximum area of impact associated with the proposed development (excluding cuttings pile).

Infrastructure	Area of seabed impacted during (km^2)	
	Temporarily & permanently impacted	Permanently impacted
Positioning of the drilling rig	0. 113	N/A*
Cement deposit footprint	N/A	0.0004
Subsea installation footprint	0.0957	0.03195
Total	**0.2087**	**0.03195**

*Considered N/A as once anchors and anchor line are recovered, though scars will possibly remain, the seabed will begin to recover.

In addition to the area impacted by the anchors, cement deposits and subsea infrastructure there will be an area of seabed impacted by the cuttings, the majority of which will be deposited within 50 m of the seabed with cuttings at a decreasing thickness occurring out with this area.

The physical disturbance resulting from the drilling rig's anchors, the installation of pipelines and structures and the placement of rockdump, mattresses and grout bags can cause mortality or displacement of motile benthic species in the impacted area, direct mortality of sessile seabed organisms that cannot move away from the contact area and direct loss of habitat. In addition, disturbance from sediment re-suspension will occur in the immediate area when the structures are initially positioned.

Mattresses, rockdump and grout bags have similar impacts in terms of loss of habitat and smothering of the benthos. In addition, to causing mortality or displacement of benthic animals the stabilisation features (i.e. rock cover, mattresses and grout bags) may also create habitats for benthic organisms that live on hard substrates e.g. sponges, soft corals and tubeworms, sea slugs, hermit crabs and brittle stars.

The impacts associated with the surface lay of the pipelines and umbilical are not expected to impact on the seabed sediments, considered to comprise gravel and sand with varying pebbles, cobbles and small to sized medium boulders which has been found to be typical of the Greater Schiehallion Area whilst the installation of the anchors associated with the drilling rig will likely cause some scars on the seabed, they will be subsequently recovered such that the substrate in the area will not change.

The cuttings from the tophole sections of the wells and the cement deposits that could result on the seabed following cementing of the tophole sections will result in a change in composition of the seabed in a small area in close proximity to the wells. The drilling activities will result in small 'pieces' of rock being returned to the seabed whilst the cement will likely result in broken up pieces of concrete on the seabed. However, given that the area is known to comprise pebbles, cobbles and small to medium sized boulders, the addition of these 'pieces' of rock and cement are not expected to significantly change the composition of the seabed sediments in the area.

It is possible that disturbed sediment particles may be transported via tidal currents for re-settlement over adjacent seabed areas. This may have indirect negative effects on the benthic ecology in the vicinity, including smothering and scour of seabed communities causing a loss of species diversity, abundance and biomass in effected areas. Sessile epifaunal species may be particularly affected by increases in suspended sediment concentrations as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus (Nicholls *et al*., 2003). Larger, more mobile animals, such as crabs and fish, are expected to be

able to avoid any adverse suspended solid concentrations and areas of deposition.

As mentioned previously the benthic animals identified in the surveys carried out in the Greater Schiehallion Area are expected to be indicative of those occurring at the proposed Alligin location (see Section 3.4.2). It is possible that some of the filter feeders identified in those surveys could be negatively impacted by the suspended sediments in the water column. It is thought *A. islandica* could occur along the pipeline routes. Surfacing laying of the pipelines will minimise seabed disturbance and any associated sedimentation. However, A. *islandica* is considered to be highly sensitive to a high degree of siltation change but not sensitive to a low degree of siltation change (Marine Scotland's 'Feature Activity Sensitivity Tool' (FEAST)). The proposed surface lay of the pipelines and umbilical will minimise sedimentation such that the potential impacts on this bivalve are not expected to be significant.

As sessile suspension feeders, most sponges are likely to be impacted by changes in sediment levels. Generally little is known about how they respond to sediment changes and it has been shown that some soft bottom specialist sponge species are highly resilient to sedimentation (Ilana and Abelson, 1995) whilst in some cases sedimentation has actually been shown to correlate with increased sponge diversity (Bells and Barnes, 2000a). Despite this, sedimentation is generally thought to have a negative impact on sponges (references cited in Bell *et al*., 2015) and can adversely affect sponges and other filter feeders (e.g. *A. islandica* another feature for which the Faroe-Shetland Sponge Belt NCMPA is designated) in a number of ways:

- through direct ingestions of fine particles which can block or clog their filtering apparatus and impact physiological processes;
- through scouring of external surfaces by larger sediment particles;
- by increasing turbidity and reducing light penetration which would impact phototrophic species (not considered a concern at the Alligin Field due to water depths; and,
- by preventing settling larvae from reaching suitable substrate if covered in settled sediment.

Therefore, the temporarily suspended sediments found in the water column and the settled sediments on the seabed could impact on sponges in the area. This also applies to any benthic species in the vicinity including those that may be associated with sponge aggregations (see Section 3.4.2). Kjeilen-Eilertsen *et al*., (2004) concluded that, in general, a thickness of 6.5 mm can be adopted as a threshold at which 5% of the most sensitive species would be affected, which is deemed a tolerable risk level (Commission Directive 93/67/EEC). In addition, the scientific program "Coral Risk Assessment, Monitoring and Modelling" (CORAM) has indicated that sedimentation in the order of 6.5 mm may cause adverse effects on *Ophelia peruse* (Larsson and Purser, 2011). The modelling shows that the area impacted by the discharged cuttings at a depth of 6.5 mm or more is *c*. 0.44 km^2.

In addition, it is possible that the benthic species in the area may be impacted by the reservoir oil (and resultant deoxygenation) associated with the cuttings from the $8^1/_2$ section. However, it should be noted that ongoing studies by the Marine Alliance for Science and Technology Scotland (MASTS) have found that some sponge species are able to cope with exposure to oil associated with sediments (Vada and Duran, 2017).

As explained in Section 8.1.2 and Appendix E, the impact of grain size change, burial thickness, chemical toxicity and deoxygenation should be cumulatively considered to determine the environmental risk. Section 8.1.2 explains the conservative nature of the modelling carried out that resulted in the precautionary assessment of > 5 % of biota being exposed to conditions above their PNEC suggesting that an area of *c*. 0.72 km^2 is impacted whereby deoxygenation is the main stressor. In addition, Section 8.1.2 explains how, using a threshold derived from experience, the actual harmful effects associated with the oil is the area is far smaller at 0.00065 km^2. As a compromise this ES therefore assumes an area of potentially significant impact associated with the cuttings pile of *c*. 0.44 km^2. Combined with the area of impact considered in Table 8-3, the maximum area of seabed whereby the associated benthic species could be significantly impacted is

considered to be 0.93 km^2 which comprises 0.02 % of the area of the Faroe-Shetland Sponge Belt NCMPA. As mentioned previously this area of impact is out with the deep-sea sponge grounds considered to be the main focus of habitat protection and is a maximum worst case estimate.

The ability for organisms to detect predators may also be reduced as a result of low visibility associated with suspended sediments. In instances of persistent and widespread suspended sediments there is the possibility of reduced feeding success among juvenile fish which may influence survival, year-class strength, recruitment and overall condition (Clarke and Wilber 2000).

The impacts of discharged cuttings on fish has been discussed previously in Section 7.1.3.

The maximum area of seabed that could be significantly impacted by the proposed activities is 0.93 km^2 and is contained within the Faroe- Shetland Sponge Belt NCMPA. However, the impacts are out with the region of the deep-sea sponge grounds which are considered the main focus of habitat protection in the NCMPA. These deep-sea sponge grounds are located *c.*120 km to the north-east of the proposed drill centre location.

It is concluded that given the sediment type in the area, the minimal amount of sedimentation associated with surface lay operations and the distance of the project from the sponge aggregations of importance the environmental impact associated with the activities causing disturbance to the seabed (including both temporary and permanent disturbance) is considered to be (2) whilst the environmental risk is considered moderate given the duration of the impact (considered to be 4).

8.6 Cumulative and Transboundary Effects

The drilling activities and infrastructure to be installed as part of the proposed Alligin Field Development will increase the footprint of the infrastructure associated with the Greater Schiehallion Area. However, the increase in impacts has been minimised where possible e.g. by typing into existing infrastructure where possible and surface laying the flowlines and umbilicals, such that the overall cumulative effect is kept to a minimum. Given the distance (c. 20 km) from the UK / Faroe median line no transboundary seabed impacts associated with the proposed activities.

8.7 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with disturbance to the seabed resulting from the proposed development.

Proposed Mitigation Measures

- Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors;
- Use of dynamically positioned vessels;
- Surface laid pipelines;
- The use of mattresses, rockdump and grout bags will be minimised through optimal project design; and
- Sharing Alligin Site and Pipeline Route Survey reports with JNCC and MSS.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the seabed disturbance from the proposed activities are considered to be of a moderate environmental risk and are therefore considered acceptable provided the risks are reduced to ALARP, and managed under the additional controls and mitigation measures as described.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

9. UNDERWATER NOISE

This chapter assesses the impact of noise associated with the proposed Alligin Field Development Project, using the risk assessment methodology outlined in Section 4.

9.1 Introduction

Marine fauna use sound for navigation, communication and prey detection (Southall ***et al***., 2007; Richardson, ***et al***., 1995). Therefore, the introduction of anthropogenic underwater sound has the potential to impact on marine animals by interfering with the animal's ability to use and receive sound (OSPAR, 2009b). Offshore exploration and production activities invariably generate underwater sound; for example, during geophysical exploration, during drilling activities or piling operations and from the vessel operations. The level and frequency range of sound generated varies with the type of activity.

It is generally accepted that exposure to anthropogenic sound can induce a range of adverse effects on marine life (e.g. OSPAR, 2009b). The impact of sound on an animal depends on many factors including the level and characteristics of the sound, hearing sensitivity of the species and behaviour of the species. These can vary from insignificant impacts such as temporary avoidance or changes in behaviour to significant impacts such as auditory and physical injury (Southall ***et al.,*** 2007; Richardson ***et al.,*** 1995).

The Offshore Marine Regulations 2007 (as amended, 2010) make it an offence to injure or disturb European Protected Species (EPS) (including all marine mammals), where disturbance has a likelihood of impairing their ability to survive, to breed or reproduce, to rear or nurture their young, or to migrate. It also includes the likelihood of significantly affecting the local distribution or abundance of the species. New developments must assess if their activity, either alone or in combination with other activities, is likely to cause an offence involving an EPS.

9.2 Sound Sources Associated with the Proposed Project

Underwater sound associated with the proposed Alligin Field Development will primarily result from vessel use and drilling operations.

Vessel traffic can be considered the largest contributor to anthropogenic ocean noise with the primary sources of sound coming from the propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002).

There will be some noise and vibration associated with drilling operations. This noise will propagate from any rotating machinery such as generators, pumps and the drilling unit and risers (McCauley, 1998). Drilling sounds, although of a relatively low level, will be continuous and generated for long periods throughout the drilling phase.

There are no explosives, piling or seismic activities associated with the proposed Alligin Field Development. Should a requirement for seismic profiling be identified at a later date, a geological survey permit application would be submitted to BEIS prior to execution. The application would be supported by determining the impact that noise generated during the seismic profiling would have on marine mammals. This would be assessed by modelling the received levels of noise with distance from the operations and comparing with precautionary thresholds for injury and disturbance as identified by Southall ***et al***. (2007) and the National Oceanic and Atmospheric Administration (NOAA) (NMFS, 2016).

9.3 Sensitivity of Receptors to Underwater Sound

The potential impact of underwater noise on receptors depends on the actual level of noise received by the receptor and the receptor's sensitivity and response to that noise.

9.3.1 Marine Mammals

Section 3.4.5 discusses the marine mammals known to occur in the West of Shetland area. These are shown grouped according to the hearing range for the species in Table 9-1 (Southall *et al.,* 2007) indicating which noise sources present produce noise relevant to each hearing range group. In many species sensitive to underwater sound, sensitivity is related to their use of high frequency sound for echolocation.

Table 9-1: Marine mammal known to occur in the Alligin area and hearing group.

Functional hearing group	Species known to occur in the Alligin area	Activities producing sound in this band*
Low-frequency cetacean	Minke whale, fin whale, blue whale, sei whale, humpback whale	Vessel engine and propeller noise Drilling rig engine noise
Mid-frequency cetacean	Killer whale, long finned pilot whale, Atlantic white-sided dolphin, sperm whale, bottlenose whale, white-beaked dolphin, bottlenose dolphin and Risso's dolphin	Vessel noise especially dynamic positioning Drilling rig machinery noise
High-frequency cetacean	Harbour porpoise Other species while echolocating	No significant high-frequency sources present

* The frequency bands distinguish between very broad categories of sensitivity and noise sources

Richardson *et al*. (1995) reviewed the effects of vessel noise on marine mammals. They noted that it is not always possible to distinguish between effects due to the sound, sight or even smell of a vessel to an animal but there is evidence that noise from vessels has an impact on marine mammals. Animals have been reported to display a range of reactions from ignoring to avoiding the noise. The latter can lead to temporary displacement from an area. Vessel noise can mask communication calls between cetaceans, reducing their communication range (Jensen *et al*., 2009). It is not obvious whether temporary behavioural reactions translate into long-term effects on an individual or population. Exposure to low frequency ship noise may be associated with chronic stress in whales; Rolland *et al*. (2012) reported a decrease in baseline levels of stress-related faecal hormones concurrent with a 6 dB reduction in underwater noise along the shipping lane in the Bay of Fundy, Canada, when traffic levels decreased. The development area around Alligin presents many background noise sources of vessel movements to which marine mammals are exposed.

9.3.2 Fish

Fish species differ in their hearing capabilities depending on the presence of a swim bladder, which acts as a pressure receiver (McCauley, 1994). Most fish can hear within the range of 100 Hz to 1 kHz, with some able to detect lower frequencies. Within this range, the hearing threshold varies from approximately 50 dB re 1 µPa for hearing specialists to 110 dB re 1 µPa for non-specialists. Fish with a connection between the swim bladder and otolith system have more sensitive hearing and may detect frequencies up to 3 kHz (Popper *et al*., 2003). Many species of fish produce sounds for communication that are typically emitted at frequencies below 1 kHz (Montgomery *et al*., 2006). This information suggests that sound from vessels, which is primarily between 10 Hz and 10 kHz and is strongest at 50 Hz to 1 kHz, is likely to be within the frequency range of sound detection for most fish species.

Anthropogenic noise has the potential to interfere with acoustic communication, predator avoidance, prey detection, reproduction and navigation in fish. The effects of "excessive" noise on fish include avoidance reactions and changes in shoaling behaviour (Slabbekoorn *et al*., 2010). Prolonged avoidance of an area may interfere with feeding or reproduction or cause stress-induced reduction in growth and reproductive output.

Fish exhibit avoidance reactions to vessels and it is likely that radiated underwater noise is the cause; 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).

9.4 Cumulative and Transboundary Effects

There will be a modest increase in activities in the Alligin area which will result in underwater noise; the drilling rig presence and additional vessel movements. Given that these activities will occur within a well-established area for oil and gas activity and will be short term in nature, cumulative impacts are not expected.

The Alligin subsea tieback will be located *c.* 20 km from the UK/Faroe median line and therefore no transboundary impacts associated with the underwater noise from the drilling rig or vessels are expected.

9.5 Mitigation Measures

The vessel and drilling operations associated with the proposed development do not require significant mitigation measures to minimise the impact of underwater noise.

Proposed Mitigation Measures

- Optimise duration of drilling and installation activities.
- No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels.

It is likely that short term behavioral effects may be observed among cetaceans as a result of vessel and drilling activities, but the overall environmental impact of the noise sources is considered to be (1). Given duration of the vessel and drilling activities (ranked as 4) the environmental risk is considered minor.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

10. WASTE GENERATION

This section discusses the types of waste likely to be generated as a result of the proposed Alligin Field Development Project, and the waste management procedures that will be implemented to minimise and monitor the volumes produced and disposed to landfill. Waste will be generated during all phases of the project.

BPEOC is committed to reducing waste production and to managing all produced waste, by applying approved and practical methods and by adhering to a waste hierarchy similar to that shown in Figure 10-1 (Scotland's Environment, accessed 2017). Waste will only be disposed of if it cannot be prevented, reclaimed or recovered. All wastes will be managed in accordance with BPEOC's Waste Management Procedure and via the existing waste contract. The procedure establishes the controls required to manage the hazards associated with the transportation and disposal of waste from offshore sites and the processes, and verification activities, necessary to ensure legal obligations are satisfied.

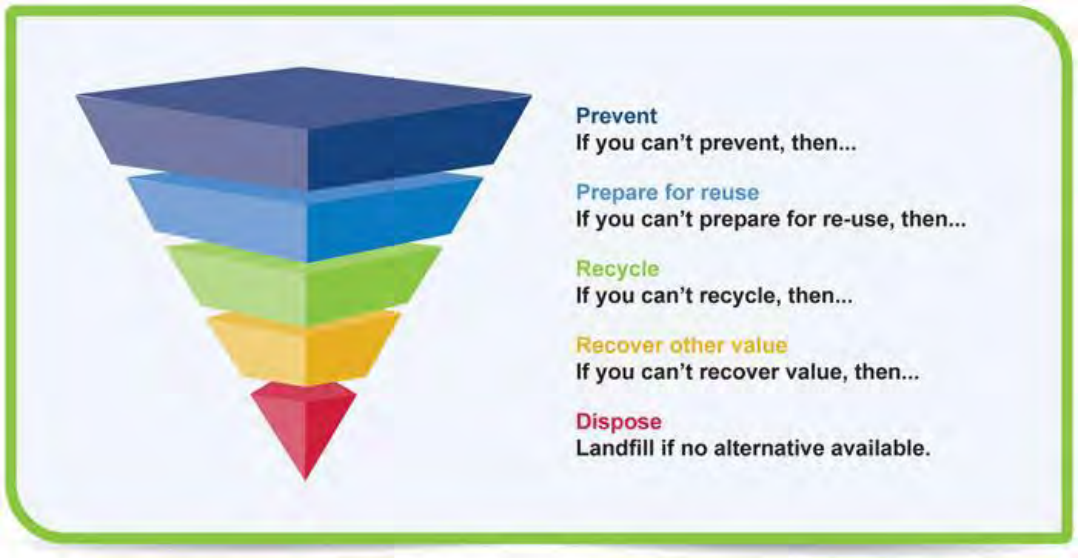

Figure 10-1 Representative schematic of Scotland's Environment waste hierarchy (Scotland's Environment, 2017).

Consent to transfer to the United Kingdom shore is not required but Duty of Care (under the Environment Protection Act 1990) makes it the waste producer's responsibility to ensure that waste is only transferred to an appropriately licensed carrier who should have a Waste Carrier Registration. Transfer of Controlled Waste requires a Transfer Note to be completed (or Consignment Note in the case of Special Waste). The Transfer Note details the type and quantity of waste, from whom and to whom the waste has been transferred, the category of authorised person to whom the waste has been consigned, relevant licence numbers, time, place and date of transfer.

10.1 Vessel Waste

Waste will be generated from a number of vessels associated with the proposed development including AHVs, survey, supply, ERRV and construction vessels. Waste from these vessels will be managed in line with the individual vessel Waste Management Plan (WMP) in accordance with MARPOL requirements, which regulate discharges of waste to sea from ships.

10.2 Drilling Waste

Drilling rigs generate various waste products during routine operations including LTOBM contaminated cuttings, waste oil, chemical and oil contaminated water and scrap metal. Wastes will be minimised by use of appropriate procurement controls, and all wastes will be properly segregated for recycling / disposal / treatment. The appointed waste management contractor will supply monthly reports of waste sent to shore and will complete Controlled Waste Transfer Notes as required, and records of monthly disposals will be maintained. Waste Management Duty of Care audits will also be carried out.

LTOBM contaminated cuttings will be shipped to shore for disposal. The chosen waste contractor will thermally treat the cuttings onshore and any oil that is separated out may be used as an energy source on site. Any excess oil will be stored for onward transportation to oil recyclers. Process water will be used to dampen the dry cuttings before final disposal to landfill.

10.3 Installation and Commissioning Phase

Installation activities will routinely generate a number of wastes including scrap metal, wooden crates etc. All wastes will be properly segregated for recycling/disposal/treatment in accordance with BPEOC's Waste Management Procedure and Controlled Waste Transfer Notes will be completed. The project is not expected to result in a change to the current waste streams occurring at the Glen Lyon FPSO installation.

10.4 Production Phase

The Glen Lyon FPSO complies with BPEOC's waste management procedures. Controlled waste transfer notes will continue to be completed as required and records on monthly waste disposal activities will be maintained.

10.4.1 General Waste

On the Glen Lyon FPSO general waste streams are segregated by personnel at the source of generation, and manually handled to the appropriate labelled waste receptacle until transferred onshore for disposal. All waste is segregated in accordance with waste management procedures and controlled waste transfer notes will be completed. Waste Management Duty of Care audits will also be carried out. Production of general waste on the Glen Lyon FPSO is not expected to change as a result of the proposed Alligin Field Development Project.

10.4.2 Laboratory Waste

On the Glen Lyon FPSO, chemicals are segregated on site and sent to shore for disposal via a licensed contractor. As for general waste streams, a WMP is in place to minimise laboratory waste. Production of laboratory waste on the Glen Lyon FPSO is not expected to change as a result of the proposed Alligin Field Development Project.

10.4.3 Special Waste

The Glen Lyon FPSO ships to shore a number of hazardous solid and liquid waste streams which may include Naturally Occurring Radioactive Material (NORM) / Low Specific Activity (LSA) scale. The types of hazardous wastes handled on the Glen Lyon FPSO will not change as a result of the proposed project.

10.5 Decommissioning Phase

The waste generated as a part of the decommissioning activities will be a combination of both hazardous (special) and non-hazardous wastes. As operator, BPEOC will have in place a WMP developed to identify, quantify (where possible) and discuss available disposal options for waste resulting from the

decommissioning activities. Where possible, materials will be recycled or sold and reused taking into account a waste hierarchy similar to that shown in Figure 10-1.

It is intended that recovered infrastructure will be returned to shore and transferred to a decommissioning facility, which will have all necessary approvals and licences in place and possess the capability to reuse or recycle the majority of recovered material. The minimisation of waste is a factor considered at every stage of the project.

10.6 Cumulative and Transboundary Effects

There will be a modest increase in waste generation as a result of the proposed project. Waste will be managed in line with existing procedures and significant cumulative or transboundary impacts are not expected.

10.7 Mitigation Measures

The following mitigation measures are proposed to minimise the waste produced from the proposed Alligin Field Development Project.

Proposed Mitigation Measures

- BPEOC will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle;
- Existing asset and vessel WMPs will be followed;
- Only permitted disposal yards / landfill sites will be used.

With the application of the above control measures the environmental impact of waste generated throughout the project is considered to be (1) whilst the environmental risk is considered minor given the duration of the activities that will result in waste streams (ranked as 4). The environmental risks associated with the different waste streams are therefore considered acceptable when managed within the additional controls and mitigation measures described.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix B.

11. ACCIDENTAL EVENTS

This section assesses the environmental risk associated with accidental hydrocarbon release from a subsea well blowout at the proposed Alligin development. Accidental diesel spills (e.g. from loss of fuel inventory from auxiliary vessels) are covered by the Glen Lyon Oil Pollution Emergency Plan (OPEP) which includes a Communications and Interface Plan with the Deepsea Aberdeen drilling rig.

11.1 Overview of Potential Hydrocarbon Releases

11.1.1 Drilling Phase

11.1.1.1 Loss of contaminated discharges

During drilling, in addition to a potential subsea well blowout (see below) accidental releases of contaminated discharges could include the loss of: cleaning chemicals, mud inventory, brine contaminated with LTOBM, cuttings containing LTOBM and other oily slops. There is also a risk of an accidental spillage of mud or diesel during bunkering operations.

These releases could result in toxic or sub-lethal effects on sensitive organisms and ecosystems. The resultant impacts are dependent on spill size, prevailing wind, sea state, temperature and sensitivity of the environmental receptors (e.g. benthic species, fish, marine mammals, birds and protected areas) affected.

To mitigate the likelihood of such accidental events and to minimise their impact should they occur, approved operational procedures will be adhered to. For example, the quantities of chemicals stored on the Deepsea Aberdeen will be optimised. COSHH assessments will be completed and Safety Data Sheets (SDS) will be made available. Where possible given technical requirements, chemicals that are PLONOR, have a RQ <1, or do not carry substitution warnings will be prioritised. Spill kits will be located in close proximity to chemical and oil storage areas to enable a quick response.

Procedures, in line with best industry practice guidelines will be in place to minimise the risk of an accidental spill from bunkering. These will include for example, regular checks of the integrity of the hose and competence of operators. Trained personnel will undertake bunkering operations in accordance with approved procedures. Containment facilities and drains will be inspected as part of marine assurance standards.

An approved OPEP will be in place to respond to an accidental hydrocarbon release. BPEOC is a member of Oil Spill Response Limited (OSRL) and the Offshore Pollution Liability Association Ltd. (OPOL). Local access to dispersant will be available via the ERRV. OPPC permit requirements will be adhered to. Any accidental hydrocarbon release from the Deepsea Aberdeen will be responded to in accordance with arrangements set out in the Glen Lyon OPEP.

The environmental impact is considered to vary between the different accidental discharges identified (see Appendix C). For example, the impact associated with a release of hydrocarbons during bunkering operations is considered to be (2) whilst the impact associated with a loss of OBM is considered to be (3). However, when the likelihood of these accidental events taking place is taken into account most are considered to be a minor risk. Of these smaller release volumes only the loss of hydrocarbons during bunkering operations or from drains is considered to be moderate (due to a likelihood of 3). This risk will be reduced to ALARP and managed under the mitigation measures described such that it is considered acceptable.

11.1.1.2 Well blowout

A well blowout refers to the uncontrolled release of hydrocarbons from a well after the pressure control systems have failed. Primary well control is achieved by maintaining a hydrostatic pressure in the wellbore greater than the pressure of the fluids in the formation being drilled, but less than the formation fracture pressure. In a worst case scenario, there can be insufficient pressure in the wellbore fluids (i.e. the drilling mud or completion fluids) to resist formation pressure and an influx occurs. Wellbore fluids are carefully designed, monitored and actively managed to prevent such occurrences.

Well blowouts are most likely during drilling operations. In the event of an influx, the flow of reservoir fluids into the well is stopped by closing the BOP which is the initial stage of secondary well control. The BOP has multiple sets of rams that can close off the well bore in an emergency. Secondary well control is completed by circulating the well with kill weight fluid and displacing the influx out of the well. If primary and secondary well control fails a blowout can occur.

During production, downhole safety valves are in place to seal wells should an unplanned well event occur. These downhole safety valves are in addition to valves contained within the tree. After production has ceased, wells are plugged with cement and decommissioned.

The International Association of Oil and Gas Producers (OGP) has issued datasheets (OGP, 2010) on well blowout frequencies for drilling operations of a North Sea Standard (NSS), where the operation is performed with a BOP installed and where the “two barrier” principle is followed (Table 11-1). The dataset is derived from the Foundation for Scientific and Industrial Research International (SINTEF) well blowout database where a blowout is defined as an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers or the activation of the same have failed. The blowout frequencies have been calculated per well drilled in the North Sea and are not an annual frequency. Note that the frequencies of blowouts per total wells drilled is very low, indicating that the likelihood of a blowout occurring is very remote. The likelihood of a blowout occurring at a maximum flow rate, or for an extended period, is lower still.

Table 11-1: Well blowout frequencies for North Sea offshore operations (OGP, 2010).

Operation	Gas	Oil	Unit
Development drilling (oil)*	-	4.8×10^{-5}	Per well drilled
Development drilling (HP/HT)	4.3×10^{-4}	-	
Development drilling shallow gas (topside)	4.7×10^{-4}	-	
Development drilling shallow gas (subsea)	7.4×10^{-4}	-	
* This figure is relevant to the Alligin development. Other types of well are shown for comparison			

Spill modelling has been undertaken using the Oil Spill Contingency and Response (OSCAR) model developed by SINTEF, to support the assessment of the environmental risk of a subsea well blowout at the Alligin Field Development. Appendix D presents the modelling carried out to support the assessment whilst the results are discussed further in Section 11.2.

11.1.1.3 Loss of fuel inventory from rig

In line with BEIS Guidance (BEIS, 2018) this ES assesses in detail the impact of a worst-case hydrocarbon release (i.e. a subsea well blowout at the Alligin Field: see Section 11.2 and Appendix D). It is acknowledged that other spills such as a loss of total fuel inventory (estimated at *c*. 3,150 m^3) from the drilling rig could occur. Separate modelling studies have not been carried out to determine the fate of a loss of fuel inventory at the site, given that any impacts would be expected to be within the envelope of impacts associated with a subsea well blowout (see Section 11.2). Results from the modelling of a loss of diesel inventory (6,944 m^3) at the Glen Lyon FPSO location showed the impact of a diesel release would be restricted to the vicinity of the release location. The surface slick extended for a maximum of 37 km for the release point with no shoreline impacts. A loss of fuel inventory from the Deepsea Aberdeen whilst at the Alligin Field would be subjected to a number of processes including spreading, evaporation, natural dispersion, sedimentation and biodegradation such that similar to the results of the modelling carried out for the Quad204 ES (BP, 2010) a relatively small surface area, and volume of water would be expected to be impacted. A very limited volume, if any, would be expected to end up at the seabed. It is also expected that there would be no shoreline beaching. The environmental impacts of such a release are therefore considered to be (3).

Given the mitigation measures discussed in Section 5, regarding notifications to be given prior to any drilling rig mobilisations, drilling rig and vessel lighting requirements, the application for a 500 m exclusion zone at the rig, and all operations occurring within a charted Offshore Development Area, the likelihood of a collision resulting in the loss of fuel inventory from the drilling rig is considered to be of low probability (ranked as 2) such that the environmental risk is considered moderate. This risk will be reduced to ALARP and managed under the mitigation measures described such that it is considered acceptable.

11.1.2 Installation and Commissioning Phase

During the Installation and Commissioning Phase, there is a risk of accidental discharges of water-based hydraulic fluids or treated seawater. This release could result in short term localised effects on water quality, flora and fauna.

To mitigate the potential of such a release occurring, containment facilities will be inspected as part of the vessels HSE Management System audit, and a chemical risk assessment will be undertaken as part of the Production Operation MAT application. Industry standard operating procedures and checks will be carried out to prevent such a release where possible. Chemicals that are PLONOR, have a HQ < 1 and / or do not carry substitution warnings will be prioritised where technically possible.

With the above mitigation measures in place the environmental impact of an accidental discharges of water-based hydraulic fluids or treated seawater is considered to be (1) whilst the environmental risk is considered to be minor (likelihood ranked as 3). The risk is therefore considered acceptable when managed within the additional mitigation measures described.

11.1.3 Production Phase

The Glen Lyon FPSO has an approved OPEP in place (BEIS Reference No. 15113) and this will be amended to capture the proposed Alligin well including details on the flowrate and interface with the Deepsea Aberdeen drilling rig. The likelihood of an accidental event at the FPSO is not considered to change as a result of the Alligin tie-back such that it is not discussed further.

Potential accidental events associated with the production phase that could occur as a result of the Alligin tie-back were considered in the ENVIID. These included snagging of fishing gear on subsea infrastructure, subsea control system failures resulting in small losses of hydraulic fluids, or small volumes of hydrocarbons. The environmental impact associated with each of these potential events was considered to be (1).

A number of mitigation measures were identified including application for an exclusion zone at Alligin, optimal material selection, operating procedures in place, preference for the use of water based hydraulic fluids etc. With these mitigation measures in place the environmental risk of each of these potential accidental events is considered to be minor and are therefore acceptable when managed within the mitigation measures described.

11.2 Environmental Impact of a Subsea Well Blowout

Appendix D presents the modelling carried out using the Oil Spill Contingency and Response (OSCAR) model developed by The Foundation for Scientific and Industrial Research (SINTEF), to support the assessment of the environmental risk of a subsea well blowout at the proposed Alligin Field Development. The Appendix introduces the OSCAR model; provides a description of the methodology applied including release parameters, hydrocarbon characteristics and metocean data; describes the thresholds applied; and presents the results. This section assesses the impact of the spill by considering the modelling results in relation to the receptors likely to be impacted. A summary of the subsea well blowout scenario modelled is presented in Table 11-2 below.

Table 11-2 Release parameters

Scenario and location	Hydrocarbon type	Initial release rate[1]	Release duration[2]	Total quantity released	Release depth	Release temperature
Subsea well blowout 60º22'26.12" N 4º11'32.32" W	Crude with associated solution gas	33,600 bpd oil plus 11.75 MMscfd gas	144.5 days	2,626,075 bbls	467 m	52.6 ºC

1. Release rate declines over time: see Appendix D, Table D-3.
2. Total model duration included an additional 30 days following the end of the discharge.

11.2.1 Summary of Modelling Results

A brief summary of the modelling results is presented here. Full details are provided in Appendix D.

11.2.1.1 Oil on the surface

The probability of a visible surface sheen with a thickness > 0.3 µm is predicted to extend as far as 490 km east and 915 km northeast with 90-100 % probability. Note a sheen thickness > 0.3 µm is the minimum thickness expected to produce negative impacts on sea life encountering oil at the sea surface (see Section D.2.4).

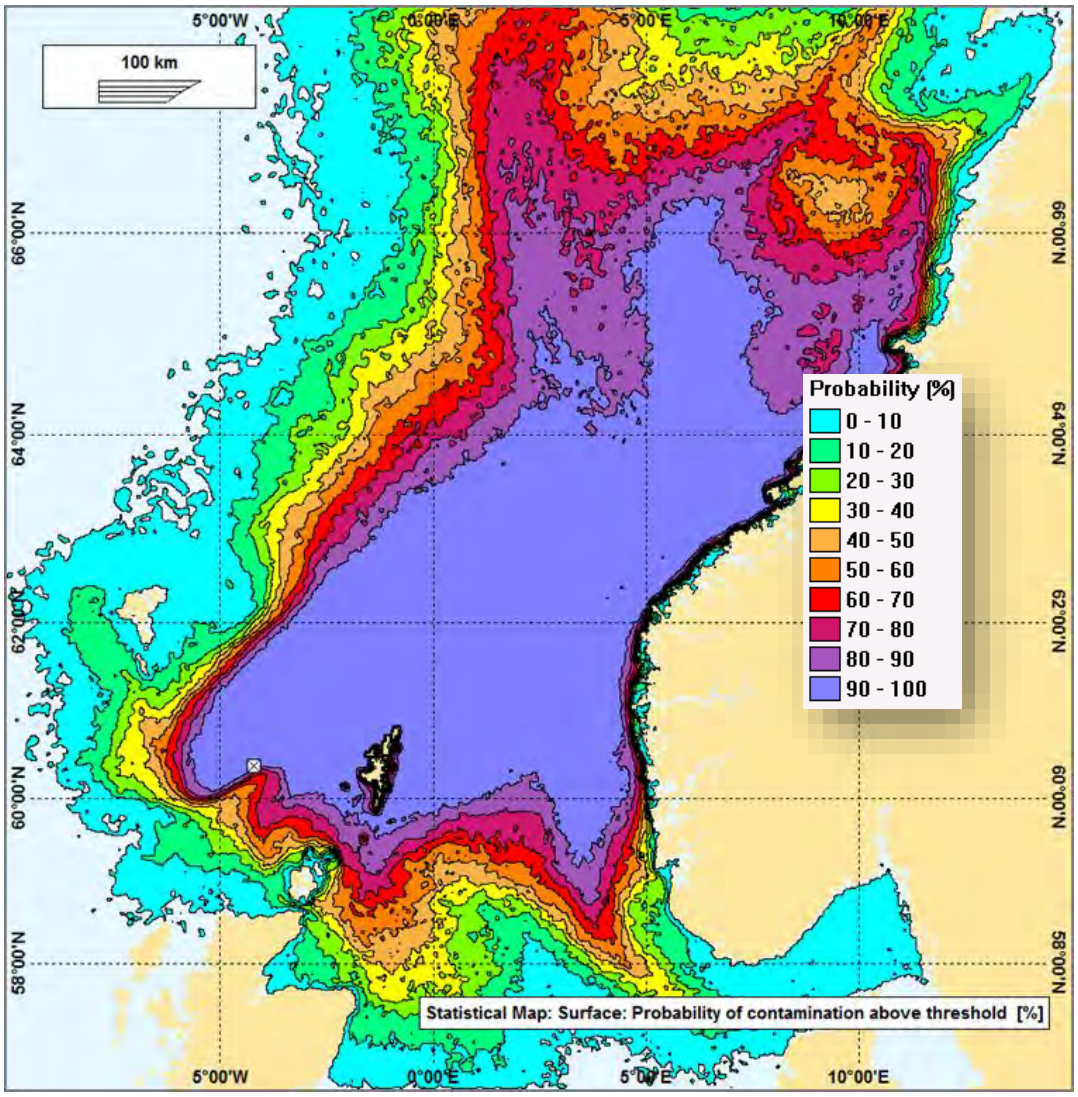

Figure 11-1: Probability of a surface sheen > 0.3 µm at some point during the subsea well blowout.

The modelling predicted that the total sea surface area impacted by oil above a thickness of 0.3 µm would be *c.* 446,000 km^2. The modelling also predicted that a visible surface sheen would still be present at least 30 days after the cessation of hydrocarbon release from the subsea well blowout.

11.2.1.2 Shoreline beaching

The probability of oil beaching on shorelines at a concentration ≥ 100 g/m^2 is shown in Figure 11-2. Note 100 g/m^2 is considered to be the impact threshold for oiling of birds whilst benthic epifaunal invertebrates living on hard substrates in intertidal habitats would be coated at these concentrations (see Section D.2.4).

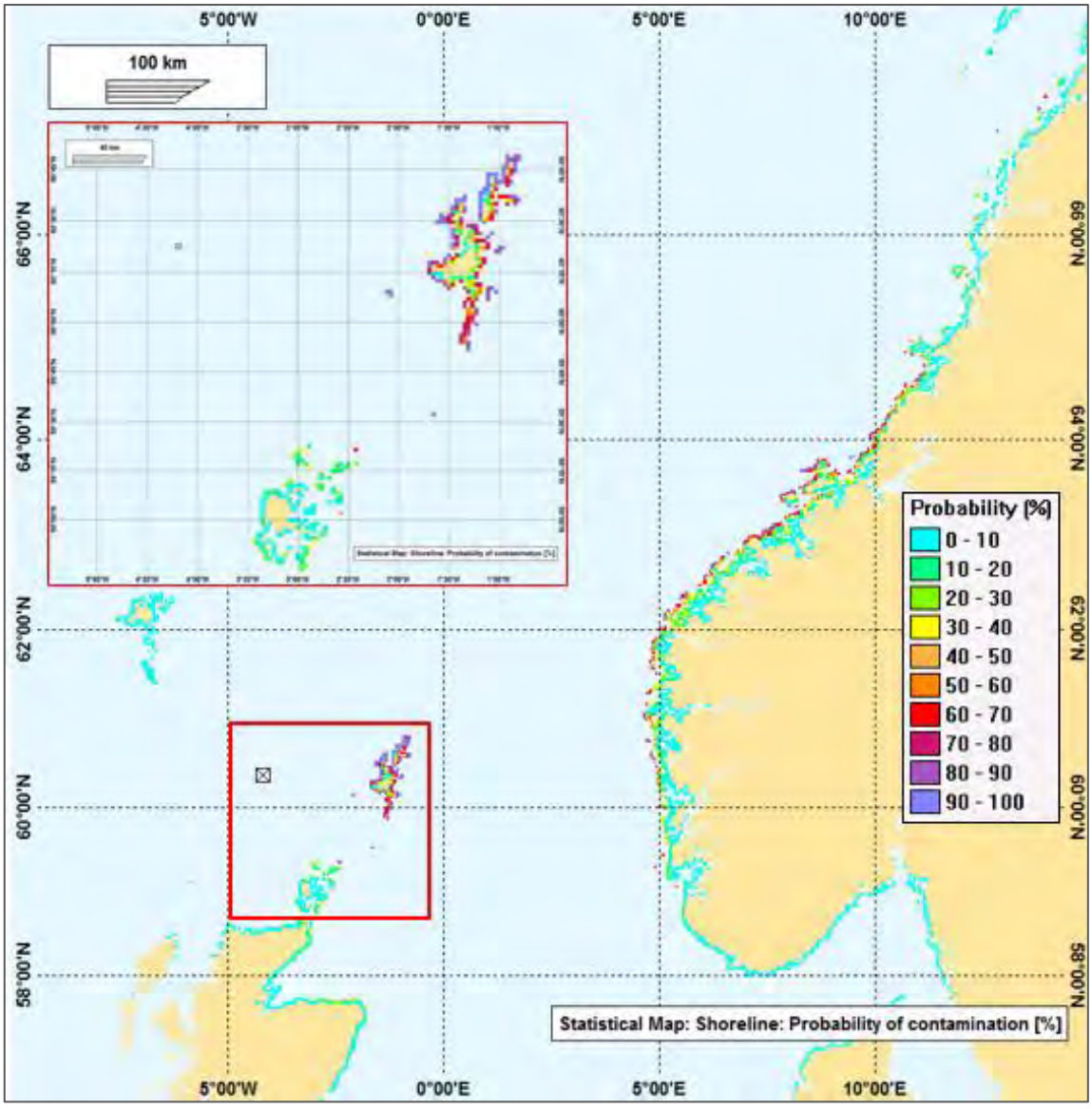

Figure 11-2: Probability of oil beaching at a concentration ≥ 100 g/m^2.

11.2.1.3 Water column concentrations

The probabilities of hydrocarbon concentrations ≥ 25 ppb in the water column are shown in Figure 11-3 for the subsea well blowout scenario. Total water column concentrations ≥ 25 ppb are expected to impact on fish eggs and larvae, which are considered among the most sensitive organisms in the water column (see Section D.2.4).

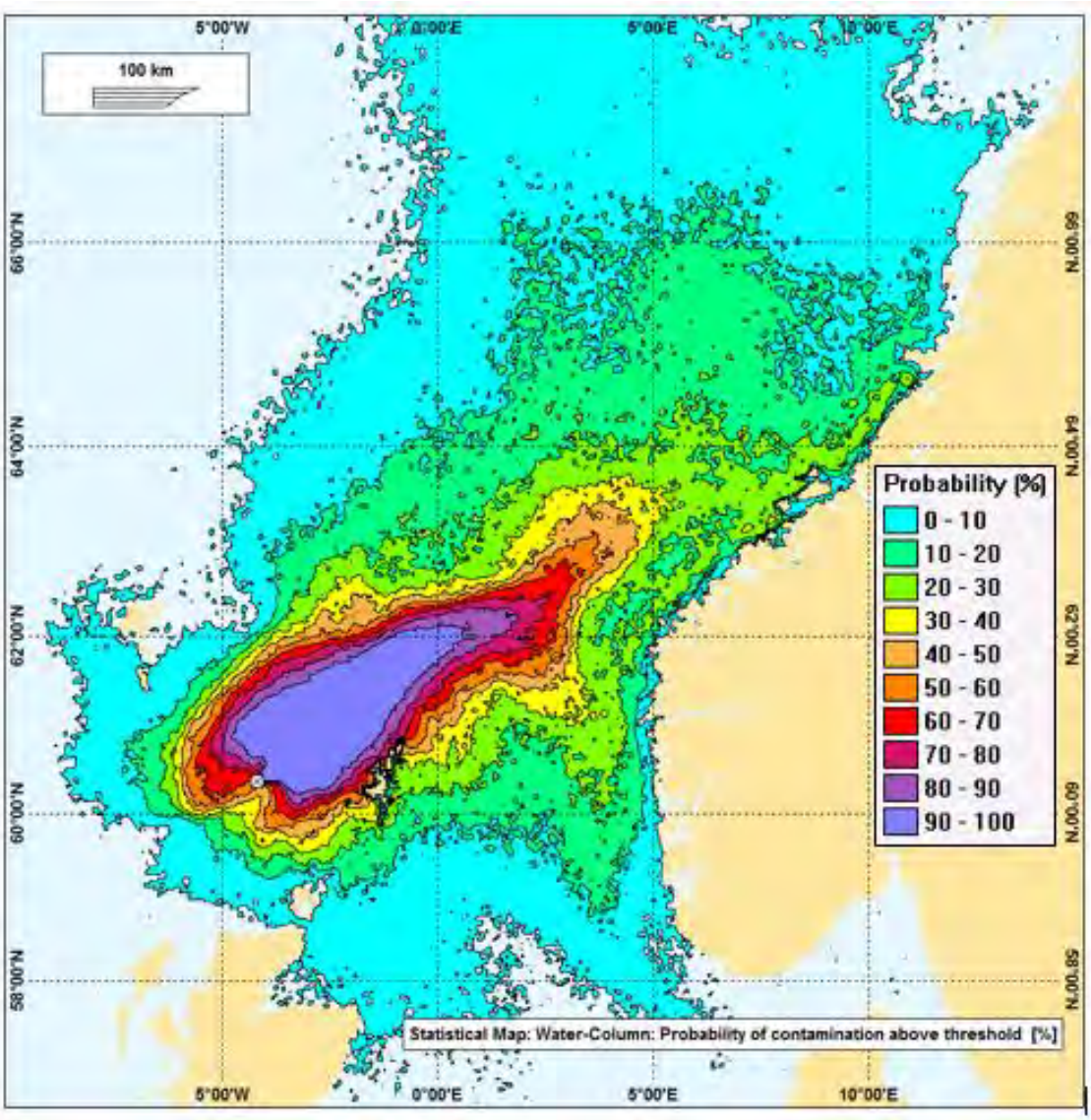

Figure 11-3: Probability of water column impacts at concentrations ≥ 25 ppb.

11.2.1.4 Deposition of oil in sediment

Deposition of oil in seabed sediments at concentrations > 50 mg/kg due are shown in. 50 mg/kg is the concentration at which toxic effects on benthic fauna may begin to be discernible (see Section D.2.4). Area impacted at these concentrations is *c*. 2,000 km^2.

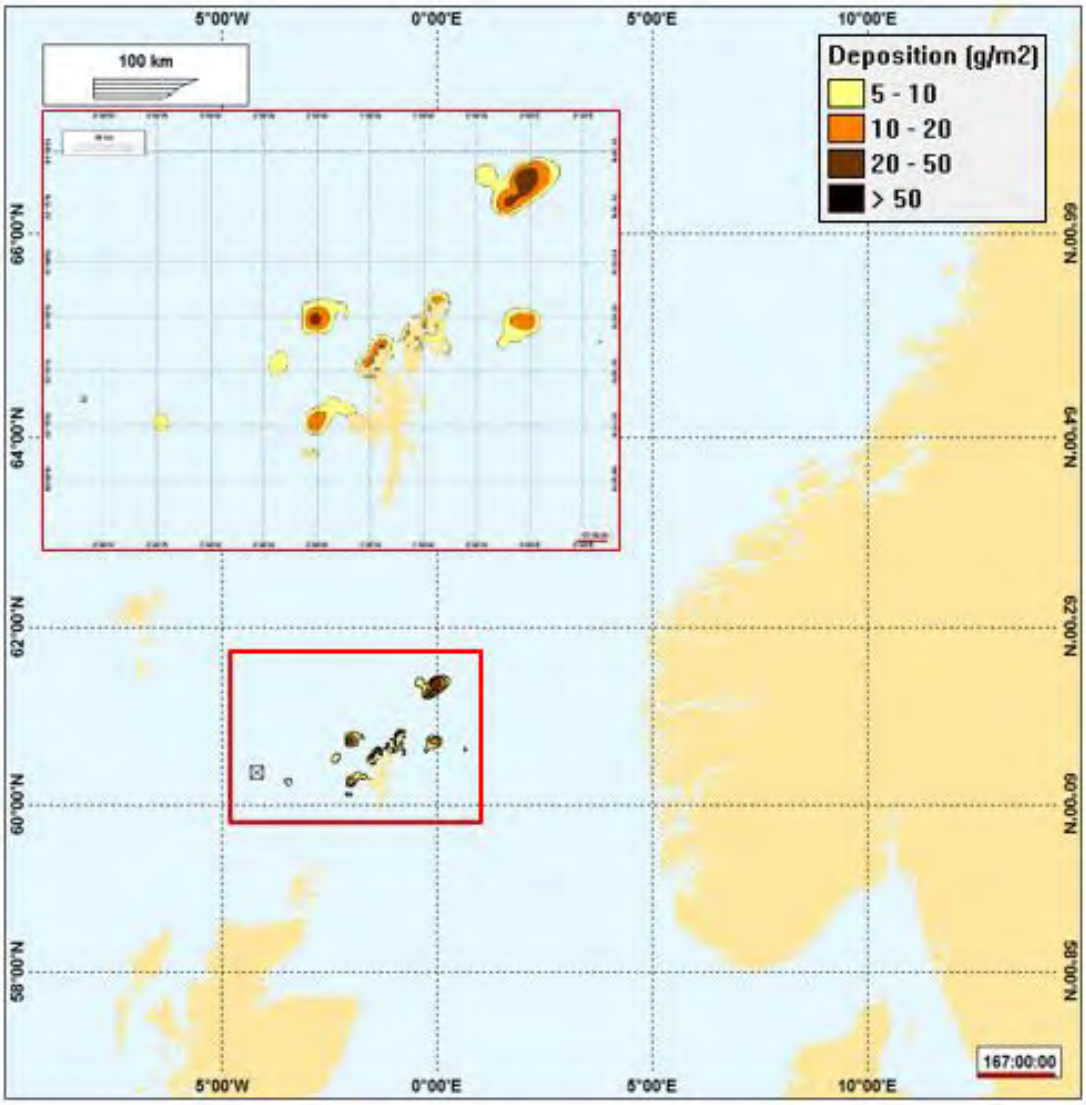

Figure 11-4: Deposited oil in the sediment.

11.2.2 Impact of a Subsea Well Blowout on Receptors

The modelling results show that a number of environmental receptors will be impacted in the event of a subsea well blowout scenario. The impact on these receptors is discussed here.

11.2.2.1 Impact on plankton

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton) that drift with the oceanic currents. These organisms form the basis of marine ecosystem food chains.

Because oil can float on the water's surface and disperse within the ocean as it weathers, plankton are exposed to both floating oil slicks and to small dissolved droplets of oil in the water column (Cormack, 1999; Almeda *et al*., 2013).

Changes in the patterns of distribution and abundance of phytoplankton can have a significant impact on the entire ecosystem (Ozhan *et al*., 2014). Both oil and oil biodegradation can impact phytoplankton in the immediate vicinity of a spill. Oil slicks can inhibit air-sea gas exchange and reduce sunlight penetration into the water column and hinder photosynthesis and phytoplankton growth (González *et al*., 2009). The PAHs in the oil also affect phytoplankton growth, with responses ranging from stimulation at low concentrations of oil (1 mg/l i.e. 1,000 ppb) to inhibition at higher concentrations (100 mg/l i.e. 100,000 ppb; Harrison *et al*., 1986). After the Macondo blowout in the Gulf of Mexico in 2010, it has been speculated that phytoplankton community structure changed and biomass increased due to a combination of the detrimental effects of oil contamination and the beneficial effects of decreased predation (Abbriano *et al*., 2011).

Zooplankton at the air-sea interface are thought to be particularly sensitive to oil spills due to their proximity to high concentrations of dissolved oil and to the additional toxicity of photo-degraded hydrocarbon products at this boundary (Bellas *et al*., 2013). Following an oil spill zooplankton may suffer from loss of food in addition to the direct exposure of oil toxicity resulting in death from direct oiling as well as impaired feeding, growth, development, and reproduction (Blackburn *et al*., 2014 and references therein).

Tolerance to oil varies by species, and a study of Gulf of Mexico zooplankton communities found that mortality tended to be more dependent upon exposure time than concentration of oil, though the highest oil concentrations led to the highest mortalities (50% after 50 hours; Lee and Nicol, 1977). Although individual zooplankton species may have experienced relative mortality or enhanced growth, the direct negative effects of oil were probably largely offset by a decrease in predation.

The limited swimming ability of the free-floating early life stages (meroplankton i.e. eggs and larvae) of invertebrates such as sea urchins, molluscs and crustaceans renders them unable to escape oil-polluted waters. These early life stages are more sensitive to pollutants than adults and their survival is critical to the long-term health of the adult populations (Blackburn *et al*., 2014 and references therein). For example, the eggs and larvae of planktonic oysters exposed to oil show impaired development and decreased settlement of juveniles (Geffard *et al*., 2002a, 2002b; Choy *et al*., 2007). After the Prestige oil tanker spill off the northwest coast of Spain in November 2002, sea urchin embryo development was inhibited by as much as 50 % when fuel oil content in the water was over 3.8% whilst oil levels below 1.9 % did not appear to be toxic (Fernandez *et al*., 2006).

Generally, studies on the long-term effects of oil contamination on plankton are limited because few regions have comprehensive pre-spill data on plankton communities to use for comparison and the large degree of natural variability in plankton populations and the effects of ocean processes and climate on their distribution can further complicate detection of impacts. Existing research has shown substantial short and long-term toxicity of oil and its weathered by-products to eggs, larvae and mature zooplankton following large spills. Johansson *et al*. (1980) documented short term impacts on zooplankton biomass in the month following the Tsesis oil spill off the coast of Sweden in 1977. Though the guts and feeding appendages of the zooplankton were contaminated with oil for the three-week duration of the study suggesting the potential for even longer term population effects, the actual biomass levels were re-established within five days. In contrast the 480,000 metric tonne loss of oil over a 10-month period from the Ixtoc I well in the Gulf of Mexico in 1979 resulted in a fourfold decrease in zooplankton concentrations for three years afterwards (Guzmán del Próo *et al*., 1986).

The distribution of plankton across the UKCS is generally uniform and widespread such that when the volume of water impacts by a blowout at Alligin is taken into account the severity of impact is considered to be a (2).

Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.2 Impact on benthic animals

As described in Section D.2.4 concentrations of 50 mg/kg (i.e. 5g / m^2) and above are considered to result in discernible impacts on benthic animals. The modelling predicted that the area of sediment within which this threshold would be exceeded following a subsea well blowout could be up to c. 2,000 km^2 (Figure 11-4). None of the oil is expected to impact the sediment at this concentration within the Faroe Shetland Sponge Belt NCMPA, rather from Figure 11-4 it can be seen that the areas impacted at these concentrations are located in closer proximity to the Shetland Islands.

Oil that becomes emulsified or dissolves in the water column can attach to suspended particles and sink to the bottom thus becoming more bioavailable to benthic species (Meador, 2003). In response to oil exposure, benthic animals can either move, tolerate the pollutant (with associated impacts on the overall health and fitness), or die (Gray *et al*., 1988; Lee and Page, 1997). The response to oil by benthic species differs depending on their life history and feeding behaviour as well as the ability to metabolise toxins, especially PAH compounds. Benthic species could be vulnerable to oil deposition in the sediment, which has been investigated in the oil spill modelling.

Gardline (2014) found the most dominant infaunal species recorded across Quad 204 were characteristic of gravelly sandy sediments of the north-east Atlantic, with polychaetes representing 50% of the individuals sampled. The taxa echinodermata (specifically *Cidaris cidaris*) and Arthropoda (specifically *Munida sp*.) were also observed in the wider Alligin area (Gardline, 2017b).

The responses of polychaete populations to oil spills are complex and varied and are thought to differ depending on their different feeding strategies and trophic relationships in benthic environments. Some species decrease in abundance after an oil spill whilst others may be the first colonisers in the aftermath of oil spill die-offs (Blackburn *et al*., 2014 and references therein). Some polychaetes contribute to biodegradation of oil in sediments whilst some have different abilities to metabolise contaminants (Bauer *et al*., 1988; Driscoll and McElroy, 1997).

The different response of polychaetes to oil pollution is likely a consequence of their different feeding strategies and trophic relationships in benthic environments. For example, *Capitella capitata* has been found to be amongst the first colonisers in the aftermath of a spill. This species thrives in the absence of competition and is a non-selective deposit feeder consuming detritus and algae and benefitting from organic pollution. In contrast *Heteramalla sarsi* is a predatory polychaete that feeds on benthic amphipods. Numbers of this species dropped to less than 5 % of their pre-spill biomass following the 1977 Tseis oil spill in the Baltic Sea. This decrease in polychaetes was in correlation with a decrease observed in amphipods in the region (Elmgren *et al*., 1983). The highest recorded abundance of polychaete (*Paramphinome jeffreysii)* occurring in the area is reported to be tolerant of hydrocarbon concentrations (Olsgard and Grey, 1995).

Acute oil toxicity to echinoderms following major oil spills have resulted in significant starfish mortality e.g. a large number of starfish mortalities resulted from the grounding of the Morris J Bergman barge in Puerto Rico in 1994 and from the Erika oil spill off France in 1994 (Mignucci-Giannoni 1999; Joly-Turquin *et al*., 2009). Multiple sub lethal impacts of oil pollution on starfish have also been documented in laboratory studies including detrimental effects on growth, locomotion, ability to detect prey and feeding behaviour (Ordzie and Garofalo 1981; O'Clair and Rice 1985; Temara *et al*., 1999). The magnitude of these effects differed depending on the type of oil and/or starfish species.

Significant negative impacts have been observed on amphipod populations following oil spills. For example, amphipod populations in several families were supressed for up to six years at sites impacted by the 1989

Exxon Valdez spill in Prince William Sound, Alaska (Jewett and Dean, 1997). After the 1978 Amoco Cadiz spill off the Atlantic coast of France, ampeliscid amphipods were completely absent from sites where they had been the dominant population (Dauvin, 1982). Recolonisation of impacted areas was low and amphipod densities did not reach pre-spill levels for 11 years, which likely had impacts on amphipod-eating fish (Dauvin, 1982). After the 1977 Tseis oil spill in the Baltic Sea, amphipods (*Pontoporeia* spp) at oiled sites were reduced to less than 5 % of their pre-spill biomass. Surviving females produced significantly greater numbers of abnormal larvae and population recovery was not detected for almost three years after the spill (Elmgren *et al*., 1983).

Amphipods are possibly especially sensitive to the effects of local pollution because of their low dispersal rate, limited mobility and lack of a planktonic larval stage.

An accidental release in the event of a subsea blowout in the Alligin Field could have a significant impact on molluscs found in the area such as *Bivalvia sp*. (Gardline, 2017b). These filter feeders will ingest oil from the water column. Filter feeders tend to have a limited capacity to metabolise hydrocarbons such that toxic PAH compounds have been shown to accumulate in filter feeders (Blackburn *et al*., 2014 and references therein; Menon and Menon, 1999). Cellular pathologies observed in the tissues of benthic bivalves may be linked to chronic oil exposure and to the uptake from contaminated sediments (Neff and Haensly 1982; Berthou *et al*., 1987).

The generally widespread distribution of benthic species populations on the UKCS means that they are unlikely to be significantly affected at the population level, rather the impact would be more on an individual animal level. In addition, seabed oil concentrations would not reach levels at which discernible impacts on benthic animals would be expected within the Faroe Shetland Sponge Belt NCMPA. However, given the area of seabed impacted at these toxic concentrations, the impact severity on benthic communities is considered to be (3). Section 11.2.3 considers the overall environmental risk of a blowout when the impact on all receptors as a whole is considered.

11.2.2.3 Impact on fish

The oil spill modelling predicted that the total impacted cumulative (over the whole model run) volume of water where concentrations were above 25 ppb could be up to 11,800 km^3. The modelling also predicted that water column concentrations ≥ 25 ppb would likely still persist up to 2.5 days after the cessation of hydrocarbon release from the subsea well blowout. As discussed in Appendix D Section D.2.4, concentrations ≥ 25 ppb is the concentration considered to cause acute effects on fish.

Exposure of fish to contaminants can occur either through uptake of dissolved fractions across the gills or skin or direct digestion of the pollutant. Fish spending the majority of their life-cycle in the water column are likely to receive the highest exposure to contaminants that remain in solution though some will also accumulate sediment bound contaminants indirectly through their diet (i.e. digestion of animals that have accumulated the contaminants in their tissues). Fish associated with the seabed (e.g. flatfish) are more exposed to particle bound contaminants with the main exposure route being either directly through ingestion of contaminated sediments or through their diet. Seabed dwelling organisms can also absorb contaminants through the surface membranes as a result of contact with interstitial water. Once the oil disappears from the water column fish generally lose their oil content very quickly. This rapid loss of oil from fish tissue is linked to the fact that fish will metabolise accumulated hydrocarbons very rapidly (Krahn *et al*. 1993).

Test results following the Braer oil spill south of Shetland in 1993 showed that a spill of that size (*c*. 85,000 tonnes), in which the oil is rapidly dispersed through the water column can quickly lead to highly contaminated and tainted fish and shellfish. This differs to the observations made following the Sea Empress spill off the southwest of Wales in 1996 (*c*. 72,000 tonnes) whereby hydrocarbon and PAH concentrations in all species

of finfish, including migratory salmon and sea trout, remained low throughout the incident. Following the Braer incident it was observed that PAH levels in individual sandeels did not differ between samples taken from sites differing in exposure levels. This is presumed to indicate that the rate of metabolism is sufficient to control the accumulation of these substances in fish. Observations on sea bass following the Sea Empress oil tanker spill showed that in the first year sea bass recruitment was reduced, however this impact was short lived with recruitment returning to original levels the following year. Similarly, overall sandeel densities a year after the Braer incident were found to have returned to pre-spill densities. In both instances the finfish fisheries were reopened before the shellfish fisheries.

Following the Braer incident some shellfish (particularly crustaceans) were found to lose hydrocarbons from their tissue as quickly as finfish while others (molluscs) lose their accumulated hydrocarbons much more slowly (Topping *et al*. 1997). Crabs and lobsters retained significant levels of contamination (up to 225 µg/kg) for a longer period while molluscs were found to accumulate the highest concentrations of PAHs e.g. levels detected in some scallop gonads were up to 20,000µg/kg wet weight. Lower concentrations were seen in whelks which are likely to be a result of the fact that they are carnivores rather than filter feeders, the latter ingesting dispersed oil droplets directly.

Following the Exxon Valdez spill in 1989, fish embryos and larvae were chronically exposed to partially weathered oil in dispersed forms that accelerate dissolution of 3, 4- and 5-ringed hydrocarbons. Laboratory experiments showed that these multiringed PAHs from partially weathered oil at concentrations as low as 1 ppb are toxic to pink salmon eggs exposed for the months of development and to herring eggs exposed for 16 days (Peterson *et al*. (2003) and references therein). This process explains the elevated mortality of incubating pink salmon eggs in oiled rearing streams for at least 4 years after the oil spill (Bue *et al*., 1998). This long-term exposure had consequences for salmon and herring through indirect effects on growth, deformities, and behaviour with long term consequences on mortality and reproduction.

In conclusion the Sea Empress, Braer oil and Exxon Valdez oil spills did have adverse effects on the fish and shellfish communities in the areas of the oil spills. However, following a relatively short period, the fin fish fisheries were reopened with recruitment and densities of monitored stocks returning to pre-spill numbers a year later. Though fish stocks are expected to recover, a number of protected/designated fish species occur in the area that would be impacted by an oil spill (Sections 3.5.4 and 3.5.5), such that the environmental impact of a subsea well blowout at the Alligin Field location on fish is considered to be (3). Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.4 Impact on marine mammals

Marine mammals may be exposed to oil in one of two ways:

- Internally (swallowing contaminated water, consuming prey containing oil based chemicals, or inhaling of volatile oil related compounds); and
- Externally (swimming in oil or dispersants, or oil or dispersants on skin and body).

The effects of oil on marine mammals are dependent upon species but may include:

- Hypothermia due to conductance changes in skin;
- Toxic effects and secondary organ dysfunction due to ingestion of oil, congested lungs;
- Damaged airways;
- Interstitial emphysema due to inhalation of oil droplets and vapour;
- Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding;
- Eye and skin lesions from continuous exposure to oil;
- Decreased body mass due to restricted diet; and
- Stress due to oil exposure and behavioural changes.

The nature of the oil and how much it has weathered may also be an important factor in determining impacts on wildlife. Individuals oiled early in a spill may be exposed to the more toxic components of the oil by direct contact and ingestion and suffer greater toxicity than those affected by a more weathered oil.

There is little documented evidence of cetacean behaviour being affected by oil spills. Smultea and Wursig (1995) found that bottlenose dolphins apparently did not detect sheen oil and that although they detected slick oil, they did not avoid traveling through it. Evans (1982) observed that gray whales *Eschrichtius robustus* typically swam through oil seeps off California. Although the gray whales modified their swim speeds and breathing rates, there was no consistent pattern of behaviour regarding the presence of the oil. Lack of an olfactory system likely contributes to the difficulty cetaceans have in detecting oil.

Within 24 hours of the Exxon Valdez spill (42 million litres of crude) killer whales were observed within the slick which was several hundred kilometres long. Travelling whales e.g. killer whales, may spend three to ten minutes at a time under water and when they surface to breathe, they may have travelled hundreds of metres. Waves and darkness can reduce their visual ability at the surface and it is possible that individuals could resurface within a fresh slick and find it difficult to locate oil-free water (Matkin *et al*., 2008). In the months following the Exxon Valdez spill there were numerous observations of gray whales, harbour porpoises, Dall's porpoises and killer whales swimming through light to heavy crude oil sheens (Harvey and Dahlheim, 1994).

There is a growing body of evidence from the Gulf of Mexico in the aftermath of the Deepwater Horizon (DWH) oil spill. Bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico have shown depressed reproductive success rates (Kellar *et al*., 2017) and increased incidence of adrenal gland and lung lesions (Venn-Watson *et al*., 2015). Bottlenose dolphins from Barataria Bay, Louisiana showed a consistent change in immune function (increase in T and B lymphocyte proliferation) compared to dolphins unaffected by the DWH spill in Sarasota Bay, Florida. These changes are compatible with those documented in other species following exposure to oil or PAHs. Changes in these cell functions are compatible with an increase in bacterial infections caused by *Brucella*, and are compatible with an increase in bacterial pneumonia (De Guise *et al*., 2017).

The way a cetacean consumes its food affects the likelihood of it ingesting oil. Baleen whales, which skim the surface are more likely to ingest oil than "gulp feeders" or toothed whales. Baleen whales are particularly vulnerable to oil while feeding, as oil may stick to the baleen while the whales "filter feed" near oil slicks. Geraci and St. Aubins (1990) estimated that a long-finned pilot whale *Globicephala melas* would need to ingest 30 l of oil over a period of weeks in order to suffer severe effects. Chronic ingestion of subtoxic quantities of oil may have subtle effects which would only become apparent through long-term monitoring. The transfer of petroleum hydrocarbons through the mother's milk to suckling young is another way oil affects cetaceans.

Cetaceans have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces. Oil tends to adhere to rough surfaces, hair or calluses of animals, so contact with oil by cetaceans may cause only minor oil adherence.

Cetaceans can be susceptible to inhaling oil and oil vapour. This is most likely to occur when they surface to breathe. Several days after the Exxon Valdez spill, gray whales were observed swimming lethargically at the surface and oil fumes were recorded at an altitude of 200 m (references within Matkin *et al*., 2008). Inhaling oil and oil vapour may lead to damaging of the airways, lung ailments, mucous membrane damage or even death. A stressed or panicking dolphin tends to move faster, breathe more rapidly and therefore surface more frequently into oil and increase exposure. Following the Exxon Valdez spill a coated Dall's porpoise was observed to be stressed and remaining at the surface for extended periods of time (Harvey and Dahlheim, 1994).

Seals are very vulnerable to oil pollution because they spend much of their time near the surface and regularly haul out on beaches. Seals have been seen swimming in oil slicks during a number of documented spills (Geraci and St. Aubins, 1990). Most pinnipeds scratch themselves vigorously with their flippers but do not lick or groom themselves so are less likely to ingest oil from skin surfaces. However, a pinniped mother trying to clean an oiled pup may ingest oil. The risk of oiling increases for pinniped pups. They spend much of their time in rocky shore areas and tidal pools where spilt oil can accumulate. Recent evidence suggests that pinniped pups are very vulnerable during oil spills because the mother/pup bond is affected by the odour and pinnipeds use smells to identify their young. If the mother cannot identify its pup by smell in the large colony it may not feed the pup, and this leads to abandonment and starvation.

Oil can impact on the mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, anal and urogenital orifices of seals. This can cause corneal abrasions, conjunctivitis and ulcers. Consumption of oil-contaminated prey will lead to the accumulation of hydrocarbons in tissues and organs. Spraker *et al*. (1994) found four types of lesions characteristic of hydrocarbon toxicity in the brains, principally the thalamus, in oiled seals collected months after the Exxon Valdez spill.

Given the occurrence of marine mammals in the area impacted (Section 3.4.5) and their protected status (Section 3.5.4) the environmental impact of a subsea well blowout at the Alligin Field location on marine mammals is considered to be (3). Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.5 Impacts on Seabirds

The probability of a visible surface sheen with a thickness > 0.3 µm is predicted to extend as far as 490 km east and 915 km northeast with 90-100 % probability (Figure 11-1). As discussed in Section D.2.4 a sheen thickness > 0.3 µm is the minimum thickness expected to produce negative impacts on sea life encountering oil at the sea surface.

Birds are vulnerable to oiling from surface oil pollution, which can cause direct toxicity through ingestion and hypothermia as a result of a bird's inability to waterproof their feathers. Oil pollution can also impact birds indirectly through contamination of their prey. Seabird species vary greatly in their responses and vulnerability to surface pollution, therefore in assessing their vulnerability it is important to consider species-specific aspects of their feeding, breeding and population ecology (White *et al*., 2001).

Species that spend a greater proportion of their time on the sea surface are considered to be more at risk from the effects of surface pollution; for example, auk species (e.g. guillemot, razorbill, little auk and puffin) are more likely to be affected than the highly aerial petrels. Species that are wholly dependent on the marine environment for feeding and resting (e.g. procellarids such as northern fulmar) are considered more vulnerable to the effects of surface pollution than species that use offshore areas only seasonally or move offshore only to rest or roost. Additionally, the potential reproductive rate of a species will influence the time taken for a population to recover following a decline. Other factors such as mortality and migration rates, species abundance and conservation status (e.g. globally threatened) shall also determine the effects of an oil spill on seabird populations.

With such large quantities of oil released, transient surface sheens can be expected for several weeks after the spill has ceased, and oil will continue to be released from any affected shorelines.

The sensitivity of birds to surface oil pollution in the immediate vicinity of the Alligin Field is is generally low throughout the year (Section 3.4.4), however given the wide area impacted and the fact that a number of protected birds from the SPAs on Shetlands, Orkney etc. will be impacted the environmental impacts is considered to be (4). Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.6 Impact on offshore protected areas

A number of offshore protected areas would be affected by hydrocarbon released as a result of a subsea well blowout at the Alligin Field location. The Alligin field is located within the Faroe-Shetland Sponge Belt NCMPA. As discussed previously (Section 11.2.2.2) sediment hydrocarbon concentrations within this NCMPA would not be expected to exceed toxic concentrations. Similarly, when the results shown in Figure 11-4 are considered in relation to the location of offshore protected areas (Section 3.5) toxic hydrocarbon concentrations within sediments are not expected within any offshore protected areas. However toxic water column and surface concentrations are expected within other offshore designated sites such that some of the designated features may be impacted e.g. birds feeding in the Seas of Foula pSPA. Therefore, though none of the designating features associated with the Faroe Shetland Sponge Belt NCMPA (Section 3.5.3) are likely to be significantly impacted by a subsea well blowout at the Alligin Field location, the environmental impact is considered to be (4) due to the potential impact on designated features at other offshore sites. Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.7 Impact on the coast including protected areas

Modelling results show that there is a 100 % probability of oil beaching at a concentration > 100 g/m^2 on the Shetland and Norwegian coast lines. Probability of beaching on Mainland UK (45 %), Orkney (73%), Sweden (17%) and Denmark (8 %) is lower (Section D.3.2). Concentrations > 100 g/m^2 are considered to be the impact threshold for oiling of birds whilst benthic epifaunal invertebrates living on hard substrates in intertidal habitats would be coated at these concentrations (see Section D.2.4).

The modelling predicted that the highest concentrations of oil arriving on the Shetlands could be as high as 12 kg/m^2 (heavy oiling) although most oiling is moderate to light. The coastal SPAs and SACs in Shetland with a high probability of being impacted include:

- Papa Stour SAC
- Foula SPA
- Sumburgh Head SPA
- Sullom Voe SAC
- Ronas Hill – North Roe and Tingon SPA
- Ramna Stacks and Gruney SPA
- Otterswick and Graveland SPA
- Pobie Bank Reef SAC
- Hermaness, Saxa Vord and Valla Field SPA

Internationally, the coast of Norway has many small protected sites that are mainly designated for seabirds. In addition, some sites are protected for their local mammal populations or their geomorphological features of importance (see Figure 11-5).

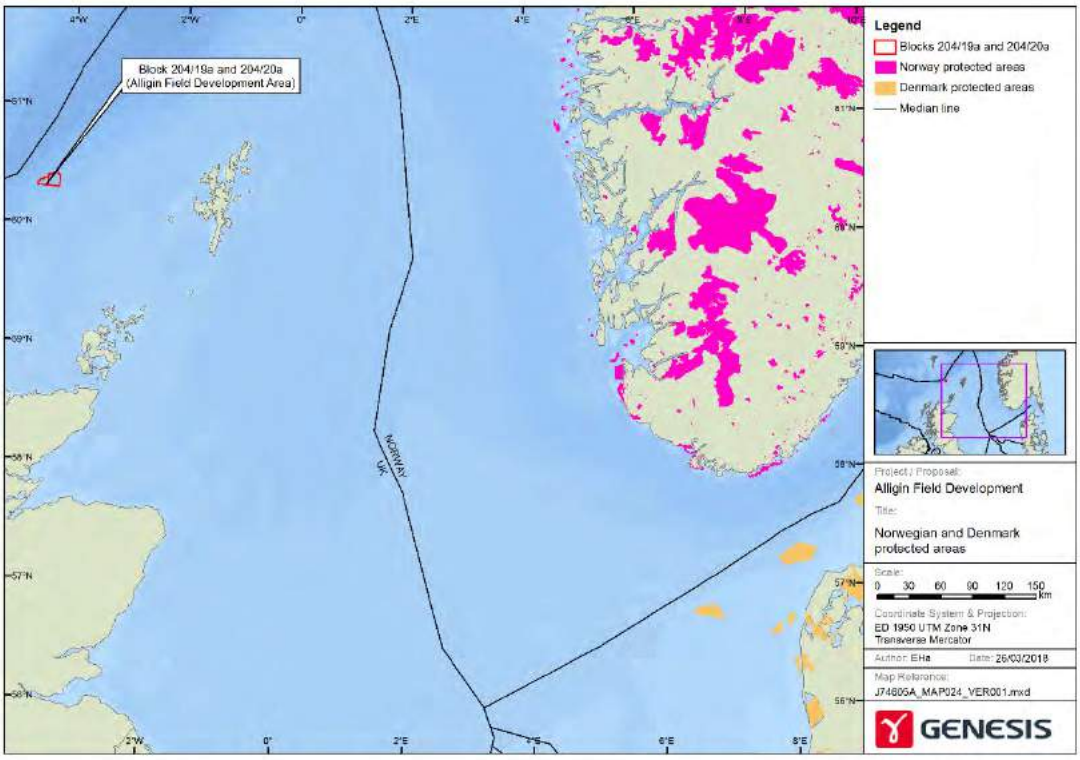

Figure 11-5: Norwegian and Denmark protected areas
(Source: Miljodirektoratet - Norwegian environment directorate; OSPAR, 2013 (accessed 2018)).

Due to the potentially large volumes of oil that could beach at some areas (up to 12 kg/m^2 in some areas of Shetland: detailed in Section D.2.4) and the fact that designated areas are very likely to be impacted, the environmental impact of a subsea well blowout at the Alligin Field location is considered to be (4). Section 11.2.3 considers the overall environmental risk of a subsea well blowout when the impact on all receptors as a whole is considered.

11.2.2.8 Impact on aquaculture

Section 3.6.4 shows the location of finfish and shellfish farms at Shetland and Orkney. The results of the modelling indicate a 100% probability of beaching at toxic concentrations and a 100% probability of toxic water concentrations in the area of some aquaculture sites. Therefore, the environmental and social impact of a subsea well blowout at the Alligin Field on aquaculture is considered to be (3).

11.2.2.9 Impact on shellfish water protection sites

Section 3.6.5 shows the location of Shellfish Water Protection Sites, a number of which occur on the Shetland Islands. Given the probability of toxic water column concentrations in the vicinity of these sites the environmental impact of a subsea well blowout at the Alligin Field on Shellfish Water Protection Sites is considered to be (3).

11.2.3 Summary of Impact and Overall Risk to Receptors

Table 11-3 summarises the severity of the environmental impact of a subsea well blowout at the Alligin Field location on the receptors considered.

Table 11-3: Summary of impacts on environmental sensitivities.

Receptor	Severity of impact
Plankton	(2)
Benthos	(3)
Fish	(3)
Marine mammals	(3)
Seabirds	(4)
Offshore protected areas	(4)
Coast and onshore protected areas	(4)
Aquaculture	(3)
Shellfish Water Protection Sites	(3)

When all receptors are taken into account the severity of the environmental impact is considered to be (4). Following the application of mitigation measures, the ENVIID considered the likelihood of such an event to be of low probability ((2) i.e. such an event has happened in the industry). The overall environmental risk is therefore considered to be major. However, it should be noted that if the likelihood of such an event was considered within the UKCS/North Sea, the environmental risk would be considered moderate as the likelihood would be (1) following application of the mitigation measures described in Section D.4 and summarised in 11.7. The environmental risk of such an accidental event is therefore considered tolerable and will be reduced to ALARP through management under the mitigation measures described.

11.3 Decommissioning Phase

During decommissioning activities, the impact of any accidental events are anticipated to be within the impacts discussed above.

11.4 Transboundary Effects

Of the accidental events discussed, only the impact of a well blowout is expected to result in any transboundary impacts. The modelling suggests that the probability of crossing different median lines and the time to cross them varies depending on the time of year, though there is a 100 % chance of it crossing the UK/Norway and UK//Faroe median lines.

Table 11-4: Time for hydrocarbons to cross median lines following a subsea well blowout.

Median line	Probability (>5%) of crossing and minimum time to reach (days)							
	Dec to Feb		Mar to May		Jun to Aug		Sep to Nov	
	Prob	Days	Prob	Days	Prob	Days	Prob	Days
UK – Norway	100%	5	100%	5	100%	4	100%	5
Norway – Denmark	17 %	45	20%	59	17%	60	25%	50
Denmark – Sweden	8 %	51	7%	97	9%	82	11%	62
Norway – Sweden	6 %	52	8%	91	7%	87	11%	63
UK – Faroe Islands	100%	1	100%	1	100%	1	100%	1

However as discussed the likelihood of a subsea well blowout at the project location following the mitigation measures described in Section D. 4 is considered unlikely such that the environmental risk of transboundary impacts is considered moderate.

11.5 Natural Disasters

Some natural disasters could increase the risk of a major pollution event occurring at the proposed Alligin Field Development. For example, an earthquake could lead to damage to the subsea infrastructure and potential loss of well control. The likelihood of an earthquake of sufficient magnitude on the UKCS to impact seabed infrastructure is extremely remote.

Climate change effects, such as sea level change and extreme weather events, are not considered to alter significantly the range of effects considered. Extreme weather may make accidents to the drilling rig more likely, but the rig has procedures in place for making safe and shutting down operations during extreme weather, along with emergency procedures in the case of rig damage, and a full loss of fuel inventory has been considered in the Glen Lyon OPEP.

11.6 Major Environmental Incident Assessment

The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015 (SCR 2015) apply to oil and gas operations on the UKCS. The primary aim of SCR 2015 is to reduce the risks from Major Accident Hazards (MAHs) to the health and safety of the workforce employed on offshore installations or in connected activities. The Regulations also aim to increase the protection of the marine environment and coastal economies against pollution and ensure improved response mechanisms in the event of such an incident.

As part of the introduction of the SCR 2015 regulations there is now a requirement to include environmental information in the Safety Case that was not previously required. For example, the potential for a Major Environmental Incident (MEI) from the installation and/or within the 500 m safety zone must be considered and assessed as part of the MAH, and a description of the results must be included within the Safety Case. An MAH could be a fire, explosion, loss of well control or the release of a dangerous substance that results in loss of life. A MEI is the outcome of a MAH which is likely to result in significant adverse effects on the environment.

The likelihood of major releases of oil from the Alligin wells or the tieback to the Glen Lyon FPSO is very low. The environmental assessment within the Glen Lyon Safety Case addresses a range of representative oil release scenarios from the Glen Lyon FPSO and associated wells. The main potential impacts identified, in the event of a significant release of oil to sea, are degradation of offshore benthic habitats, stranding of oil on the coastlines of Scotland mainland and the northern isles (Orkney and Shetland) where there are numerous SACs and SPAs, seasonal offshore seabird vulnerability, seasonal fish sensitivities and cetacean sensitivities. It is therefore concluded that a large release of oil to sea related to the Alligin Field could lead to impacts that would qualify as a MEI as defined in SCR 2015, if the release was associated with a major accident.

11.7 Mitigation Measures

The mitigation measures associated with potential accidental events are captured in Sections 5 to 10. More specifically the mitigation measures associated with preventing a subsea well blowout are detailed in Section D.4 and summarised here.

Proposed Mitigation Measures

- Activities will be carried out by trained and competent offshore crews and supervisory teams;
- An approved Offshore Pollution Emergency Plan (OPEP) will be in place prior to any activities being undertaken;
- Records will be kept of oil spill training and exercises as required by the OPEP;
- A co-ordinated industry oil spill response capability will be available;
- Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for BPEOC personnel;

Wells specific control measures:

- A robust BOP pressure and functional testing regime will be in place;
- Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed, as well as visual integrity checks whenever BOPs are recovered to the surface will be undertaken; and
- Appropriate mud weights will be used to ensure well control is maintained;
- In case of an emergency, arrangements will be in place with a well capping provider to provide specialist advice and support;

Operations-specific control measures:

- Import and export facilities will be secured by a combination of topside Emergency Shut Down Valves (ESDV) and Subsea Isolation Valves (SSIV);
- Pipelines will be protected by pressure alarms and a leak detection system; and
- Oil spill control measures will be followed as outlined in the OPEP.

Applying the risk assessment methodology described in Section 4, three accidental events were identified to have a moderate environmental risk such that the risks are acceptable once reduced to ALARP and managed under the mitigation measures identified. One accidental event, a subsea well blowout, was considered to be a major risk due to its potential impact on the receptors impacted and because such an event has been known to occur within the industry. However, if the likelihood of such an event was considered within the UKCS/North Sea, the environmental risk would be considered moderate as the likelihood would be (1) following application of the mitigation measures described in Section D.4 and summarised above. The environmental risk of such an accidental event at the Alligin Field is therefore considered tolerable and will be reduced to ALARP through management under the mitigation measures described.

12. CONCLUSIONS

A detailed assessment of the potential environmental impacts associated with the proposed Alligin Field Development Project has been carried out, and the EIA process will continue throughout the project. The identification of the potential impacts is based on the nature of the proposed activities and was informed by available literature and guidance documents, industry specific experience and consultation with BEIS and their advisors. The commitments made in this ES will be incorporated into environmental management plans for the drilling, installation and operations phases of the development.

12.1 Environmental Effects

The development area is located WoS in a mature oil and gas province.

The potential impacts to the environment from all phases of the project were assessed. The environmental aspects of each of the key activities for each phase of the development were identified and quantified in terms of their duration (or likelihood with regards to accidental events) and the severity of impact. The results were assessed on the basis of the risk posed to the environment and were summarised as being either negligible, minor, moderate or major in significance.

The environmental impact assessment considered both planned activities and unplanned events. The assessment showed that the majority of the planned activities are of negligible or minor risk. Following identification of mitigation measures two planned activities were considered to be a moderate risk, whilst none were found to be a major risk (Table 12-2 and Appendix C).

The risk of three unplanned events were considered to be of moderate significance following mitigation. A well blowout was the only unplanned event considered found to present a major risk which was driven by the severity of the impact rather than the likelihood.

Table 12-1: Activities identified to have a moderate or major significance of risk.

Aspect	Activity	Significance of risk following mitigation
Seabed disturbance	Installation of subsea infrastructure e.g. manifold, FTA, pipelines, umbilicals, jumpers, stabilisation features etc.	Moderate
Seabed Disturbance	Discharge of drill cuttings and associated WBMs.	Moderate
Unplanned / accidental events	Release of hydrocarbons / chemicals to sea (e.g. from drains, bunkering operations etc.).	Moderate
	Major release to sea of drilling rig fuel hydrocarbon inventory in the result of a vessel collision.	Moderate
	Well blowout (uncontrolled hydrocarbon release in the event of loss of well control).	Major
	Alligin flowline rupture and subsequent release of hydrocarbons to sea.	Moderate

12.2 Minimising Environmental Impact

Following identification of suitable mitigation and control measures, additional assessment was undertaken for the activities initially identified as moderate or major risk. This includes quantification of seabed disturbance, modelling of drill cuttings discharges and oil spill modelling. Following implementation of identified mitigation and control measures, all residual risks to the environment are considered to be ALARP.

The execution of the proposed Alligin Field Development Project, incorporating the control measures identified in this ES, is not expected to have a significant impact on the environment.

Routine atmospheric emissions and discharges to sea would be expected to disperse within a limited distance from the development. It is therefore unlikely that planned emissions and discharges will have a transboundary impact given that the nearest median line (UK/Faroe median line) is *c*. 20 km from the proposed development. Hence no significant transboundary impacts were identified as a result of planned activities. There is a risk of transboundary impacts associated with an accidental spill/release of oil, as discussed in Section 11, Measures will be in place to minimise the likelihood of such an event occurring. However, should an uncontrolled release occur there will be measures in place to ensure a co-ordinated and co-operative response (Section 11).

12.3 Commitments

Project specific commitments and mitigation measures to minimise the impact of the proposed Alligin Field Development Project on the environment have been highlighted throughout the ES and are summarised in Table 12-2. These will be captured in the project environmental management plan, which includes roles and responsibilities for their implementation.

Table 12-2: Alligin Field Development project commitments.

Aspect	Commitments
Physical presence	• Ongoing consultation with SFF; • Notice to Mariners will be circulated prior to rig mobilisation; • Notice will be sent to the NLB of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the semi-submersible drilling rig; • The Deepsea Aberdeen drilling rig will abide by CtL conditions; • A Collision Risk Management Plan will be produced if determined to be required; • All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.; • The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations; • Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site; • Flowlines will be designed in accordance with industry standards to minimise buckling and to minimise interactions with fishing gear; • All infrastructure will be laid within an existing charted Offshore Area Development; • A 500 m safety zone will be applied for at the Alligin drill centre whilst the infrastructure at Loyal will be laid within the existing 500 m exclusion zone at that drill

Aspect	Commitments
	centre; and • The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with industry SFF best practice.
Emissions to air	• The drilling rig will be subject to audits ensuring compliance with UK legislation; • The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity; • During drilling there will be adherence to good operating practices and maintenance programmes; Emissions from combustion equipment are regulated through EU ETS and PPC Regulations. As part of the PPC permit the following measures will be in place: • During production there will be adherence to good operating practices, maintenance programmes and optimisation of quantities of gas flared during emergency shut-downs; • The emissions from the combustion equipment will be monitored; • Plant and equipment will be subject to an inspection and energy maintenance strategy; • UK and EU air quality standards are not exceeded; • Fuel gas usage will be monitored; and • Energy assessments will be carried out as required.
Discharges to sea	• Deepsea Aberdeen is audited under BPEOC's marine assurance standards and subject to rig recertification audits; • All vessels used will be MARPOL compliant; • Where technically feasible BPEOC will prioritise the selection of PLONOR, or chemicals with a lower RQ; • The base case is for total reinjection of PW (reaching a minimum target of 95 % availability); and • The discharges of PW and associated chemicals are regulated by the OPPC and OCR regulations and reported through the Environmental Emissions Monitoring Scheme (EEMS). As such, during abnormal operations, BPEOC will ensure that sampling, analysis and reporting are undertaken in line with the regulations and permit conditions.
Seabed disturbance	• Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors; • Use of dynamically positioned vessels; • Surface laid pipelines; • The use of mattresses, rockdump and grout bags will be minimised through optimal project design; and • Sharing Alligin Site and Pipeline Route Survey reports with JNCC and MSS.

Aspect	Commitments
Underwater noise	• Optimise duration of drilling and installation activities. • No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels.
Waste	• BPEOC will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; • Existing asset and vessel WMPs will be followed; • Only permitted disposal yards / landfill sites will be used.
Accidental events	• Activities will be carried out by trained and competent offshore crews and supervisory teams; • An approved Offshore Pollution Emergency Plan (OPEP) will be in place prior to any activities being undertaken; • Records will be kept of oil spill training and exercises as required by the OPEP; • A co-ordinated industry oil spill response capability will be available; • Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for BPEOC personnel; Wells specific control measures: • A robust Blowout Preventer (BOP) pressure and functional testing regime will be in place; • Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed, as well as visual integrity checks whenever BOPs are recovered to the surface will be undertaken; and • Appropriate mud weights will be used to ensure well control is maintained; • A contract will be in place with a well capping advice provider, in case of emergency; Operations-specific control measures: • Import and export facilities will be secured by a combination of topside Emergency Shut Down Valves (ESDV) and Subsea Isolation Valves (SSIV); • Pipelines will be protected by pressure alarms and a leak detection system; and • Oil spill control measures will be followed as outlined in the OPEP.

12.4 Overall Conclusion

BPEO on behalf of itself and its Co-Venturer, Shell, is proposing to develop the Alligin Field located, *c*. 140 km West of Shetland within the Faroe-Shetland Sponge Belt NCMPA. The hydrocarbon reservoirs of the proposed Alligin Field Development Project are well understood (based on the industry's history of drilling and field development in this area of the North Sea) and will be developed using proven technology incorporating current best practices and latest generation equipment. A robust design, strong operating practices and a highly trained workforce will ensure the proposed development does not result in any significant long-term environmental, cumulative or transboundary effects. Additional measures will also be in place during the operating phase to effectively respond to potential emergency scenarios.

The ES assesses the worst case impact of the project on the environment and is therefore very conservative. Even then applying the mitigations measures identified it is the conclusion of this ES that the current proposal for the Alligin Field Development can be completed without causing any significant long term environmental impacts or cumulative and transboundary effects.

13. REFERENCES

Atlantic Frontier Environmental Network (AFEN) (2000). Atlantic Margin Environmental Surveys of the Seafloor 1996 and 1998. AFEN Final Report, 2000 (CD-Rom)

AFEN (2001). The UK Atlantic Margin Environment – Towards a better understanding. Aurora Environmental and Hartley Anderson. AFEN, Aberdeen.

Abbriano, R., Carranza, M.M., Hogle, S.L., Levin, R.A., Netburn, A.N., Seto, K.L., Snyder, S.M., and Franks, P.J.S. (2011). Deepwater Horizon oil spill: A review of the planktonic response. Oceanography 24:294-301.

Adebanjo, O. and Simms, N. (2016). Upheaval buckling of pipelines. Journal of pipeline engineering incorporating the journal of pipeline integrity. School of applied science, Cranfield University, UK.

Almeda, R., Wambaugh, Z., Wang, Z., Hyatt, C. Liu, Z. and Buskey, E.J. (2013). Interactions between zooplankton and crude oil: toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. PloS ONE 8(6): e67212.

Bakke, T., Green, N.W. and Pedersen, K.N.A. (1985). Drill cuttings on the seabed Phase 1 & 2 field experiment on benthic recolonisation and chemical changes in response to various types and amounts of cuttings. Report prepared by the Norwegian Institute for Water research, Oslo.

Bakke, T., Klungsøyr, J. and Steinar, S. (2013). Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry. Marine Environmental Research 92: 154-169.

Basford, D., Elefherious, A. and Raffaelli, D. (1990). The infauna and epifauna of the northern North Sea. Netherlands Journal of Sea Research. 25: 15-173.

Bauer J.E., Kerr R.P., Bautista M.F., Decker C.J., and Capone D.G. (1988). Stimulation of microbial activities and polycyclic aromatic hydrocarbon degradation in marine sediments inhabited by *Capitella capitata*. Marine Environmental Research 25(1):63-84.

BEIS (2018). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide. Published March, 2018. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/692941/OPRED_EIA_Guidance_-_2018_Revision_4_-_22_Mar_18.pdf (Accessed 04/18).

Bell, J.J., McGrath, E., Biggerstaff, A., Bates, T., Bennett, H., Marlow, J. and Shaffer, M. (2015). Sediment impacts on marine sponges. Marine Pollution Bulletin 94(2015) 5-13.

Bell, J.J. and Barnes, D.K., (2000). A sponge diversity centre within a marine 'island'. Anonymous Island, ocean and deepsea biology. Springer, pp. 55-64.

Bellas, J., Saco-Álvarez, L., Nieto, Ó., Bayona, J.M., Albaigés, J. and Beiras, R. (2013). Evaluation of artificially-weathered standard fuel oil toxicity by marine invertebrate embryogenesis bioassays. *Chemosphere*, *90*(3), pp.1103-1108.

Berthou F, Balouet G, Bodennec G, Marchand M. (1987). The occurrence of hydrocarbons and histopathological abnormalities in oysters for seven years following the wreck of the Amoco Cadiz in Brittany (France). Marine Environmental Research 23(2):103-133.

Bett, B.J. and Rice, A.L. (1992). The influence of hexactinellid sponge (*Pheronema carpenteri*) spicules on the patchy distribution of macrobenthos in the Porcupine Seabight (bathyal NE Atlantic). *Ophelia*, 36, pp.217-26.

Blackburn M., Mazzacano C.A.S., Fallon C., Black S.H. (2014). Oil in Our Oceans. A Review of the Impacts of Oil Spills on Marine Invertebrates. 152 pp. Portland OR: The Xerces Society for Invertebrate Conservation.

Bonn Agreement. (2009). Bonn Agreement Aerial Operations Handbook.

British Petroleum (BP) (2004). Schiehallion Wider Field Perspective – Environmental Statement. BP Document Reference Z-8000-ZS-4034.

BP (2013) Schiehallion and Loyal Decommissioning Programmes Phase I. Downloaded at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207203/Schiehallion_Loyal_Fields_Phase_1_Decommissioning.pdf . The supporting Environmental and Socio-Economic Impact Assessment can be downloaded at: http://www.bp.com/content/dam/bp/pdf/Schiehallion_Loyal_Decommissioning_Phase1_ESIA.pdf

BP (2014a). Schiehallion and Loyal Field Suspension. Supporting document to Marine Licence Application. Application for preparatory works. Version B13 submitted to DECC in July 2014.

BP (2014b). Schiehallion and Loyal Field Suspension. Supporting document to Marine Licence Application. Application for decommissioning works. Version B7 submitted to DECC in September 2014.

Bue, B.G., Sharr, S., Seeb, J.E. (1998). Evidence of damage to pink salmon inhabiting Prince William Sound, Alaska, two generations after the Exon Valdez oil spill. Trans. Am. Fish. Soc. 127: 35-43.

Callaway, R., Alsvag, J., de Boois, I., Cotter, J., Ford, A., Hinz, H., Jennings, S., Kroncke, I., Lancaster, J., Piet, G., Prince, P. and Ehrich, S. (2002). Diversity and community structure of epibenthic invertebrates and fish in the North Sea. ICES Journal of Marine Science 59: 1199-1214.

Centre for Environment Fisheries and Aquaculture Science (CEFAS) (2001). North Sea Fish and Fisheries. Technical Report TR_003. Technical report produced for Strategic Environmental Assessment – SEA2. DTI.

Certain, G., Jørgensen, L.L., Christel, I., Planque, B. and Bretagnolle, V. (2015). Mapping the vulnerability of animal community to pressure in marine systems: disentangling pressure types and integrating their impact from the individual to the community level. ICES Journal of Marine Science 75: 1470-1482.

Cetacean Stranding Investigation Programme (CSIP). (2011). UK Cetacean Strandings Investigation Programme. Final Report for the period 1st January 2005 – 31st December 2010. 98pp. Cetaceans Strandings Investigation Programme.

Chanin, P.R.F. (2003). Ecology of the European Otter *Lutra lutra*. Conserving Natura 2000 Rivers Ecology Series No.10. English Nature, Peterborough.

Choy, E.J., Jo, Q., Moon, H.B., Kang, C.K. and Kang, J.C. (2007). Time-course uptake and elimination of benzo(a)pyrene and its damage to reproduction and ensuing reproductive outputs of Pacific oyster, *Crassostrea gigas*. Marine Biology 151(1):157-165.

Clark, R. (1996). Oil Pollution. In Marine Pollution Third Edition, pp. 28-51.

Clarke, D.G. and Wilber, D.H. (2000). Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOERE9), US Army Engineer Research and Development Centre, Vicksburg, MS. 2000. Available at: http://www.dtic.mil/get-tr-doc/pdf?AD=ADA377325.

Colebrook, J.M. (1982). Continuous plankton records: seasonal variations in the distribution and abundance of plankton in the North Atlantic Ocean and the North Sea. Journal of plankton research. 4: 435-462.

Collie, J. S., Hall, S. J., Kaiser, M. J. and Poiner, I. R. (2000). A quantitative analysis of fishing impacts on shelf-sea benthos. Journal of Animal Ecology. 69: 785–798.

Committee on Climate Change (2015). Meeting Carbon Budgets – Progress in reducing the UK's emissions. 2015 Report for Parliament. Available at: https://www.theccc.org.uk/wp-content/uploads/2015/06/6.737_CCC-BOOK_WEB_030715_RFS.pdf.

Cormack, D. (1999). Response to Marine Oil Pollution- Review and Assessment (Vol 2).Dordecht: Springer Kluwer Academic.

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

Daan, N. (2006). Spatial and temporal trends in species richness and abundance for the southerly and northerly components of the North Sea fish community separately, based on IBTS data 1977-2005. ICES CM 2006 D:02: 1-10.

Dauvin J.C. (1982). Impact of Amoco Cadiz oil spill on the muddy fine sand *Abra alba* and *Melinna palmata* community from the Bay of Morlaix. Estuarine, Coastal and Shelf Science 14(5):517-531.

De Guise, S., Levin, M., Gebhard, E., Jasperse, L., Hart, L.B., Smith, C.R., Venn-Watson, S., Townsend, F., Wells, R., Balmer, B. and Zolman, E. (2017). Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the Deepwater Horizon oil spill. *Endangered Species Research*, *33*, pp.291-303.

de Robertis, A. and Handegard, N. O. (2013). Fish avoidance of research vessels and the efficacy of noise-reduced vessels: a review. ICES Journal of Marine Science. 70: 34-45.

Defra (2010). MB0102 2DB Distribution of *Arctica islandica* in the United Kingdom and Isle of Man. Marine Environmental Data and Information Network.

Department for Energy and Climate Change (DECC) (BEIS) (2011). Guidance notes on the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended). Guidance Notes for Industry. Version No. 2011/0 Issued October 2011. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193705/eiaguidancenote.pdf

Department of Energy and Climate Change (DECC) (2014). The United Kingdom Risk Based Approach Implementation Programme. Version 2, July 2014. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/517684/RBA_Implementation_Programme.pdf.

Department of Energy and Climate Change (DECC) (BEIS) (2016). Offshore Energy Strategic Environmental Assessment 3 (OESEA3). Available at: https://www.gov.uk/government/consultations/ukoffshore-energy-strategic-environmental-assessment-3-oesea3 [Accessed Nov 2017].

Draper, L. (1991). Wave climate atlas of the British Isles. HMSO, London.

Driscoll S.B.K., and McElroy A.E. (1997). Elimination of sediment-associated benzo(1)pyrene and its metabolites by polychaete worms exposed to 3-methylcholanthrene. Aquatic Toxicology 39:77-91.

ECB (2003). Technical Guidance Document on Risk Assessment. European Chemicals Bureau – Institute for Health and Consumer Protection. European Commission Joint Research Centre, Ispra, Italy.

EEMS data 2015. EEMS 2015 UKCS Emissions Data.

Ellis, J., Cruz-Martinez, A., Rackham, B. and Rodgers, S. (2004). The Distribution of Chondrichthyan fishes around the British Isles and implications for conservation. Journal of Northwest Atlantic Fishery Science. 35: 195-213.

Ellis, J., Milligan S., Readdy, L., Taylor, N. and Brown, M. (2012). Spawning and nursery grounds of selected fish Species in UK water. CEFAS Technical Report 147.

Ellis J & Heessen H (2015b). Lantern sharks (Etmopteridae). In: HJL Heessen, H Daan & JR Ellis (2015). Fish Atlas of the Celtic Sea, North Sea and Baltic Sea. Wageningen Academic Publishers, the Netherlands, pp. 87-88.

Elmgren R.S., Hansson S., Larsson U., Sundelin B., Boehm P.D. (1983). The Tsesis oil spill: Acute and long-term impact on the benthos. Marine Biology 73:51-65.

EMODnet (2017). European Seabed Habitat Maps. Available at: http://www.emodnet-seabedhabitats.eu.

Environmental Emissions Monitoring System (EEMS) (2008). EEMS-Atmospheric Emissions Calculations. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/136461/atmos-calcs.pdf

European Commission (EC). (2007). Interpretation Manual of European Union Habitats. Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

EC, European Commission, (2013). Interpretation Manual of European Union Habitats. Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

Essink, K. (1999). Ecological effects of dumping of dredged sediments; options for management. Journal of Coastal Conservation. 1999. 5: 69-80.

Evans, W. (1982). A study to determine if gray whales detect oil. In: Geraci J.R., St. Aubin D.J. (eds). Study on the effects of oil on cetaceans. Contract AA 551-CT9-22. Final report to U.S.

FeBEC. (2010). Sediment Dose Response Study. Technical Report. Prepared for Femern A/S. Doc. No. E4-TR-036. 147 pp.

Fernandez, N.A., Cesar, M.J., Salamanca, M.J., and DelValls, T.A. (2006). Toxicological characterisation of the aqueous soluble phase of the Prestige fuel-oil using sea-urchin embryo bioassay. Ecotoxicology 15:593-599.

French McCay (2009). Oil spill impact modelling: development and validation. Environmental Toxicology and Chemistry.

Fugro (2003). Seabed survey Schiehallion Phase V development UKCS Block 204/20. Report No: M1402. Undertaken on behalf of BP Exploration.

Fugro (2017). Alligin Site and Pipeline Route Survey. UKCS Quad 204. Field Report. Fugro Document No.: 179213-R-003(01). 6 December 2017. Undertaken on behalf of BP Exploration Operating Company Limited. In Draft.

Furness, R., and Wade, H. (2012). Vulnerability of Scottish Seabirds to offshore wind turbines. Macarthur Green ltd.

Gardline (2003). Schiehallion Phase IV, Phase V and Suilven Surveys. Volume 4. Report by Gardline Surveys Ltd, Great Yarnmouth, to BP, Aberdeen. Report number: 5917.4.

Gardline (2014). Foinaven and Schiehallion Environmental Survey. September.

Gardline (2017a) Schiehallion Central ROV Environmental Survey Footage – Data Analysis. Project Number 11046. Conducted 23rd May 2017.

Gardline (2017b) Schiehallion West ROV Environmental Survey Footage – Data Analysis. Project Number:11022. Conducted 17th February 2017.

Gardline Environmental Limited (GEL) (2006). South West Foinaven Environmental Survey, September 2006. Gardline Environmental Project Reference: 6978.3.

Gardline (2007). Schiehallion Environmental Survey.

GEL (2008). BP Foinaven and Schiehallion Environmental Survey Report (UKCS Blocks 240/19, 204/20 & 204/24), July 2007. Gardline Environmental Ltd, Great Yarmouth. July 2008

Gardline (2013). Foinaven and Schiehallion Environmental Survey – environmental monitoring report. Conducted August and September 2013. Project Number 9554-5.

Gordon JDM (2001). Deep-water fisheries at the Atlantic frontier. Continental Shelf Research 21: 987-1003.

Gordon JDM, Harrison EM & Swan SC (1994). A guide to the deep-water fish of the Northeastern Atlantic. Scottish Association for Marine Science (SAMS), Dunstaffnage, 24pp.

GEBCO. (2014). General Bathymetric Chart of the Oceans 30 arc second gridded bathymetry data. Data available at: http://www.gebco.net/data_and_products/gridded_bathymetry_data.

Geffard, O., Budzinski, H., and His E. (2002a). The effects of elutriates from PAH and heavy metal polluted sediments on *Crassostrea gigas* (Thunberg) embryogenesis, larval growth and bio-accumulation by the larvae of pollutants from sedimentary origin. Ecotoxicology 11: 403-46.

Geffard, O., Budzinski, H., His E., Seaman, M.N.L., and Garrigues, P. (2002b). Relationships between contaminant levels in the marine sediments and their biological effects upon embryos of oysters, *Crassostrea gigas.* Environmental Toxicology and Chemistry 21:2310-2318.

Geraci J.R and St. Aubins D.J. (1990). Sea Mammals and Oil. Confronting the Risks, Academic Press. ISBN-0-12-280600-X.

González, J., Figueiras, F. G., Aranguren-Gassis, M.,Crespo, B. G., Fernández, E., Morán, X. A. G., et al. (2009). Effect of a simulated oil spill on natural as-semblages of marine phytoplankton enclosed in mi-crocosms. Estuarine, Coastal and Shelf Science, 83(3),265–276.

Gray, J.S., Aschan, M., Carr, M.R., Clarke, K.R., Green, R.H., Pearson, T.H., Rosenberg, R. and Warwick, R.M. (1988). Analysis of community attributes of the benthic macrofauna of Frierfjord/Langesundfjord and in a mesocosm experiment. Marine Ecology Progress Series, pp.151-165.

Guzmán del Próo S.A., Chavez E.A., Alatriste F.M., de la Campa S., De la Cruz G., Gomez, L. Guadarrama, R., Guerra A., Mille S., and Torruco D. (1986). The impact of the Ixtoc-I oil spill on zooplankton. Journal of Plankton Research 8:557-581.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M.B., Scheidat, M., Teilmann, J., Vingada, J. and Øien, N. (2017). Estimates of cetacean abundance in

European Atlantic waters in summer 2016 from the SCAN-III aerial and shipboard surveys. Available at: https://synergy.st-andrews.ac.uk/scans3/category/researchoutput/ [Accessed May 2017].

Harrison, P.J., Cochlan, W.P., Acreman, J.C., Parsons, T.R., Thompson, P.A., Dovey, H.M. and Xiaolin, C. (1986). The effects of crude oil and Corexit 9527 on marine phytoplankton in an experimental enclosure. *Marine environmental research*, *18*(2), pp.93-109.

Harvey J.T., and Dahlheim M.E. (1994). Cetaceans in oil. In: Loughlin TR (ed) Marine mammals and the 'Exxon Valdez'. Academic Press, San Diego, CA, p 257–264.

Hayes, S. and Galley, L. (2013) SPE 164983, Modelling the Options for Managing Drill-Cuttings Piles on Decommissioning, prepared for the 2013 SPE European HSE Conference and Exhibition.

Health and Safety Executive (HSE) (2014). HSE Operations Notices. Available for download at: http://www.hse.gov.uk/offshore/notices/on_index.htm Accessed November 2016.

Health and Safety Executive. (HSE) (2009). Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995: Guidance on Identification of Offshore Installations. Available at: http://www.hse.gov.uk/offshore/notices/on_39.htm.

Henry, L.A. and Roberts, J.M. (2014). Applying the OSPAR habitat definition of deep-sea sponge aggregations to verify suspected records of the habitat in UK Waters. JNCC Report No. 508. Peterborough, UK: Joint Nature Conservation Committee.

Holmes, R., Bulat, J., Hamilton, I. and Long, D. (2003). Morphology of an ice sheet and constructional glacially-fed slope front, Faroe-Shetland Channel. In: Mienert J. and Weaver P. (eds), European Continental Margin Sedimentary Processes: An Atlas of side-scan sonar and seismic images. (Berlin: Springer Verlag).

Ilan, M. and Abelson, A. (1995). The life of a sponge in a sandy lagoon. Biol. Bull. 189, 363-369. Available at: http://www.tau.ac.il/lifesci/departments/zoology/members/ilan/documents/BiolBull189.pdf [Accessed 05/2018]

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

Inter-Agency Marine Mammal Working Group (IAMMWG) (2015). Management Units for Cetaceans in UK Waters JNCC Report No. 547, Peterborough. Available at: http://jncc.defra.gov.uk/pdf/Report_547_webv2.pdf [Accessed August 2017].

International Maritime Organisation (IMO) (1972). Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs). Further information available at: http://www.imo.org/about/conventions/listofconventions/pages/colreg.aspx

International Union for Conservation of Nature (IUCN) (2017). Red List of Threatened Species. Available at: https://www.iucn.org/theme/species/our-work/iucn-red-list-threatened-species [Accessed August 2017].

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Report No. 432. Peterborough: JNCC JNCC.

ITOPF (2014). Available at: http://www.itopf.com/knowledge-resources/documents-guides/fate-of-oil-spills/ [accessed 03/18].

Jensen, F. H., Bejder, L., Wahlberg, M., Aguilar Soto, N., Johnson, M. and Madsen, P. T. (2009). Vessel noise effects on delphinid communication. Marine Ecology Progress Series. 395: 161-175.

Jewett S.C. and Dean T.A. (1997). The Effects of the Exxon Valdez Oil Spill on the Eelgrass Communities in Prince William Sound, Alaska, 1990-95. Alaska Department of Fish and Game, Habitat and Restoration Division, Restoration Project Final Report 95106. 291 pp. Anchorage: Alaska Department of Fish and Game.

Joint Nature Conservation Committee (JNCC) (1999). Oil Vulnerability Index. JNCC, Peterborough. Available: http://jncc.defra.gov.uk/PDF/Using%20the%20SOSI%20to%20inform%20contingency%20planning%202017.pdf.

Jødestøl, K. and Furuholt, E. (2010). Will drill cuttings and drill mud harm cold water corals? SPE126468.

JNCC (2007). Second report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006. Conservation status assessment for: S1364: *Halichoerus grypus* - Grey seal.

JNCC (2008). UK Biodiversity Action Plan Priority Habitat Descriptions - Coastal Saltmarsh and Seagrass. Available at: http://jncc.defra.gov.uk/page-5706. [Accessed 21/02/2017].

JNCC (2015a) The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. [Apr 2018]. Available from: jncc.defra.gov.uk/MarineHabitatClassification

JNCC (2015b). Nature Conservation Marine Protected Areas (NCMPAs). Available at: http://jncc.defra.gov.uk/page-5269 [Accessed Nov 2017].

JNCC (2016). 1355 Otter Lutra lutra. Available at: http://jncc.defra.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1355 [Accessed May 2016].

JNCC (2017a). The UK Biodiversity Action Plan (BAP) Priority Fish Species. Available at: http://jncc.defra.gov.uk/page-1377 [Accessed August 2017].

JNCC (2017b). Special Area of Conservations (SAC) in Scotland. Available at: http://jncc.defra.gov.uk/ProtectedSites/SACselection/SAC_list.asp?Country=S

JNCC (2017c). Special Protected Areas (SPA) – UK. Available at: http://jncc.defra.gov.uk/page-1400 [Accessed Nov 2017]

JNCC (2017d). Using the seabird Oil Sensitivity Index to inform contingency planning. Available at: http://jncc.defra.gov.uk/page-7373 [Accessed Aug 2017]

JNCC (2017e). Offshore Marine Protected Areas. Available at: http://jncc.defra.gov.uk/page-6895 [Accessed Nov 2017]

JNCC (2018). Faroe-Shetland Sponge Belt MPA. Available at: http://jncc.defra.gov.uk/page-6479 [Accessed May 2018]

JNCC (2008). The deliberate disturbance of Marine European Species; Guidance for English and Welsh territorial waters and the UK offshore marine area.

JNCC. (2010). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise.

Johansson S, Larsson U, and Boehm, P. (1980). The Tsesis oil spill impact on the pelagic ecosystem. Marine Pollution Bulletin 11(10):284-293.

Johns, D. and Wootton, M. (2003). Plankton Report for Strategic Environment Assessment Area 4. Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, The Hoe, Plymouth.

Joly-Turquin G., Dubois P., Coteur G., Danis B., Leyzour S., Le Menach K., Budzinski H., and Guillou M. (2009). Effects of the Erika oil spill on the common starfish Asterias rubens, evaluated by field and laboratory studies. Archives of Environmental Contamination and Toxicology 56(2):209-220.

Jones, D., Bett, B. and Tyler, P. (2007). Magabenthic ecology of the deep Faroe-Shetland channel: a photographic study. Deep-sea Research I, 54, 111 – 1228.

Jones, D., Bett, B.J. and Tyler, P.A. (2006). Effects of physical disturbance on the cold-water magafaunal communities of the Faroe-Shetland Channel. Marine Ecology Progress Series, 319, 43-54.

Jones, E., McConnell, B., Sparling, C. and Matthiopoulos, J. (2013). Grey and Harbour Seal Density Maps. Sea Mammal Research Unit Report to Scottish Government. Marine Mammal Scientific Support Research Programme MMSS.001/11.

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

Kellar, N.M., Speakman, T.R., Smith, C.R., Lane, S.M., Balmer, B.C., Trego, M.L., Catelani, K.N., Robbins, M.N., Allen, C.D., Wells, R.S. and Zolman, E.S. (2017). Low reproductive success rates of common bottlenose dolphins Tursiops truncatus in the northern Gulf of Mexico following the Deepwater Horizon disaster (2010-2015). Endangered Species Research, 33, pp.143-158.

Kjeilen-Eilertsen, G., Westerlund, S., Bamber, S., Tandber, A.H., Myhre, L.P. and Tvedten, O., (2004). UKOOA phase III- Characterisation of Beryl, Brent A, Brent S, Clyde and Miller cuttings piles through field work, laboratory studies and chemical analysis. Final Report – 2004-197

Kjeilen-Eilertsen, G., Trannum, H., Jak, R., Smit, M., Neff, J. and Durell G. (2004). Literature report on burial: derivation of PNEC as component in the MEMW model tool. Akvamiljø Report no. AM-2004/024.

Klitgaard, A.B. and Tendal, O.S. (2001). Ostur - "Cheese" bottoms - sponge dominated areas in the Faroese shelf and slope areas. In G. Bruntse and O.S. Tendal, eds. *Marine Biological Investigations and Assemblages of Benthic Invertebrates from the Faroe islands.* The Faroe Islands: Kaldbak Marine Biological Laboratory. pp.13-21.

Kloppmann M & Ellis J (2015). Hatchetfish and pearlsides (Sternoptychidae). *In: HJL Heessen, H Daan & JR Ellis (2015). Fish Atlas of the Celtic Sea, North Sea and Baltic Sea.* Wageningen Academic Publishers, the Netherlands, pp. 167-170.

Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S, Wilson, L.J, and Reid, J.B. (2010), An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs, JNCC Report 431, ISSN 0963-8091. Available at: http://jncc.defra.gov.uk/page-5622 [Accessed August 2017].

Koops, W., Sanders, F.J., Gubbens, J.M. (1985). The *Katina* oil spill 1982, combatting operation at sea, in: Ludwigson, J. O. (Ed.) (1985). *Proceedings of the 1985 Oil Spill Conference (Prevention, Behavior, Control, Cleanup)*. Febuary 25-28, 1985. Los Angeles, California. American Petroleum Institute Publication, 4385: pp 293-297.

Konnecker, G. (2002). Sponge Fields. In Offshore Directory. Review of a selection of habitats, communities and species of the North-East Atlantic. WWF-UK. North-East Atlantic Programme.

Krahn, M.M., Ylitalo, G.M., Buzitis, J., Bolton, J.L., Wigren, C.A., Chan, S.L. and Varanasi, U. (1993). Analyses for petroleum-related contaminants in marine fish and sediments following the Gulf oil spill. *Marine Pollution Bulletin*, *27*, pp.285-292.

Larsson AI, Purser A. (2011). Sedimentation on the cold-water coral Lopehlia pertusa: Cleaning efficiency from natural sediments and drill cuttings. Marine Pollution Bulletin 62:1159–68. Available at: https://www.researchgate.net/publication/272822740_Effects_of_water_flow_and_drilling_waste_exposure_on_polyp_behaviour_in_Lophelia_pertusa [Accessed 05/2018]

Lee, W.Y., and J.A.C. Nicol. (1977). The effects of the water-soluble fractions of No. 2 fuel oil on the survival and behaviour of coastal and oceanic zooplankton. Environmental Pollution 12:279–292, http://dx.doi.

Lee RF, Page DS (1997). Petroleum hydrocarbons and their effects in subtidal regions after major oil spills. Mar Pollut Bull 34:928–940.

Lucke, K., Siebert, U., Lepper, P. A. and Blanchet, M. A. (2009). Temporary shift in masked hearing thresholds in a harbour porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli, J. Acoust. Soc. Am., 125 (6), pp. 4060-4070.

Macleod K, Simmonds MP and Murray E (2003). Summer distribution and relative abundance of cetacean populations off north-west Scotland. *Journal of the Marine Biological Association of the UK*, 83, 1187 – 1192.

Marine Scotland. (2017). Feature Activity Sensitivity Tool. Available at: http://www.marine.scotland.gov.uk/FEAST/. (Accessed July 2017).

Marsh, H. W. and Schulkin, M. (1962). Shallow-water transmission. Journal of the Acoustical Society of America. 34(6):863-864 NOAA (2016) Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA Technical Memorandum NMFS-OPR-55).

Matkin, C.O., Saulitis, E.L., Ellis, G.M., Olesiuk, P. and Rice, S.D. (2008). Ongoing population-level impacts on killer whales *Orcinus orca* following the Exxon Valdez' oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series. Volume 356: 269-281.

McCauley, R. D. (1994). "Seismic surveys" in Environmental Implications of Offshore Oil and Gas Development in Australia – The Findings of an Independent Scientific Review, edited by J. M. Swan, J. M. Neff, and P. C. Young. Australian Petroleum Exploration Association, Sydney, pp. 19–122.

McCauley, R. D. (1998). Radiated Underwater Noise Measured from the Drilling Rig Ocean General, Rig Tenders Pacific Ariki and Pacific Frontier, Fishing Vessel Reef Venture and Natural Sources in the Timor Sea, Northern Australia, Report to Shell Australia.

Meador, J.P. (2003). Bioaccumulation of PAHs in Marine Invertebrates. In PAHs: An ecotoxicological perspective, p.147.

Menon N.N. and Menon N.R. (1999). Uptake of polycyclic aromatic hydrocarbons from suspended oil borne sediments by the marine bivalve Sunetta scripta. Aquatic Toxicology 45(1):63-69.

Mignucci-Giannoni, A.A. (1999). Assessment and rehabilitation of wildlife affected by an oil spill in Puerto Rico. Environmental Pollution 104(2):323-333.

Mitson, R. B. and Knudsen, H. P. (2003). Causes and effects of underwater noise on fish abundance estimation. Aquatic Living Resources. 16: 255-263.

Montgomery, J. C., Jeffs, A., Simpson, S. D., Meekhan, M., and Tindle, C. (2006). Sound as an orientation cue for the pelagic larvae of reef fishes and decapod crustaceans. Advances in Marine Biology. 51: 143-196.

National Marine Fisheries Service (NMFS). (2016). Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: underwater acoustic thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. of Commer.,NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 pp.

National Science and Technology Forum (NSTF) (1993). North Sea Quality Status Report, Oslo and Paris Commissions, Olsen and Olsen, Denmark, 132 pp.

Naylor, R.L., Goldburg, R.J., Primavera, J.H., Kautsky, N., Beveridge, M.C., Clay, J., Folke, C., Lubchenco, J., Mooney, H. and Troell, M. (2000). Effect of Aquaculture on World Fish Supplies. Natue Vol 405 pp 1017. Also found online at https://search.proquest.com/openview/a37ef128361d181b77ffdbd249153b47/1?pq-origsite=gscholar&cbl=40569.

Neff, J.M., and Haensly W.E. (1982). Ecological study of the Amoco Cadiz oil spill. Report of the NOAA-CNEXO Joint Scientific Commission, USDC. 269-327 pp. Boulder, CO: National Oceanic and Atmospheric Administration.

Neff, J. M. (2005). Composition, environmental fates, and biological effect of water based drilling muds and cuttings discharged to the marine environment. A synthesis and annotated bibliography. Petroleum Environmental Research Forum (PERF) and American Petroleum Institute. 73pp.

Newcombe, CP and Jensen, JOT. (1996). Channel suspended sediment and fisheries: A synthesis for quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management. (1996). Vol. 16, 4, pp. 693-727.

Nicholls, P., Hewitt, J. and Haliday, J. (2003). Effects of Suspended Sediment Concentrations on Suspension and Deposit Feeding Marine Macrofauna. NIWA Client Report ARC03267.

O'Clair C.E., and Rice S.D. (1985). Depression of feeding and growth rates of the seastar Evasterias troschelii during long-term exposure to the water-soluble fraction of crude oil. Marine Biology 84(3):331-340.

O'Hara, P. D. and Morandin, L. A. (2010). Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds.

Oil and Gas Authority (OGA) (2017a). Other Regulatory Issues, Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/547696/29R_Other_Regulatory_IssuesV2.pdf [Accessed Nov 2017].

OGA (2017c). Matrix of Blocks and Conservation Sites. Available at: https://www.ogauthority.co.uk/media/4019/matrix-of-blocks-and-conservation-sites-_-last-updated-3rd-august-2017.pdf [Accessed Nov 2017].

OGA (2017b). Information on levels of shipping activity. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540506/29R_Shipping_Density_Table.pdf.

OGP (2010). International Association of Oil & Gas Producers: Risk Assessment data directory – Blowout frequencies. Report No. 434-2.

OGP. (2005). Fate and effects of naturally occurring substances in produced water on the marine environment. Report No. 364 February 2005.

OGUK (2015). Guidelines for the Abandonment of Wells. Issue 5. Available for purchase from http://oilandgasuk.co.uk/product/op105/.

OGUK. (2016). Environmental Report 2016. Available at: https://cld.bz/qgAn4xr/1.

Olsgard F., Gray J.S. (1995) A comprehensive analysis of the effects of offshore oil and gas exploration and production on the benthic communities of the Norwegian continental shelf. Marine Ecology –Progress Series, 122,277–306. Contamination patterns and molluscan and polychaete assemblages in two Persian (Arabian) Gulf oilfields (PDF Download Available). Available from: https://www.researchgate.net/publication/294890696_Contamination_patterns_and_molluscan_and_polychaete_assemblages_in_two_Persian_Arabian_Gulf_oilfields [Accessed Mar 02/2018].

Ordzie C.J., Garofalo G.C. (1981). Lethal and sublethal effects of short term acute doses of Kuwait Crude Oil and a dispersant Corexit 9527 on bay scallops, Argopecten irradians (Lamarck) and two predators at different temperatures. Marine Environment Research 5(3):195-210.

OSPAR Commission (2013). Marine Protected Areas OSPAR - Global View. Available at: http://mpa.ospar.org/home_ospar [Accessed 02/18]

OSPAR (2010). The Quality Status Report 2010. OSPAR Commission. Available at: http://qsr2010.ospar.org/en/ch01.html.

OSPAR (2000). Quality Status Report 2000 Region II - Greater North Sea. London: OSPAR Commission.

OSPAR. (2009b). Overview of Impact of anthropogenic underwater sound in the marine environment. Biodiversity Series, OSPAR Commission.

OSPAR (2014a). OSPAR report on discharges, spills and emissions from offshore oil and gas installations in 2012. OSPAR Commission, London, 51pp.

OSPAR (2014b). Assessment of the OSPAR report on discharges, spills and emissions to air from offshore oil and gas 2010-2012. OSPAR Commission, London, 25pp.

OSPAR (accessed 2017). List of Threatened and/or Declining Species and Habitats. Online. Available at: https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats [Accessed August 2017].

Ozhan, K., Parsons, M.L. and Bargu, S., 2014. How were phytoplankton affected by the Deepwater Horizon oil spill?. *BioScience*, *64*(9), pp.829-836.

Paxton C.G.M., Scott-Hayward L., Mackenzie M., Rexstad E., and Thomas L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resources with Advisory Note, JNCC Report 517, ISSN 0963-8091 http://jncc.defra.gov.uk/pdf/JNCC_Report_517_FINAL_web.pdf (Accessed August 2017).

Pearson, T.H., Mannvik, H.P., Evans, R. and Falk-Petersen, S. (1996) The benthic communities of the Snorre Field in the northern North Sea (61°30′N 2°10′E). 1. The distribution and structure of communities in undisturbed sediments. J Sea Res 35:301–314.

Peterson C.H., Rice, S.D., Short, J.W., Esler D., Bodkin, J.L., Ballachey B.E., and Irons D.B. (2003). Long-term ecosystem response to the Exxon Valdez oil spill (review). Science Vol 302 19th December 2003.

Pineda, M., Strehlow, B., Sternel, M., Duckworth, A., Jones, R. and Webster N.S. (2017). Effects of suspended sediments on the sponge holobiont with implications for dredging management. Scientific Reports 7:4925. Available at: https://www.wamsi.org.au/sites/wamsi.org.au/files/files/Pineda%20et%20al_%20(2017)%20Effects%20of%20suspended%20sediments%20on%20the%20sponge%20holobiont%20with%20implications%20for%20dredging%20management%20%2B%20supp%20info.pdf

Pinnegar J, Blasdale T, Campbell N, Coates S, Colclough S, Fraser H, Greathead C, Greenstreet S, Neat F, Sharp R, Simms D, Stevens H & Waugh A (2010). Charting Progress 2: Healthy and biologically diverse seas. Feeder Report, Section 3.4: Fish. Published by Defra, 128pp.

Pollard, R.T., Read, J.F. and Holliday, N.P. (2004). Water masses and circulation pathways through the Iceland Basin during Vivaldi 1996. Journal of Geophysical Research 109: C04004.

Pollock, C. M., Mavor, R., Weir, C. R., Reid, A., White, R. W., Tasker, M. L., Webb, A. and Reid, J. B. (2000). The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west Scotland. Joint Nature Conservation Committee, Aberdeen, UK.

Popper, A. N., Fay, R. R., Platt, C. and Sand, O. (2003). Sound detection mechanisms and Capabilities in Teleost fishes In: Collin, S.P. and Marshall N.J. (eds). Sensory Processing in Aquatic Environments. New York: Springer, pp 3-38.

Reid, J. B., Evans, P. G. and Horthridge, S. P. (2003). Atlas of Cetacean distribution in north-west European waters. JNCC.

Richardson, J., Greene C. R., Malme C. I. and Thomson, D. H. (1995). Marine Mammals and Noise. San Diego California: Academic Press.

Robinson, G. (1970). Continuous plankton records: Variations in the seasonal cycle of phytoplankton in the North Atlantic. Bulletin of Marine Ecology. 6: 33-345.

Rolland, R. M., Parks, S. E., Hunt, K. E., Castellote, M., Corkeron, P. J., Nowacek, D. P., Wasser, S. K. and Kraus, S. D. (2012). Evidence that ship noise increases stress in right whales. Proceedings of the Royal Society B. doi:10.1098/rspb.2011.2429.

Ross, D. (1976). Mechanics of underwater noise. Pergamon, New York. 375 pp.

Rye, H., Ø.Johansen, I.Durgut, M.Reed, M.K.Ditlevsen (2006). Restitution of an impacted sediments. SINTEF Report no. STF80MK A0622.

Rye, H. (2010) Calculation of stresses (depositions and water column concentrations) at the sea floor caused by drilling discharges. Presentation at the 2010 OLF cold-water coral workshop, held at IRIS, Stavanger, 31 May – 1 June 2010.

Scottish Biodiversity List (2013). [Online] Available at: http://www.scotland.gov.uk/Topics/Environment/Wildlife-Habitats/16118/Biodiversitylist/SBL [Accessed 27 May 2014].

Scotland's Environment. (accessed 2017). Waste. Available at: https://www.environment.gov.scot/media/1169/people-and-the-environment-waste.pdf (Accessed October 2017).

Scottish Government (2017). Fishing Effort and Quantity and Value of Landings by ICES Rectangle. Available online at: http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData [Accessed September 2017].

Scottish Government National Marine Plan Interactive. (NMPi) (2017). Available at: https://marinescotland.atkinsgeospatial.com/nmpi/ [Accessed July 2017].

Scottish Natural Heritage (SNH) (2014). Priority Marine Features in Scotland's Seas. Available at http://www.snh.gov.uk/docs/A1327320.pdf.

Scottish Natural Heritage (2015). Otter, Scotland is a European stronghold for the otter, a species of the land, river and sea. Available at: https://www.snh.scot/plants-animals-and-fungi/mammals/land-mammals/otter [Accessed Nov 2017]

Sea Mammal Research Unit. (SMRU) (2012). Grey and Harbour Seal Distribution Data. Sea Mammal Research Unit 2012.

Shapiro, S., Murray, J.G., Gleason, R.F., Barnes, S.R. Eales, B.A. and Woodward, P.R. (1997). Threats to submarine cables. Conference proceedings of SubOptic San Francisco, pp 742-749.

Shetland Otters (2016). Shetlands Otters webpage and testimonial. Available at: http://www.shetlandotters.com/shetlands-otters.php [Accessed Nov 2017].

SFF/Brown and May (2010). Commercial Fisheries Assessment for Offshore Oil and Gas Development in the West of Shetland. Report by SFF Services Ltd and Brown and May Marine, 2010. Report reference QD-BP-EV-REP-0007.

SINTEF (2006) “Documentation report for the revised DREAM model. Final version, August 2006”. ERMS Report No. 18.

Slabbekoorn, H., Bouton, N., van Opzeeland, I., Coers, A., ten Cate, C. and Popper, A. N. (2010). A noisy spring: the impact of globally rising underwater sound levels on fish. Trends in Ecology and Evolution. 25: 419-427.

Smit, M.G.D., K.I.E.Holthaus, N.B.H.M.Kaag, R.G.Jak, (2006). The derivation of a PNEC-water for weighting agents in drilling mud. TNO Report no. TNO 2006-DH-0044/A

Smultea M.A., and Wursig B. (1995). Behavioral reactions of bottlenose dolphins to the Mega Borg oil spill, Gulf of Mexico 1990. Aquat Mamm 21:171–181.

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R. Jr., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A. and Tyack, P. L. (2007). Marine mammals noise exposure criteria: initial scientific recommendations. Marine Mammals. 33(4).

Sparling, C.E. Russell, D.F., Lane, E., Grellier, K., Lonergan, M.E., McConnell, B.J., Matthiopoulous, J. and Thompson, D. (2012). Baseline Seal Information for the FTOWDG Area. SMRU-FDG-2012-0.

Spraker, T.R. Lowry, L.F. Frost, K.J. (1994). Gross necropsy and histopathological lesions found in harbor seals. In: Loughlin TR (ed) Marine mammals and the ‘Exxon Valdez’. Academic Press, San Diego, CA, p 281–312.

Stark, U. and Mueller, A. (2003). Particle Size Distribution of Cements and Mineral Admixtures - Standard and Sophisticated Measurements. Proceedings of the 11th International Congress on the Chemistry of Cement (ICCC) 11 - 16 May 2003, Durban, South Africa.

Stone, C.J. (2003a). Marine mammal observations during seismic surveys in 2000. JNCC Report No. 322.

Stone, C.J. (2003b). The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Report 323.

Teal, J.M., and Howarth, R.W. (1984). Oil spill studies: A review of ecological effects. Environmental Management 8(1): 27-44.

Temara A., Gulec I., Holdway D.A. (1999). Oil-induced disruption of foraging behaviour of the asteroid keystone predator, *Coscinasterias muricata* (Echinodermata). Marine Biology 133(3):501-507.

Thompson, D. and Duck, C. (2010). Berwickshire and Northumberland Coast European Marine Site: Grey seal population status. Report to Natural England 20100902-RFQ.

Todd, V. L. G., Pearse, W. D., Tregenza, N. C., Lepper, P. A., and Todd, I. B. (2009). Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around North Sea offshore gas installations. ICES Journal of Marine Science. 66: 734–745.

Topping, G., Davies, J.M., Mackie, P.R. and Moffat, C.F. (1997). The Impact of Braer Spill on Commercial Fish and Shellfish. *The Impact of an Oil Spill in Turbulent Waters: The Braer*. Chapter 10.

Trannum, H.C. (2004) Calculation of PNEC for changed grain size based on data from MOD. Akvaplan-NIVA Report no. APN-411.3088.1.

Turrell, W.R. (1992). New hypotheses concerning the circulation of the Northern North Sea and its relation to the North Sea fish stocks recruitment. ICES Journal of Marine Science. 49: 107-123.

Turrell, W.R., Hansen, B., Osterhus, S., Hughes, S., Ewart, K. and J. Hamilton (1999). *Direct observations of inflow to the Nordic Seas through the Faroe-Shetland Channel 91994-1997), ICES CM 1999/L:o1*. International Council for the Exploration of the Sea, Copenhagen.

Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. & Crawford-Avis, O.T. (2016). Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.

UK Marine SACs Project (2001). UK Marine Special Areas of Conservation. Available at: http://www.ukmarinesac.org.uk.

UKOOA, 2002. UKOOA Drill Cuttings Initiative Final Report, February 2002. UKOOA Drill Cuttings Initiative Executive Committee. 58pp

UKOOA, 2005. UKOOAJIP 2004 Drill Cuttings Initiative Phase III. Final Reprt, 20132900. 26 January 2005.

US Army Corps of Engineers (2003). Available at: http://onlinebooks.library.upenn.edu/webbin/book/lookupname?key=United+States+Army+Corps+of+Engineers [Accessed on 03/18]

Vad, J. and Duran, L. (2017). MASTS report: impact of hydrocarbon contaminated sediments on sediment associated bacterial communities and sponges. Marine Alliance for Science for Science and Technology. Available at: http://www.masts.ac.uk/media/36252/sg352-mastsreport.pdf [Accessed 05/2018]

Van Brummelen, T.C., Van Hattum, B., Crommentuijin, T. and Kalf, D.F. (1998). Bioavailability and ecotoxicity of PAHs. In The Handbook of Environmental Chemistry (pp. 3J 205-263). Berlin: Springer-Verlag.

Venn-Watson, S., Colegrove, K.M., Litz, J., Kinsel, M., Terio, K., Saliki, J., Fire, S., Carmichael, R., Chevis, C., Hatchett, W. and Pitchford, J. (2015). Adrenal gland and lung lesions in Gulf of Mexico common bottlenose dolphins (Tursiops truncatus) found dead following the Deepwater Horizon oil spill. *PLoS One*, *10*(5), p.e0126538.

Wales, S. C. and Heitmeyer, R. M. (2002). An ensemble source spectra model for merchant ship-radiated noise. Journal of the Acoustical Society of America. 111: 1211-1231.

Weise, F. K., Montevecchi, W. A., Davoren, G. K., Huettmann, F., Diamond, A. W. and Linke, J. (2001). Seabirds at risk around offshore oil platforms in the North-west Atlantic. Marine Pollution Bulletin Vol. 42: 12. 1285–1290.

Wessex Archaeology (2009). UKCS Offshore Oil and Gas and Wind Energy Strategic Environmental Assessment: Archaeological Baseline. Technical Report prepared for the Department of Energy and Climate Change, Wessex Archaeology, Salisbury, 89pp.

White, R.W., Gillion, K.W., Black, A.D. and Reid, J.B. (2001). Vulnerability concentrations of seabirds in Falkland Island Waters. JNCC Peterborough.

Wilson, G. (2003). Assessment Survey: Shetland. In: Dawson T (Ed.) Coastal Archaeology and Erosion in Scotland. Historic Scotland, Edinburgh pp. 45-54.

APPENDIX A

A.1 Legislative Overview

Consenting		
Issue	**Legislation**	**Regulator and Requirements**
EIA	EC Directive 2014/52/EU (the EIA Directive) (amending Directive 2011/92/EU)	Under the EIA Directive all Annex I projects are considered to have an effect on the environment and require an EIA and, consequently, an Environmental Statement (ES). Annex I projects include oil and gas exploration and production projects, and certain CCS projects.
	Offshore Petroleum Production and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) regulations 2017	The Secretary of State for Business, Energy and Industrial Strategy will take into consideration environmental information in making decisions regarding consents for offshore developments and projects. A statutory ES and public consultation is mandatory for: • new field developments where production is predicted to exceed 500 tonnes of oil per day or 500,000 cubic meters or more per day of gas; • the construction of a pipe-line for the conveyance of petroleum or for the conveyance of CO_2 for the purpose of storage, other than one which is to form an integral part of any development requiring an ES, where the pipeline will be 40 km or more in length and a diameter of 800 mm or more; • any CO_2 storage projects; • an installation for the capture of CO_2 for the purpose of storage; and • any change to or extension of the projects above, where the change or extension itself meets the thresholds. A formal process has been established for the submission of an ES and public consultation which involves: • Submission of the ES to BEIS and their advisors (Environmental Authorities); • The ES must be advertised in the national and local press; • The ES must be available for public consultation for at least 30 days following the advertisements (longer if this includes a public holiday); • The public may request a copy of the ES and the maximum allowable charge which may be made for this is £2; • The public, Environmental Authorities, consultees and other organisations make their comments to BEIS;

Consenting		
Issue	**Legislation**	**Regulator and Requirements**
		• BEIS may require more information / clarifications from the operator or may require resubmission of the ES should they feel that they have insufficient information on which to evaluate the environmental implications of the proposed project. • Following consideration, BEIS may issue a project consent which is then advertised in the Gazette, following which there is a six week period during which those who feel 'aggrieved' by this decision may challenge it. The requirement for a Statutory ES is at the discretion of the Secretary of State for: • Smaller developments and pipelines less than the stated thresholds; • Exploration, appraisal and development wells and any sidetracks; • Production consent variations and renewals where the project extension is less that the stated thresholds. If an EIA Direction for an ES is required, then a Master Application Template (MAT) and a Subsidiary Application Template (SAT) on the Portal Environmental Tracking System (PETS) should be submitted.
Field Development Plan	Petroleum Act 1998 (as amended)	**Regulator: OGA** Operators are required to submit plans for development of field to OGA for approval.
Pipeline Works Authorisation	Petroleum Act 1998 (as amended)	Regulator: OGA Construction of a pipeline is prohibited in, under or over controlled waters, except in accordance with an authorization granted by the Secretary of State (known as the Pipeline Works Authorisation – PWA). • Application for authorisation is made under Section 14 of the Act, to the Secretary of State; • The Secretary of State decides whether applications are to be considered or not. If not to be considered reasons will be given; • if an application is being considered, the Secretary of State will give directions with respect to the application; • the applicant is to publish a notice giving such details as directed by the Secretary of State, allowing 28 days from first publication of the notice for public consultation; • publication must provide a map and such other information as directed by the Secretary of State and must make these available for public view during the specified period; • notice must also be provided to any other parties as directed by the Secretary of State; • The Secretary of State considers any representations and issues authorisation.

Consenting		
Issue	**Legislation**	**Regulator and Requirements**
		A MAT has to be submitted for a proposed pipeline and SATs for a Direction(s) under the EIA Regulations and for a permit for the use and / or discharge of chemicals during the operation of a pipeline.
	The Petroleum (Current Model Clauses) Order 1999 The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 (as amended 2009) Model Clauses of Authorisation	In the Submarine Pipeline Works Authorisation (PWA) the Secretary of State for Energy and Climate Change will authorise the project to construct and to use the submarine pipelines and associated equipment, subject to a number of terms and conditions, including; • the pipeline shall be used only for the transport of condensate, not of oil; • the pipeline shall be constructed, installed and subsequently maintained in conformity with the plans, specifications and other information furnished by the project; • the pipeline shall be used and operated in accordance with the requirements and shall be maintained in a proper state of repair and any damage to the pipeline shall be properly acted upon; • the project shall ensure that there is insurance cover in order to enable liability to third parties caused by the release or escape of any of the contents of the pipelines; • the pipelines shall be installed so that they will not impede or prevent the laying of further pipelines or cables; • those sections of the pipelines that are to be trenched shall be lowered into the subsoil as soon as practicable following pipe laying so that wherever practicable the uppermost surface of the pipelines is below the undisturbed level of the surrounding seabed; • if any part of these sections of the pipelines above the level of the seabed causes actual interference with fishing or with other activities the Secretary of State may require that part of the pipelines should be lowered below the level of the surrounding seabed by trenching; • any parts of the said pipelines left on the seabed during the period of construction shall be covered in such a way that they will not interfere with fishing gear; • the pipelines shall be suitably protected to ensure that they are not susceptible to third party damage; • the pipelines shall possess such negative buoyancy as may be required for them to remain stable where placed on the sea floor; • an effective leak detection system shall be installed; • consent shall be obtained from the placement of rock and concrete mattresses for burying, protecting or supporting the pipeline and conditions may be attached to that consent; • no object, equipment or material of any kind which is not an integral part of the pipeline shall be disposed of at sea or abandoned on the seabed during the construction and installation of the pipelines. Where such items are accidently dropped or left in the sea, every reasonable effort shall be made to recover them;

Consenting		
Issue	**Legislation**	**Regulator and Requirements**
		so far as is reasonably practicable that part of the sea bottom which is disturbed by the laying or trenching operations shall be restored to a condition that will not interfere with fishing activities; appropriate fishing organisations shall be informed every 24 hours of the positions at which construction work is being carried out during the first 24 hours and on the following 3 days. Radio broadcasts shall be made from the installation vessel twice daily; if any defects in the pipelines are disclosed by an inspection or monitoring, the Secretary of State shall be notified, such work as may be necessary to rectify it shall be carried out as soon as practicable; any contents of the pipelines released by way of a pressure relief system shall be disposed of safely and in such a manner so as to ensure that as far as is reasonably practicable no pollution occurs; substances introduced into the pipelines or any part thereof other than those consisting entirely of untreated seawater or sweet water shall not be discharged into the sea or other waters except with the prior written consent of the Secretary of State and in accordance with any conditions which may be attached to that consent. Notifications, information and documents concerning the pipelines shall be submitted to: the Secretary of State; the Hydrographer of the Navy; the Department for Environment, Food and Rural Affairs (DEFRA);
Seabed Lease	Crown Estate Act 1961	**Regulator: Crown Estate Commissioners** Minute of agreement required for occupation of seabed.
Location of Structures	Marine and Coastal Access Act 2009 (as amended 2011) The Energy Act 2008	**Regulator: BEIS** Requires impacts to be considered with respect to (i) navigation and (ii) the local habitat within the proposed area. As of April 2011, the Coast Protection Act 1949 was no longer in force and all Consent to Locate requirements were transferred to the Marine & Coastal Access Act 2009 (MCAA). The majority of oil and gas related activities are exempt from the MCAA. Consequently, a new Part 4A of the Energy Act (2008) was created, transferring Consent to Locate provisions to the Energy Act and resulting in BEIS becoming the regulatory body.
	Continental Shelf Act 1964 (as amended 1989) The Continental Shelf (Designation	**Regulator: BEIS** The Continental Shelf Act extends the UK government's right to grant licences to explore (and exploit) hydrocarbon resources to the United Kingdom Continental Shelf (UKCS).

Consenting		
Issue	**Legislation**	**Regulator and Requirements**
	of Areas) Order 2013	The Continental Shelf (Designation of Areas) (Consolidation) Order 2000 consolidates the various Orders made under the Continental Shelf Act 1964 which have designated the areas of the continental shelf within which the rights of the United Kingdom with respect to the seabed and subsoil and their natural resources are exercisable.
Well Consent	Petroleum Act 1998 (as amended) Petroleum Operations Notice No 4 (revised May 2012)	**Regulator: OGA** Application for consent to drill exploration, appraisal and development wells must be submitted to OGA through the WONS.
Licensing	Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 (as amended 2009)	**Regulator: BEIS** Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 were issued under the Petroleum Act 1998 (as amended). In order to search, bore for or get petroleum within Great Britain, or beneath the UK Territorial Sea and Continental Shelf a licence should be obtained from the Secretary of State. Petroleum Licensing (Amendment) Regulations 2009 amendments to the regulations include updates to the standard application fees for petroleum licences.
Planning	Marine Coastal Access Act 2009 (as amended 2011) Marine (Scotland) Act 2010	**Regulator: BEIS and Marine Scotland** The Marine (Scotland) Act introduces a new statutory marine planning system to sustainably manage the increasing, and often conflicting, demands on our seas. The Marine and Coastal Access Act 2009 makes provision for the amendment of the Environmental Damage (Prevention and Remediation) Regulations 2009 in order to place responsibility for enforcement in the Scottish offshore region with the Scottish Ministers, when there is significant damage to species and habitats protected under the EU Habitats and Wild Birds Directives. This responsibility will not include enforcement of the prevention and remediation of damage caused by oil and gas activities or CO_2 storage activities which will remain with BEIS.

Drilling		
Issue	**Legislation**	**Regulator and Requirements**
Rig Movements	Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 HSE Operations Notice 6 Reporting of Offshore Installation Movements HSE Operations Notice 3 Liaison with other bodies HSE Operations Notice 14 on Coast Protection Act	**Regulator BEIS, MCA and Health and Safety Executive** BEIS states that the Maritime and Coastguard Agency (MCA) should be informed as soon as possible of all rig movements as a condition of any consent to locate a rig at a new location. Under Operations Notice 6 a rig warning communication must be issued at least 48 hours before any rig movements. Notice 6 should be read in conjunction with Operations Notice 3 Liaison with other bodies and Operations Notice 14 Guidance on Coast Protection Act - consent to locate and the marking of offshore installations. Rig movements must be reported to the Health and Safety Executive (HSE) when an installation is due to enter or leave UK waters as per regulation 5 of the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995.
Muds, Cuttings and Chemical Use and Discharge	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** It is a breach of the Regulations to discharge reservoir hydrocarbons and cuttings to the marine environment without an exemption from the Secretary of State. The Paris Commission decision 92/2 established maximum oil on cuttings concentration of 1% by weight for discharge of cuttings to sea. The contamination of cuttings by muds comes under the Offshore Chemical Regulations 2002 (as amended), but discharges / cuttings contaminated with reservoir oil fall under the OPPC regulations. A permit is required for discharge of oil to sea and is obtained from BEIS. Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010 permits now extend to CCS activities The Offshore Petroleum Activities (Oil Pollution Prevention and Control) (Amendment) Regulations 2011 came into force on March 30th 2011. These amendments include a new definition of “offshore installation”, which now includes pipelines. This ensures that all discharges of oil from pipelines used for offshore oil and gas activities will now be controlled under the OPPC regulations.
	Offshore Chemicals Regulations 2002 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010) OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals	**Regulator: BEIS** Under these Regulations, offshore drilling operators need to apply for permits to cover both the use and discharge of chemicals. The permits are applied for through PETS (UK Oil Portal). The application requires a description of the work carried out, a site specific environmental impact assessment and a list of all the chemicals intended for use and / or discharge, along with a risk assessment for the environmental effect of the discharge of chemicals into the sea. The permit obtained may include conditions. These Regulations amend the Deposits to Sea (Exemptions) Order 1985 to make the discharges of chemicals to sea exempt from requiring a licence under MCAA when the discharge has a permit under the

Drilling		
Issue	**Legislation**	**Regulator and Requirements**
	(as amended by OSPAR Decision 2005/1) and associated Recommendations.	Offshore Chemicals Regulations 2002 (as amended 2011). Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits extend to CCS activities. The Offshore Chemicals (Amendment) Regulations 2011 also came into force on March 30th 2011. The key change is to ensure that enforcement action can be taken in respect to non-operational emissions of chemicals, such as accidental leaks or spills. Under the 2002 regulations a permit can only be granted in respect of discharge of chemicals which occur during day to day oil and gas production, as a discharge is limited to "an operational release of offshore chemicals." Therefore, it is not an offence to emit chemicals other than in the course of normal operations, for example, as a result of leaks or spills. The 2011 amendments remedy this. Under the regulations, a "discharge" now covers any intentional emission of an offshore chemical and a new definition of "release" has been inserted which catches all other emissions (regulation 4(a) and (h) of the amendments). Under the 2011 amendments, well suspension and abandonment also require a formal permitting process and will usually require approval under the MCAA licensing regime, both of which are registered by BEIS's Environmental Management Team. These requirements are in addition to the MAT/SAT required consent to abandon a well.
	OSPAR Recommendation 2006/5 on a management regime for offshore cuttings piles	OSPAR Recommendation 2006/5 outlines the approach for the management of cuttings piles offshore. The purpose of the Recommendation is to reduce to a level that is not significant, the impacts of pollution by oil and / or other substances from cuttings piles. The Cuttings Pile Management Regime (outlined by the Recommendation) is divided into two stages: Stage 1 involves initial screening of all cuttings piles. This should be completed within 2 years of the Recommendation taking effect. Stage 2 involves a BAT and / or BEP assessment and should, where applicable, be carried out in the timeframe determined in Stage 1.

Drilling		
Issue	**Legislation**	**Regulator and Requirements**
Rig Stabilisation	Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended 2007) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010) Offshore Petroleum (Conservation of Habitats) Regulations 2001 (as amended 2007)	**Regulator: BEIS** Deposits to sea for the purpose of rig stabilisation requires a Direction under the EIA and Habitat Regulations. This is in addition to the Direction required for deposits associated with pipelines. The deposit of stabilisation or protection materials, such as jack-up rig stabilisation / anti-scour deposits, or pipeline protection / free-span correction deposits, must be the subject of a direction under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended). This does not apply to decommissioning sediments, which will require an MCAA licence (see Decommissioning).
Dangerous Goods	The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997 (as amended 1999)	**Regulator: MCA** The regulations require that dangerous goods and marine pollutants are labelled and packed according to the International Maritime Dangerous Goods (IMDG) code and that dangerous goods declarations are provided to vessel masters prior to loading.
Chemical Data Sheets and Labelling	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (as amended 2008) (revoked by the Chemicals (Hazard Information and Packaging for Supply) Regulations 2009)	**Regulator: Health and Safety Executive** The transport of chemicals to and from offshore fields is principally by road to shore base and then by sea. These regulations (commonly known as CHIP 3) specify safety data sheet format and contents and required packaging and labelling of chemicals for supply. The 2009 regulations, CHIP4, consolidate all amendments made to the Chemicals (Hazard Information and Packaging for Supply) Regulations since 2002.
	EC Regulation 1907/2006 (REACH) REACH Enforcement Regulations 2008 SI 2852	**Regulator: BEIS (and SEPA within Scottish territorial waters)** REACH deals with the registration, evaluation, authorisation and restriction of chemical substances. REACH now extends to CCS activities, as stated under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010. Furthermore, the duty to enforce REACH within the seaward limits of the Scottish Territorial sea now lies with SEPA.

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
General	MARPOL 73/78	UK Regulations apply to *all* vessels regardless of flag whilst in UK Territorial Waters (12nm from coastline), and implement the requirements of MARPOL 73/78. Similarly, MARPOL 73/78 requirements apply to *all* vessels whilst on the High Seas (outside territorial waters).
	MARPOL: Annexes I Prevention of pollution by oil, II Control of pollution by noxious liquid substances, IV Prevention of Pollution by Sewage from Ships, V Prevention of pollution by garbage from ships and VI Prevention of Air Pollution from Ships.	The International Maritime Organisation (IMO) may designate areas of sea as 'Special Areas' for oceanographic reasons, ecological condition and in relation to character of shipping and other sea users. The North West European Waters (including the North Sea) have been given 'Special Area' status from August 1999. In these areas special mandatory methods for the prevention of sea pollution are required and these special areas are provided with a higher level of protection than other areas of the sea.
Rock Dumping and Other Deposits on the Seabed	The Petroleum Act 1998 (as amended).	**Regulators: BEIS supported by Marine Scotland and CEFAS and within territorial waters Scottish Government Marine Directorate** Deposits in the sea were regulated through the MCAA but, as a result of the Petroleum Act 1998 (as amended) this does not apply to anything done: (a) for the purpose of constructing a pipeline as respects any part of which an authorisation (within the meaning of Part III of the Petroleum Act 1998 (as amended)) is in force; or (b) for the purpose of establishing or maintaining an offshore installation within the meaning of Part IV of that Act. The application for consent to deposit items on the seabed required under the Petroleum Act 1998 (as amended) for these activities is incorporated within the PWA process. Similarly, the application for the consent to discharge required under the Act is incorporated within PETS. However, a licence is required for "the deposit, by means of seabed injection, of material arising from offshore hydrocarbon exploration and production operations" and for deposits of rock, mattresses etc (excluding rig stabilisation)

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
Fisheries Liaison	The Petroleum (Current Model Clauses) Order 1999. The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 Model Clauses of Licence HSE Offshore Safety Division Operations Notice 3	**Regulator: BEIS** From the 7th and 8th Licensing rounds onwards, operators have been required to appoint a Fisheries Liaison Officer to liaise with the fishing industry and Government Fisheries Departments on exploration and production activities. HSE Offshore Safety Division Operations Notice 3, Liaison with Other Bodies, June 2008 outlines liaison routes to improve communication between operators and other users of the sea and includes a requirement for a Fisheries Liaison.
Machinery Space Drainage from Shipping	The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended 2005) (as amended by the Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009)	**Regulator: Maritime and Coastguard Agency** These regulations implement MARPOL Annex I (Prevention of Pollution by Oil) into UK legislation. Within a 'Special Area', ships which are 400GT or above can discharge water from machinery space drainage providing the oil content of the water does not exceed 15ppm. Vessels must be equipped with oil filtering systems; automatic cut offs and oil retention systems. All vessels must hold an approved Shipboard Oil Pollution Emergency Plan (SOPEP) and must maintain a current Oil Record Book and the ship must be proceeding on its voyage. All vessels must hold a UKOOP certificate or an IOPC certificate for foreign ships. Installations can obtain a temporary exception from MCA under an informal agreement between OGUK and the MCA, however new installations need to demonstrate their 'equivalence' to other offshore installations where temporary installations are being issued and they are unlikely to obtain a certificate unless they fully comply with the requirements. Note, if all machinery drainage is routed via the hazardous or non-hazardous drainage systems this will fall under OPPC and not require a UKOOP certificate. MARPOL 73/78 also defines a ship to include "floating craft and fixed or floating platforms" and these are required where appropriate to comply with the requirements similar to those set out for vessels. The amendments made under the Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009 close an existing loop hole, where some large oil and chemical spills were not open to prosecution under MARPOL.

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
Waste from Vessels and Construction	MARPOL 73/78 Annex V	Annex V totally prohibits the disposal of plastics anywhere into the sea, and severely restricts discharges of other garbage from ships into coastal waters and "Special Areas". The Annex also obliges Governments to ensure the provision of facilities at ports and terminals for the reception of garbage. The special areas established under the Annex are: the Mediterranean Sea — the Baltic Sea Area the Black Sea area — the Red Sea Area the Gulfs Area — the North Sea the Wider Caribbean Region — Antarctic Area
	The Merchant Shipping (Prevention of Pollution by Sewage and Garbage) Regulations 2008 (as amended 2010)	**Regulator: MCA** The Merchant Shipping (Prevention of Pollution by Sewage and Garbage) Regulations 2008 implements Annexes IV and V of MARPOL and supersedes The Merchant Shipping (Prevention of Pollution by Garbage) Regulations 1998) Under the regulations all wastes are to be segregated and stored and returned to shore for disposal and no garbage can be dumped overboard in a 'Special Area' Food waste can be discharged only if: Greater than 12 miles from coastline Ground to less than 25mm particle size Vessels must have a garbage management plan with suitable labelling and notices displayed.
Sewage from Vessels	MARPOL 73/78 Annex IV Regulations for the Prevention of Pollution by Sewage from Ships	**Regulator: MCA** Requirement for ships to discharge sewage only under certain conditions: Comminuted and disinfected sewage may only be discharged more than 4nm from the coast; Non-comminuted or disinfected sewage may only be discharged 12nm from the coast; Original international regulations entered into force in September 2003 and the revised annex entered into force in 2005. This does not apply to offshore installations as defined in the Petroleum Act 1998 (as amended).
	The Merchant Shipping (Prevention of Pollution by Sewage and	**Regulator: MCA** Implements Annexes IV and V of MARPOL

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
	Garbage) Regulations 2008 (as amended 2010)	Supersedes The Merchant Shipping (Prevention of Pollution by Garbage) Regulations 1998 No consent is required unless the vessel is >400 GRT or <4000 GRT and engaged in international voyage; here an International Sewage Pollution Prevention Certificate is needed.
Atmospheric Emissions from Vessels	MARPOL 73/78 Annex VI the Prevention of Air Pollution from Ships	**Regulator: MCA** Annex VI is concerned with the control of emissions of ozone depleting substances, NOx, SOx, and VOCs and require ships (including platforms and drilling rigs) to be issued with an International Air Pollution Certificate following survey. The Annex sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances. It caps 4.5% m/m on the sulphur content of fuel oil. The Annex sets special SOx emission control areas (SECAS) where sulphur emissions are limited further and sulphur content in fuel oil must not exceed 1.5% m/m or have an exhaust gas cleaning system fitted. The North Sea is one such SECAS. No new installations containing ozone-depleting substances are permitted, with the exception of HCFCs which are permitted till 1 January 2020. NOx emissions from diesel engines are to be limited by the implementation of NOx technical code. No incineration of contaminated packing materials or PCBs onboard ships. Annex VI only applies to diesel engines over 130 KW and does not apply to turbines. Emissions arising directly from the exploration, exploitation and associated offshore processing of seabed mineral resources are exempt from Annex VI, including the following: emissions resulting from flaring, burning of cuttings, muds, well clean-up emissions and well testing; release of gases entrained in drilling fluids and cuttings; emissions from treatment, handling and storage of reservoir hydrocarbons; and emissions from diesel engines solely dedicated to the exploitation of seabed mineral resources. In addition, Regulation 13 concerning NOx does not apply to emergency diesel engines, engines installed in lifeboats or equipment intended to be used solely in case of emergency.
	The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended 2010)	**Regulator: MCA** The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 implements Annex VI of MARPOL into UK law. The Regulations aim to reduce air pollution from shipping. This will be achieved through controls on emissions of Nitrogen Oxides, Sulphur Oxides, Volatile Organic Compounds and Ozone Depleting Substances, which are not Greenhouse Gases (GHGs). Additionally, elements of the Regulations limit the sulphur content of marine fuels and require a register of local marine fuel suppliers.

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
		The 2010 amendments primarily implement provisions concerning the sulphur content of marine fuels
Antifouling Coating on Vessels	International Convention on the Control of Harmful Antifouling Systems on Ships 2001; EC Regulation 782/2003 on the Prohibition of Organotin Compounds on Ships The Merchant Shipping (Anti-Fouling Systems) Regulations 2009	**Regulator: MCA** It was proposed by the International Convention on the Control of Harmful Antifouling Systems on Ships that the use of tributyltin (TBT) would be banned on new vessels from 2003 with a total ban on all hulls from 2008. However, currently, in the UK, the use is only restricted under the Surface Waters (Dangerous Substances) (Classification) Regulations, 1997. Additionally, it is listed as a priority hazard substance under the Water Framework Directive, for priority action under the OSPAR and Helsinki Conventions and its sale and use are restricted under the Control of Pesticides Regulations (as amended). EC Regulation 782/2003 prohibits ships from having organotin compound based anti-fouling paints applied to their hulls or other external surfaces, and it establishes a survey and certification regime in relation to anti-fouling systems. The Merchant Shipping (Anti-Fouling Systems) Regulations 2009 implements the EC Regulation into UK law.
	EC Directive 76/464 The Surface Waters (Dangerous Substances) (Classification) (Scotland) (No.2) Regulations 1998 OSPAR and Helsinki Conventions	**Regulator: Marine Scotland, MCA** EC Directive 76/464 deals with pollution caused by certain dangerous substances discharged into the aquatic environment. The Surface Waters (Dangerous Substances) (Classification) Regulations 1998 prescribe a system for classifying the quality of inland freshwaters, coastal waters and relevant territorial waters with a view to reducing the pollution of those waters by the dangerous substances within List II of EC Directive 76/464.
Discharges	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** As with drilling, discharges contaminated with reservoir oil during installation require an OPPC permit. These can be either term permits or life permits depending on the duration of the discharge. An OPPC permit is not required if the discharge originated from a vessel covered by the Merchant Shipping (Prevention of Oil Pollution) Regulations. Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits now extend to CCS activities. A permit is required for discharge of oil to sea and is obtained from BEIS. Specific monitoring and reporting requirements will be included on each permit. Reporting is via the Environmental Emissions Monitoring System (EEMS).
	Offshore Chemicals Regulations 2002 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** Under these Regulations, offshore pipeline installations need to apply for permits to cover both the use and discharge of chemicals. The permits are applied for through PETS (UK Oil Portal). The application requires a description of the work carried out, a site specific EIA and a list of all the chemicals intended for use and or discharge, along with a risk assessment for the environmental effect of the discharge of chemicals into the sea. The permit obtained may include conditions.

Vessels		
Issue	**Legislation**	**Regulator and Requirements**
Vessel Movements	International Regulation for Preventing Collisions at Sea 1972 (COLREGS) (as amended 2009)	**Regulator: IMO** The COLREGs are designed to minimise the risk of vessel collision at sea and apply to all vessels on the high seas. They include 38 rules divided into five sections: Part A - General Part B - Steering and Sailing Part C - Lights and Shapes Part D - Sound and Light Signals Part E - Exemptions. There are also four Annexes containing technical requirements concerning lights and shapes and their positioning; sound signalling appliances; additional signals for fishing vessels when operating in close proximity, and international distress signals.
	The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996	**Regulator: MCA** The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996 implements the COLREGS into UK law. Vessels to which these regulations apply must comply with Rules 1-36 of Annexes I to III of the COLREGS.

Commissioning and Operations		
Issue	**Legislation**	**Regulator and Requirements**
Discharges of Linefill and Hydrotest Fluids	The Petroleum Act 1998 (as amended).	**Regulator: BEIS supported by Marine Scotland and CEFAS and within territorial waters Scottish Government Marine Directorate** Deposits in the sea, including liquid discharges, were regulated through the MCAA but, as stated above, as a result of the Petroleum Act 1998 this does not apply to anything done: (a) for the purpose of constructing a pipeline as respects any part of which an authorisation (within the meaning of Part III of the Petroleum Act 1998) is in force; or (b) for the purpose of establishing or maintaining an offshore installation within the meaning of Part IV of that Act. Discharges of line fill and hydrotest fluids are permitted under the Petroleum Act 1998 and this is incorporated and permitted within PETS.
Displacement Water	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010).	**Regulator: BEIS** The discharge of oil requires an OPPC permit which are issued by BEIS. Specific monitoring and reporting requirements will be included on each permit. Reporting is via the EEMS.
Chemical Use and Discharge	Offshore Chemicals Regulations 2002 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010).	**Regulator: BEIS** Under these Regulations, offshore pipeline installations need to apply for permits to cover both the use and discharge of chemicals. The permits are applied for through PETS (UK Oil Portal). The application requires a description of the work carried out, a site specific environmental impact assessment and a list of all the chemicals intended for use and / or discharge, along with a risk assessment for the environmental effect of the discharge of chemicals into the sea. The permit obtained may include conditions. Note: Permits now extend to carbon sequestration activities under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010.
Dangerous Goods	The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997 (as amended 1999)	**Regulator: MCA** The regulations require that dangerous goods and marine pollutants are labelled and packed according to the International Maritime Dangerous Goods (IMDG) code and that dangerous goods declarations are provided to vessel masters prior to loading.

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Issue	**Legislation**	**Regulator and Requirements**
Chemical Data Sheets and Labelling	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (as amended 2008) (revoked by the Chemicals (Hazard Information and Packaging for Supply) Regulations 2009)	**Regulator: Health and Safety Executive** The transport of chemicals to and from offshore fields is principally by road to shore base and then by sea. These regulations (commonly known as CHIP 3) specify safety data sheet format and contents and required packaging and labelling of chemicals for supply. The 2009 regulations (CHIP4) consolidate all amendments made to the Chemicals (Hazard Information and Packaging for Supply) Regulations since 2002.
Machinery Space Drainage from Shipping	The Merchant Shipping (Prevention of Pollution) (Limits) (Revocation) Regulations 2013	**Regulator: MCA** The Merchant Shipping (Prevention of Pollution) (Limits) (Revocation) Regulations 2013 implement Annex I of MARPOL into UK legislation. Within a 'Special Area' ships which are 400GT or above can discharge water from machinery space drainage providing the oil content of the water does not exceed 15ppm. Vessels must be equipped with oil filtering systems, automatic cut offs and oil retention systems. All vessels must hold an approved Shipboard Oil Pollution Emergency Plan (SOPEP) and must maintain a current Oil Record Book and the ship must be proceeding on its voyage. All vessels must hold a UKOPP certificate or an IOPPC certificate for foreign ships. Installations can obtain a temporary exception from MCA under an informal agreement between OGUK and the MCA, however new installations need to demonstrate their 'equivalence' to other offshore installations where temporary installations are being issued and they are unlikely to obtain a certificate unless they fully comply with the requirements. Note, if all machinery drainage is routed via the hazardous or non-hazardous drainage systems this will fall under OPPC and not require a UKOPP certificate. MARPOL 73/78 also defines a ship to include "floating craft and fixed or floating platforms" and these are required where appropriate to comply with the requirements similar to those set out for vessels. The amendments made under the Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009 close an existing loop hole, where some large oil and chemical spills were not open to prosecution under MARPOL.
Radioactive Sources	Radioactive Substances Act 1993 (as amended 2011 (Northern Ireland and Scotland only))	**Regulator: SEPA** A certificate issued by SEPA is required for any new sources brought onto installations. The application must refer to all temporary or permanent radioactive sources taken offshore. The certificate must be displayed or be easily accessible to those whose work activity may be affected. The Radioactive Substances Act 1993 Amendment (Scotland) Regulations 2011 came into effect on 1st October 2011 and amended sections 1 and 2, changing the definitions of radioactive material and radioactive waste. These regulations apply to Scotland only.

Commissioning and Operations		
Issue	**Legislation**	**Regulator and Requirements**
Produced Water	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** Discharge requirements under OPPC are: • A monthly average oil-in-water concentration not exceeding 30mg/l; • A maximum oil-in-water concentration not exceeding 100mg/l; • Each installation has a specific discharge limit expressed as tonnes/day. In addition, each installation will have permit for re-injection of produced water. Monthly reporting of produced water discharges is via EEMS. Bi-annual sampling and analysis is required for total aliphatics, total aromatics and total hydrocarbons (BTEX, NPDs, PAHs, organic acids, phenols and heavy metals). Other specific monitoring requirements are attached to each permit.
	Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention) OSPAR Recommendation 2001/1 For the Management of Produced Water from Offshore Installations (as amended by Recommendation 2011/8)	**Regulators: BEIS** OSPAR Recommendation 2001/1 (as amended) requires that no individual offshore installation exceeds a performance standard for dispersed oil of 30 mg/l for produced water discharged into the sea. It also requires a 15% reduction in the discharge of oil in produced water from 2006 measured against a 2000 baseline; controlled by the issue of permits to each installation. This is implemented under OPPC.
Hazardous and Non-Hazardous Drainage (excluding machinery space drainage)	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** Requires a permit for hazardous drainage and non-hazardous drainage discharges. Specific monitoring and reporting requirements are required on each schedule permit. Reporting is via EEMS. Permits now extend to pipelines under the 2011 amendments and to CCS activities under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010.
Well Workover, Intervention and Service Fluid Discharges	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore	**Regulator: BEIS** The OPPC regulations require a permit for well workover, intervention and service fluid discharges. Under these regulations a permit is not required for the discharge of OBM / OPF and SBMs as these are permitted under the Offshore Chemical Regulations 2002 (as amended). However any material being discharged or

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Issue	**Legislation**	**Regulator and Requirements**
	Environmental Protection) Order 2010) Offshore Chemicals Regulations 2002 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	reinjected that has been contaminated by hydrocarbons from the reservoir will require a permit. Specific monitoring and reporting requirements are included on each schedule permit and reporting is via EEMS. Note: Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits now extend to carbon sequestration activities.
Maintenance and Cleaning Discharges	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** The OPPC regulations require a permit for maintenance and cleaning discharges, however it may be possible to include it in an existing permit. Permits extend to both installations and pipeline under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) (Amendment) 2011. Specific monitoring and reporting requirements are included on each schedule permit and reporting is via EEMS. Note: Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits now extend to CCS activities.
Other Minor Oily Discharges	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** The OPPC regulations require a permit for minor oily discharges such as those associated with BOP actuation, subsea valve actuation, subsea production start-up and pipeline disconnection. Specific monitoring and reporting requirements are included on each schedule permit and reporting is via EEMS. Note: Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits now extend to CCS activities.
Oily Sand and Sludge	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** The OPPC regulations require permits for discharge of oily substances to sea with measurement and reporting of total oil and sand discharged. A permit is required to discharge oil contaminated sand and scale. Under the 2011 amendments, permits now extend to pipelines. Note: Under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, permits now extend to carbon sequestration activities

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Issue	**Legislation**	**Regulator and Requirements**
Combustion Emissions	EC Directive 2008/1 on Integrated Pollution Prevention and Control (IPPC) (replacing EC Directive 96/61) (as amended by EC Directive 2009/31)	The IPPC Directive requires industrial and agricultural activities with a high pollution potential to have a permit. This permit can only be issued if certain environmental conditions are met, so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause. Annex I of the Directive defines all applicable industrial and agricultural activities, including combustion installations located on offshore oil and gas platforms and, under EC 2009/31, CCS installations where an item of combustion plant on its own, or together with any other combustion plant installed on a platform, has a rated thermal input exceeding 50 MW(th).
	Industrial Emissions Directive (2010/75/EU)	The Industrial Emissions Directive combines seven existing directives into one namely: • the Large Combustion Plant directive; • the Integrated Pollution Prevention and Control directive; • the Waste Incineration directive; • the Solvent Emissions directive; and • the three existing directives on Titanium dioxide on (i) disposal (78/176/EEC), (ii) monitoring and surveillance (82/883/EEC) and (iii) programs for the reduction of pollution (92/112/EEC). The Directive improves the interaction between the existing seven directives which it replaces and strengthens, in several instances, some provisions in existing directives, for example the Large Combustion Plant provisions.

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Issue	**Legislation**	**Regulator and Requirements**
	Pollution Prevention and Control Act 1999 (applies to waters outside the 3 nm limit) The Pollution Prevention and Control (Scotland) Regulations 2000 (as amended 2011)	**Regulator: BEIS** The Pollution Prevention and Control Act 1999 implements the EC IPPC Directive into UK law. More specifically Sections 1 and 2 of the Act confer on the Secretary of State power to make regulations providing for a new pollution control system to meet the requirements of the IPPC Directive and for other measures to prevent and control pollution. The Pollution Prevention and Control (Scotland) Regulations 2000 enact the IPPC Directive in Scotland and were made under the Pollution Prevention and Control Act 1999. The regulations require operators to apply for a permit for new offshore combustion processes which are to be permanently installed and, on its own or in addition to existing equipment on that installation, will result in a thermal rated input greater than 50 MW. Requirements included: The operator to apply for a permit, in writing to Secretary of State with prescribed information detailed in the Regulations Secretary of State will publish applications in the Gazettes specifying where applications can be obtained, and specifying a date not less than 4 weeks from the final Gazette publication, by which public will be permitted to make representations Public consultation period must be at least 28 days Permit will either be granted, along with conditions, or rejected (reasons for rejection will be given) Regular permit reviews are required to check whether the permit conditions are still relevant. These will be carried out by BEIS at least once every five years, following which the Department may either request an application for a permit variation or proceed to issue a revised permit.
	The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 Offshore Combustion Installation (Prevention and Control of Pollution) Regulations 2001 (as amended)	**Regulator: BEIS** The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 ("the Offshore PPC Regulations 2013") transpose the appropriate provisions of Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (the Industrial Emissions Directive). The regulations replace previous IPPC 2001 and IPPC 2007 Regulations. However, these regulations still apply for Permits granted before the 2013 Regulations came into force. They apply to combustion installations located on offshore oil and gas platforms and where an item of combustion plant on its own, or together with any other combustion plant installed on a platform, has a rated thermal input exceeding 50 MW(th).
	EC Directive 2003/87 establishing a scheme for greenhouse gas emission	The EU Emissions Trading Scheme (EU ETS) Directive was published in October 2003 and came into effect in January 2005. It aims to achieve reductions in GHG emissions as outlined in the Kyoto Protocol. The EU

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Issue	**Legislation**	**Regulator and Requirements**
CO_2 Combustions Sources and Emissions	allowance trading with the community (as amended by EC Directive 2009/29)	ETS Directive covers six GHGs; however, to date only CO_2 is covered. The Directive applies to numerous installations, including those with combustion facilities with a combined rated thermal input of >20 MW (th). The Directive has been amended by three subsequent acts: EC Directive 2004/101 EC Directive 2008/101 EC Directive 2009/29 The revised Directive outlines Phase III of the EU ETS, which takes place between 2013 and 2020. Phase III includes: Centralised, EU-wide cap which will decline annually by 1.74% delivering an overall reduction of 21% below 2005 verified emissions by 2020. Adjustment of the EU ETS cap up to the 30% GHG reduction target when the EU ratifies a future international climate agreement. A significant increase in auctioning levels – at least 50% of allowances will be auctioned from 2013; compared to around 3% in Phase II.
	Greenhouse Gas Emissions Trading Scheme Regulations 2005 (as amended 2011 and 2017) Greenhouse Gas Emissions Trading Scheme (Nitrous Oxide) Regulations 2011	**Regulator: BEIS** Greenhouse Gas Emissions Trading Scheme Regulations 2005 (as amended) provide a framework for a GHG emissions trading scheme and implement Directive 2003/87/EC establishing a scheme for GHG emission allowance trading. A permit is required to emit GHG from combustion plants with an aggregate thermal rating of >20MW(th) and from flaring. The requirement must be registered and an application made from the UK allocation plan. Under the amendments made to the regulations by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, "offshore installations" does *not* include gas storage and unloading installations within the seaward limits of the territorial sea adjacent to Wales or Scotland. The purpose of the Greenhouse Gas Emissions Trading Scheme (Nitrous Oxide) Regulations 2011 is to enable the UK to take advantage of the option, accorded by Article 24 of Directive 2003/87/EC, to apply the EU ETS to other greenhouse gases and activities, in this case nitrous oxide (N_2O) emissions from nitric acid production ("the N_2O opt-in"). For that purpose, the regulations detail an amended plan for the allocation of allowances in line with the Greenhouse Gas Emissions Trading Scheme Regulations 2005.

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Issue	**Legislation**	**Regulator and Requirements**
	The Greenhouse Gas Emissions Data and National Implementation Measures Regulations 2009	**Regulator: BEIS** and **Environment Agency** The Regulations give effect to two parts of the EU ETS Directive. Firstly, the Regulations enable specified GHG emissions data to be collected. Secondly, the Regulations enable production and other data to be collected for the purpose of enabling the United Kingdom, as it is required to do so by the Directive, to publish and submit to the European Commission its national implementation measures for the third phase of the GHG emission allowance trading scheme which commences on 1st January 2013 (EU ETS Phase III).
	CRC Energy Efficiency Scheme Order 2010 (as amended 2013)	**Regulator: BEIS** The CRC Energy Efficiency Scheme Order 2010 is a mandatory scheme designed to promote energy efficiency and reduce carbon emissions.
Ozone Depleting Substances	EC Regulation 842/2006 Fluorinated Greenhouse Gases Regulations 2009 (as amended 2012)	**Regulator: BEIS, Defra and SEPA** Provisions relating to the control and prohibition of F-gas emissions including: Prevent and repair detected leakages of F-gases from all equipment covered by the EU F-Gases Regulation. Undertake periodic leakage inspections to equipment that contains 3kg or more of F-gases Maintain records Monitor and annually report (by 31 March each year) data to EEMS on all emissions of HFCs / PFCs and SF6 from relevant equipment The Fluorinated Greenhouse Gases Regulations 2009 prescribe offences and penalties applicable to infringements of EU Regulation 842/2006 on certain fluorinated greenhouse gases (F gases), amongst others, as well as dealing with other requirements relating to leakage checking, reporting and labelling, together with proposed powers for authorised persons to enforce these Regulations. There Regulations also give effect to the following EC Regulations relating to certain fluorinated GHGs: - EC Regulation 1493/2007 - EC Regulation 1494/2007 - EC Regulation 1497/2007 - EC Regulation 1516/2007 - EC Regulation 303/2008 - EC Regulation 304/2008 - EC Regulation 305/2008 - EC Regulation 306/2008 - EC Regulation 307/2008 The regulations now extend to carbon sequestration activities under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010.

Commissioning and Operations		
Issue	**Legislation**	**Regulator and Requirements**
	EC Regulation No 1005/2009 on substances that deplete the ozone layer (as amended by EC Regulation No 744/2010)	**Regulator: BEIS, Defra and SEPA** These regulations consolidate and replace EC Regulation 2037/2000 as amended by introducing tighter controls on the use / reuse of certain controlled substances. UK Statutory Instruments providing for EC Regulation 2037/2000 will continue to be in force until updated / amended for the new consolidated Regulation (see pending legislation). EC Regulation No 744/2010 extends the cut-off date for the use of certain essential uses of halons in fire protection systems
	The Environmental Protection (Controls on Ozone Depleting Substances) Regulations 2011 (revokes and replaces the Environmental Protection (Controls on Ozone Depleting Substances) Regulations 2002 (as amended 2008).	**Regulator: BEIS** The 2011 regulations revoke and replaces the previous regulations. The regulations enforce the provisions of 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.
Flaring and Venting	Energy Act 1976 Petroleum Act 1998 (as amended) Pollution Prevention and Control Act 1999. The Petroleum (Current Model Clauses) Order 1999 The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 Model Clauses of Licences Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2007	**Regulator: OGA** Consent required for flaring or venting. The Model Clauses are incorporated into the Production Licences and require a flare and venting consent to be granted by OGA. Annual flare consents must be obtained from OGA. During commissioning and start up flare consents for short durations can be issued until flaring levels have stabilised. Flaring requirements must not exceed installations' flare consent. All flaring and venting volumes must be reported to OGA.

Commissioning and Operations		
Issue	**Legislation**	**Regulator and Requirements**
Sewage from Installations	Food and Environment Protection Act 1985 (as amended) Deposits in the Sea (Exemptions) Order 1985	**Regulator: BEIS supported by CEFAS and Marine Scotland** Discharges of sewage and grey and black water as part of routine operations are permitted discharges under the Deposits in the Sea (Exemptions) Order 1985.
Waste	EC Directive 2006/12 (EU Waste Framework Directive) (repealed by EC Directive 2008/98) (as amended by EC Directive 2009/31)	**Regulator: SEPA** The Waste Framework Directive establishes a legal framework for the treatment of waste in the EU. It aims at protecting the environment and human health through the prevention of the harmful effects of waste generation and waste management. It does not apply to the following (which are captured under various other regulations discussed): gaseous effluents radioactive elements decommissioned explosives faecal matter waste waters animal by-products carcasses of animals that have died not from being slaughtered elements resulting from mineral resources
	National Waste Strategy 2000 (as amended 2007) The Waste (Scotland) Regulations 2012	**Regulator: SEPA and Local Authorities** Commits the UK to a target of cutting landfill of biodegradable waste by two thirds by 2020. The Waste (Scotland) regulations 2012 apply onshore and transpose Articles 11(1) (re-use and recycling) and 22 (bio-waste) of Directive 2008/98/EC on waste. Waste transported onshore must be segregated and recycled and requires persons who produce or manage controlled waste to take reasonable steps to ensure that high quality waste is available for recycling.
	MARPOL Annex V: Prevention of pollution by garbage from ships The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 (as amended 2010)	**Regulator: Maritime and Coastguard Agency** There have been significant amendments to Annex V of MARPOL since it first entered into force in 1998. The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 (as amended) supersedes Merchant Shipping (Prevention of Pollution by Garbage from Ships) Regulations 1998 and brings the previous implementing regulations into line with the current version of Annex V.

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Issue	**Legislation**	**Regulator and Requirements**
		Under the regulations: All wastes are to be segregated and stored and returned to shore for disposal. No garbage is to be dumped overboard from an installation (including incinerator ashes from plastics as they may contain toxic or heavy metal residues). Food waste can be discharged only if ground to less than 25mm particle size. Installation must have a garbage management plan and suitable labelling and notices displayed.
	Environmental Protection (Duty of Care) Regulations 1991 (as amended 2003)	**Regulator: SEPA** Duty of Care requires correct segregation, identification and disposal of wastes.
	Special Waste (Scotland) Regulations 1997 (as amended) has been superseded by the Special Waste Amendment (Scotland) Regulations 2004.	**Regulator: SEPA** Under these Regulations Waste Transfer Notes (for general waste) and Waste Consignment Notes (for waste designated 'Special' in Scotland) are to be used for hazardous wastes. In addition, the regulatory authorities need to be notified regarding the disposal of hazardous or special waste.
	The Waste Batteries (Scotland) Regulations 2009	**Regulator: SEPA** The Waste Batteries (Scotland) Regulations 2009 amends the Pollution Prevention and Control (Scotland) Regulations 2000/323 to ban incinerating waste industrial and automotive batteries and amends the Landfill (Scotland) Regulations 2003/235 to ban waste industrial and vehicle batteries from landfills.
Rock Dumping	Petroleum Act 1998 (as amended)	**Regulators: BEIS supported by Marine Scotland and CEFAS and within territorial waters Marine Scotland or DEFRA** Deposit of Materials Consent (DepCon) is required for the deposit of materials e.g. rock dumping or mattresses. This forms part of the Pipeline Works Authorisation (PWA) application process. A licence under the MCAA is required in cases where not covered by a PWA, for example: Pipeline crossing preparations or other works before a PWA or related Direction is in place Installation of certain types of cable, e.g. communications cables.

Decommissioning		
Issue	**Legislation**	**Regulator and Requirements**
Chemical Use and Discharge	Offshore Chemicals Regulations 2002 (as amended 2011) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** These Regulations require all use and discharge of chemicals at offshore oil and gas installations to be covered under a permit system. Exceedance of discharge limits must be reported. Amendments to the Offshore Chemicals Regulations 2002, made under Schedule 2 of the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (OPPC) increase the powers of BEIS inspectors to investigate non-compliances and risk of significant pollution from chemical discharges, including the issue of prohibition or enforcement notices.
Preliminary Discussions **Decommissioning Proposals**	Petroleum Act 1998 (as amended by the Energy Act 2008 and in accordance with OSPAR Decision 98/3) IMO Guidelines and Standards for the removal of offshore installations and structures on the continental shelf 1989 BEIS Guidance note for Industry Decommissioning of Offshore Installations and Pipelines 2009	**Regulator: BEIS** OSPAR Decision 98/3 concerns the decommissioning of installations. It requires that decommissioning will normally remove the whole of an installation, although there are some exceptions for large structures. However, currently, there are no international guidelines for the decommissioning of pipelines. Under the terms of the OSPAR Decision 98/3 there is a prohibition on dumping and leaving wholly or partly, in place of offshore installations. All installations installed post 1999 should be removed entirely. For those installed pre 1999 the topsides must be returned to shore and all installations with a jacket weight of less than 10,000 tonnes completely removed for re-use, recycling or final disposal on land with installations of greater than 10,000 tonnes being considered on an individual basis with the base case being that they will be removed entirely. The Petroleum Act 1998 (as amended) sets out requirements for undertaking decommissioning of offshore installations and pipelines including preparation and submission of a Decommissioning Programme. Decommissioning proposals for pipelines should be contained with a separate Decommissioning Programme from that of installations. However, programmes for both pipelines and installations in the same field may be submitted in one document. Part III of the Energy Act 2008 amends Part 4 of the Petroleum Act 1998 (as amended) and contains provisions to enable the Secretary of State to make all relevant parties liable for the decommissioning of an installation or pipeline; provide powers to require decommissioning security at any time during the life of the installation and powers to protect the funds put aside for decommissioning in case of insolvency of the relevant party. The Petroleum Act 1998 as amended stipulates that a decommissioning programme needs to be prepared and agreed with BEIS. The main stages of the decommissioning process are: **Stage 1 -** Preliminary discussions with BEIS **Stage 2 –** Detailed discussions submission and consideration of a draft programme **Stage 3 –** Consultations with interested parties and the public **Stage 4 –** Formal submission of a programme and approval under the Petroleum Act (as amended) **Stage 5 –** Commence main works and undertake site surveys

Decommissioning		
Issue	**Legislation**	**Regulator and Requirements**
		Stage 6 – Monitoring of site
	Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended 2007) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** Although there is no statutory requirement to undertake an EIA at the decommissioning stage, the Decommissioning Programme will need to be supported by an EIA. The ES submitted for the development requires the applicant to consider the long term impacts of the development, including decommissioning. However, due to the lengthy period between the project sanction and decommissioning, the requirement for a detailed assessment of decommissioning is deferred until closer to the time of actual decommissioning and submitted as part of the Decommissioning Programme.
	Pipelines Safety Regulations 1996 (as amended 2003)	**Regulator: Health and Safety Executive** These Regulations administered by the Health and Safety Executive (HSE) provide requirements for the safe decommissioning of pipelines.
	OSPAR Recommendation 2006/5 on a management scheme for offshore cuttings piles	**Regulator: BEIS** This recommendation outlines the approach for the management of cuttings piles offshore. The assessment of the disposal options of cuttings takes into account a number of factors, including timing of decommissioning.
	Marine and Coastal Access Act 2009 (as amended 2011) Marine (Scotland) Act 2010	**Regulator: BEIS, Marine Scotland** Although most activities associated with exploration or production / storage operations that are authorised under the Petroleum Act (as amended) or Energy Act are exempt from the MCAA, this exemption does not extend to decommissioning operations. A licence under the MCAA (and the Marine (Scotland) Act 2010) will be required for all decommissioning activities including: Removal of substances or articles from the seabed Disturbance of the seabed (e.g. localised dredging to enable cutting and lifting operations) Deposit and use of explosives that cannot be covered under an application for a Direction. Disturbance of the seabed e.g. disturbance of sediments or cuttings pile by water jetting during abandonment operations
Stabilisation Materials	Marine and Coastal Access Act 2009 (as amended 2011) Marine (Scotland) Act 2010	**Regulator: BEIS, Marine Scotland** MCAA licence is required for deposit of stabilisation or protection materials related to decommissioning operations. A licence under this act will be required for all decommissioning activities and for any deposits, removals or seabed disturbance during abandonment
Power Generation	Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001 (as amended	**Regulator: BEIS** As discussed previously, under the Offshore Combustion Installations (Prevention and Control of Pollution) Regulations a permit is required if the aggregated thermal capacity of the combustion installation exceeds 50

Decommissioning		
Issue	**Legislation**	**Regulator and Requirements**
	2013) (as amended by the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	MW(th). Such permits will have been issued prior to decommissioning operations and when aggregated thermal capacity falls below the 50 MW(th) threshold during the course of decommissioning operations the installation will no longer be subject to the controls and the operators will be required to surrender the permit.
	The Greenhouse Gas Emissions Trading Scheme Regulations 2005 (as amended 2013)	**Regulator: BEIS, Environment Agency** Similarly, under these Regulations a permit is required to cover the emission of greenhouse gases if the aggregated thermal capacity of the combustion equipment on the installation exceeds 20 MW(th). Such permits will have been issued prior to decommissioning and must be surrendered when the aggregated thermal capacity falls below the threshold. The installation will then be deemed closed and will drop out of the EU ETS. Installations will be able to retain and trade any surplus allowance for the year of closure, but will not receive any allowances for future years.

Accidental Events		
Issue	**Legislation**	**Regulator and Requirements**
Oil Pollution Emergency Planning (Installations)	Offshore Installations (Emergency Pollution Control) Regulations 2002 (as amended by the Energy Act (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** In the event of an incident or accident involving an offshore installation where there may be a risk of significant pollution of the marine environment or where the operator fails to implement effective control and preventative operation the Government is given powers to intervene. BEIS under agreement with MCA will notify the Secretary of State Representative (SOSREP) in the event of an incident if there is a threat of significant pollution into the environment. The SOSREP's role is to monitor and if necessary intervene to protect the environment in the event of a threatened or actual pollution incident in connection with an offshore installation. The Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010 amends the Offshore Installations (Emergency Pollution Control) Regulations 2002 to ensure that the powers of the Secretary of State to prevent or reduce accidental pollution extend to accidents resulting from CCS.
	Offshore Chemical Regulations 2002 (as amended 2011) (as amended by the Energy Act (Consequential Modifications) (Offshore Environmental Protection) Order 2010) Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2011) (as amended by the Energy Act (Consequential Modifications) (Offshore Environmental Protection) Order 2010)	**Regulator: BEIS** These Regulations require all use and discharge of chemicals at offshore oil and gas installations to be covered under a permit system. Exceedance of discharge limits must be reported. Amendments to the Offshore Chemicals Regulations 2002 made under Schedule 2 of the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (OPPC) increase the powers of BEIS inspectors to investigate non-compliances and risk of significant pollution from chemical discharges, including the issue of prohibition or enforcement notices. Under these Regulations it is an offence to make any discharge of oil other than in accordance with the permit granted under these Regulations for oily discharges (e.g. produced water). However, it will be a defence to prove that the breach of permit arose from an event that could not be reasonably prevented. Permits now extend to pipelines under the 2011 amendments and to carbon sequestration activities under the Energy Act (Consequential Modifications) (Offshore Environmental Protection) Order 2010.
	OSPAR Recommendation 2010/18	**Regulator: BEIS** OSPAR recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities came into force on 24th September 2010. According to OSPAR recommendation 2010/18, contracting parties should: Continue or, as a matter of urgency, start reviewing existing frameworks (i.e. the regulatory mechanisms and associated guidance applied by the Contracting Parties in the OSPAR area), including the permitting of drilling activities in extreme conditions. Extreme conditions include, but are not limited to, depth, pressure and weather Evaluate activities on a case by case basis and prior to permitting.
	The Merchant Shipping (Implementation of Ship-Source	**Regulator: MCA**

Accidental Events		
Issue	**Legislation**	**Regulator and Requirements**
Oil Pollution Emergency Planning (shipping)	Pollution Directive) Regulations 2009	EC Directive 2005/35 on ship-source pollution and on the introduction of penalties for infringements states that ship-source polluting discharges constitute in principle a criminal offence. According to the Directive this relates to discharges of oil or other noxious substances from vessels. Minor discharges shall not automatically be considered as offences, except where their repetition leads to deterioration in the quality of the water, including in the case of repeated discharges. The Directive applies to all vessels; polluting discharges are forbidden in: Internal waters, including ports, of the EU; Territorial waters of an EU country; Straits used for international navigation subject to the regime of transit passage, as laid down in the 1982 United Nations Convention on the Law of the Sea (UNCLOS); The exclusive economic zone (EZZ) of an EU country; The high seas. The Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009 implement EU Directive 2005/35/EEC by making amendments to the following: The Merchant Shipping Act 1995 The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 The Merchant Shipping (Dangerous or Noxious Liquid Substances in Bulk) Regulations 1996 The Regulations limit the defences available to the master or owner of a ship involved in an oil spill or chemical spill and extend liability for the discharge to others such as charterers and classification societies. This closed a loop hole in the existing legislation where some large spills were not open to prosecution under MARPOL.
	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation) Regulations 1998 (as amended 2001)	**Regulator: BEIS** Requires the Operator to produce a site specific Oil Pollution Emergency Plan (OPEP) to be submitted to BEIS and statutory consultees at least 2 months prior to start of activities. An OPEP needs to cover the procedures and reporting requirements on how to deal with an incident where hydrocarbons are being released into the sea. All approved OPEPs must be reviewed and resubmitted to BEIS and consultees no later than five years after initial submission. In order to ensure adequate cover the operator must submit the plan at least 2 months prior to the end of this deadline. Regular reviews are further required to ensure that response capabilities, operation details and contact details remain current. Vessels that are in transit will be covered under the SOPEP; however, once on site and carrying out work for the operator the vessels should be covered by the operator's OPEP.

Accidental Events		
Issue	**Legislation**	**Regulator and Requirements**
Pipeline Emergency Prevention	Pipelines Safety Regulations 1996 (as amended 2003)	**Regulator: Health and Safety Executive** Under the Pipeline Safety Regulations 1996 (as amended): pipelines must be designated and constructed to ensure safe and effective shut-down in the event of an emergency; HSE must be notified of proposed pipeline construction; pipelines must have emergency shutdown valves and major accident prevention documentation.
Spill Reporting	The Petroleum (Current Model Clauses) Order 1999 The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 Model Clauses of Licence PON 1	**Regulator: BEIS** All oil spills must be reported to BEIS, the nearest HM coastguard and JNCC using a PON1.

Wildlife Protection		
Issue	**Legislation**	**Regulator and Requirements**
Birds and other Wildlife **Protected Sites and Species** **SACs and SPAs**	EC Directive 2004/35 on Environmental Liability (as amended by EC Directive 2009/31)	**Regulator: Defra** The Directive establishes a framework for environmental liability based on the "polluter pays" principle, with a view to preventing and remedying environmental damage. Under the terms of the Directive, environmental damage is defined as: direct or indirect damage to the aquatic environment covered by Community water management legislation; direct or indirect damage to species and natural habitats protected at Community level by the Birds or Habitats Directives; direct or indirect contamination of the land which creates a significant risk to human health.
	European Council Directive 79/409 (The Birds Directive) (as amended by EC Directive 2009/147)	**Regulator: Defra** The Birds Directive aims to protect ranges of species, as well as population and breeding, of certain populations of birds. Under the Birds Directive, Member States are to take measures to conserve certain areas, including the establishment of Special Protection Areas (SPAs) both on land and within UK territorial waters.
	European Council Directive 92/43/EEC (EC Habitats Directive) (and 97/62/EC and 2006/105/EC amendments)	The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The regulations provide for the designation and protection of Special Areas of Conservation (SACs).
	Nature Conservation (Scotland) Act 2004	**Regulator: Marine Scotland, SNH, JNCC** The Nature Conservation (Scotland) Act 2004 places duties on public bodies in relation to the conservation of biodiversity, increases protection for SSSIs, amends legislation on Nature Conservation Orders, provides for Land Management Orders for SSSIs and associated land, strengthens wildlife enforcement legislation, and requires the preparation of a Scottish Fossil Code.
	The Conservation (Natural Habitats &c.) Regulations 1994 (as amended 2012) The Conservation of Species and Habitats Regulations 2010 (as amended 2012) The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2011	**Regulator: BEIS**, **Marine Scotland, SNH, JNCC** The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) transpose the Habitats and Birds Directives into UK law. They apply to land and to territorial waters out to 12 nautical miles from the coast and have been subsequently amended several times. In Scotland, the Habitats and Birds Directives are transposed through a combination of the Conservation of Habitats and Species Regulations 2010 (in relation to reserved matters) and the 1994 Regulations. The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2011 make amendments to the 1994 regulations (in Scotland only). The amendments place a legislative requirement on Scottish Ministers to classify SPAs in terrestrial and inshore environments. Since the Birds Directive first came into force in 1979, the UK government and Scottish Ministers (since devolution) have actively delivered this responsibility without

Wildlife Protection		
Issue	**Legislation**	**Regulator and Requirements**
		a legislative requirement (153 SPAs have been classified in Scotland to date). In recent years, SPAs have been identified in accordance with agreed guidelines for the selection of SPAs which were published by the Joint Nature Conservation Committee (JNCC) in 1999. The amendments came into force on 6th April 2011. The Conservation of Species and Habitats Regulations 2010 also implement aspects of the Marine and Costal Access Act 2009.
	The Offshore Marine Conservation (Natural Habitats, &c) Regulations 2007 (as amended 2012)	**Regulator: BEIS**, These regulations transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, CCS plans and projects. The Regulations apply to the UK's offshore marine area (i.e. outside the 12 nm territorial limit) and English / Welsh territorial waters. The 2012 Amended Regulations make various insertions for new enactments (e.g. amendments to the Birds Directive by EC Directive 2009/147) and also devolve certain powers to Scottish Ministers.
	Offshore Petroleum (Conservation of Habitats) Regulations 2001 (as amended 2007) The Petroleum Act 1998 (as amended)	**Regulator: BEIS**, Similar to the Offshore Marine Conservation (Natural Habitats &c) Regulations, the Offshore Petroleum (Conservation of Habitats) Regulations transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, CCS plans and projects. These regulations apply to projects wholly or partially on the UKCS and adjacent waters outside territorial waters. The Offshore Petroleum (Conservation of Habitats) Regulations require consent to be obtained for geological surveys related to oil and gas activities undertaken on the UKCS. The 2007 amendments extend these provisions to UK waters (sea adjacent to UK from the low water mark up to the seaward limits of territorial waters), as well as requiring prior consent for the testing of equipment to be used in geological surveys. Regulation 5 of the 2001 Regulations requires the Secretary of State to consider whether an appropriate assessment should be undertaken prior to granting a licence under the Petroleum Act 1998 (as amended), where the licence relates to an area wholly or partly on the UKCS. The amended Regulations extend this requirement to those licenses within UK waters. Licenses now extend to carbon sequestration activities in the UKCS as a result of the Energy Act 2008 (Consequential Modifications) Offshore Environmental Protection) Order 2010.
Birds	Convention on Wetland of International Importance Especially as Waterfowl Habitats 1971 (The Ramsar Convention)	**Regulator: Defra** The Ramsar convention aims to prevent encroachment or loss of wetlands on a worldwide scale, recognising the importance of a network of wetlands on waterfowl. It is applicable to marine areas to a depth of 6m at low tide and other areas greater then 6m depth that are recognised as being important to waterfowl habitat.
Cetaceans	Agreement on the Conservation of Small Cetaceans of the Baltic and	**Regulator: Marine Scotland, Defra**

Wildlife Protection		
Issue	**Legislation**	**Regulator and Requirements**
	North Seas 1991 (ASCOBANS) and 2008 amendments	Requires governments to undertake habitat management, conduct surveys and research and to enforce legislation to protect small cetaceans. Originally ASCOBANS only covered the North and Baltic Seas, as of February 2008 the ASCOBANS area has been extended to include the North East Atlantic and Irish Sea.
European Protect Species	The Offshore Marine Conservation (Natural Heritage & C) (Amendment) Regulations 2012	**Regulator: Marine Scotland** The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 as amended by The Offshore Marine Conservation (Natural Habitats, &c.) (Amendment) Regulations 2012 transpose the habitats directive and the birds directive into national law. These Regulations apply to the UKs offshore marine area (outside the 12 nm territorial limit) and English / Welsh territorial waters. These Regulations make it an offence to deliberately disturb wild animals of a European Protected Species in such a way as to significantly affect a) the ability of any significant group of animals to survive or breed or b) the local distribution or abundance of that species. Offshore consents to protect EPS as required under article 12 of the Habitats Directive. Application process for an EPS licence for offshore activities via the PETs system.

General		
Issue	**Legislation**	**Regulator and Requirements**
Accidental discharge	EU Offshore Safety Directive (OSD) 2013, implemented in the UK by the Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 (SCR 2015)	**Regulator: The Offshore Safety Directive Regulator (OSDR) (a partnership between the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) and HSE)** The Directive came into force in July 2013. The primary aim of SCR 2015 is to address major accidents and hazards (MAH) and reduce the associated risks to the health and safety of the workforce employed on offshore installations or in connected activities. SCR 2015 also aims to increase the protection of the marine environment and coastal economies against pollution and to ensure appropriate response mechanisms are in place in the event of such an incident taking place. The objectives of this Directive are to: • Attain best industry practice throughout the EU based on primary duty of major accident risk control with consequent leverage on global standards, • Implement best regulatory practice for major accident prevention and mitigation via independent expert regulators in every relevant member state, • Implement fully joined up emergency preparedness and response procedures in all EU offshore regions, • Improve and clarify existing EU liability and compensation provisions New environmental regulations will be required to implement some of the objectives, specifically relating to Environmental Management Systems and Environmentally Critical Elements. Under the EIA Regulations and SCR 2015, developers are expected to assess the impact of: The major accident scenario that would result in the worst-case potential release of hydrocarbons; The major accident scenarios identified in a related OSD submission (such as a safety case or well notification); and The major accident scenarios identified in an OSD submission that would result in a Major Environmental Incident (MEI). The major accident scenario that would result in the worst-case potential release of hydrocarbons must be modelled and assessed both to inform the EIA and to support the OPEP submission, but a MEI can only occur as a consequence of a MAH identified in the OSD submission
Emissions	The Climate Change Act 2008 Climate Change (Scotland) Act, 2009	**Regulator: Scottish Government and Defra** The Climate Change Act introduces powers to combat climate change by setting targets to reduce CO_2 emissions by at least 60% by 2050 and an interim target of 26-32% by 2020, against a 1990 baseline. Similarly, the Climate Change (Scotland) Act targets for an 80% reduction in CO_2 emissions from 1990 levels by 2050 with an interim target of 42% by 2020. The Act also requires Scottish Ministers set annual targets, in secondary legislation, for Scottish emissions from 2010 to 2050.

General		
Issue	**Legislation**	**Regulator and Requirements**
Territorial Waters	Territorial Sea Act 1987 (as amended 2002) Territorial Waters Order in Council 1964 (as amended 1979) Control Oil Pollution Act 1974	Defines the territorial waters of the UK.
Public Participation	EC Directive 2003/35 on Public Participation	The Public Participation Directive (PPD) was issued by the European Commission in order to provide members of the public with opportunities to participate on the permitting and ongoing regulation of certain categories of activities within Member States, including Environmental Impact Statements.
Environmental Liability	EC Directive 2004/35 on Environmental Liability with Regard to the Prevention and Remedying of Environmental Damage	The Environmental Liability Directive enforces strict liability for prevention and remediation of environmental damage to 'biodiversity', water and land from specified activities and remediation of environmental damage for all other activities through fault or negligence.
	Environmental Damage (Prevention and Remediation) Regulations 2009 (as amended 2010) Environmental Liability (Scotland) Regulations 2009 (as amended 2011)	**Regulator: Marine Scotland, SEPA** These regulations implement EC Directive 2004/35 on Environmental Liability, forcing polluters to prevent and repair damage to water systems, land quality, species and their habitats and protected sites. The polluter does not have to be prosecuted first, so remedying the damage should be faster. The regulations were amended in 2010 to provide for the devolution to the Scottish Ministers of certain of the Secretary of State's functions with respect to preventing and remedying damage to marine nature conservation in the Scottish offshore region. However, the Secretary of State still enforces preventing and remedying damage caused by oil, gas and carbon dioxide storage activities and marine transport activities. The 2011 amendments amend the Regulations in accordance with EC Directive 2009/31.
Marine Management	EC Directive 2008/56 (the Marine Strategy Framework Directive) The Marine Strategy Regulations 2010	**Regulator: Marine Scotland** The Marine Strategy Regulations 2010 transpose the requirements of the Marine Strategy Framework Directive into UK law. The Directive requires Member States to implement measures to achieve or maintain good environmental status of their marine environment by 2020. Specifically, the Directive requires Member States to create a strategy for the following: An initial assessment of the current environmental status of a Member State's marine waters by 2012 Development of a set of characteristics which describe what "Good Environmental Status" means for those waters by 2012 Establishment of targets and indicators designed to show the achievement of Good Environmental Status by 2012 Establishment of a monitoring programme to measure progress toward achieving Good Environmental Status by 2014

General		
Issue	**Legislation**	**Regulator and Requirements**
		Establishment of a programme of measures designed to achieve or maintain Good Environmental Status (to be designed by 2015 and implemented by 2016).
	Marine and Coastal Access Act 2009 (as amended 2011) Marine (Scotland) Act 2010	**Regulator: BEIS, Marine Scotland** The Marine and Coastal Access Act (MCAA) came into force in November 2009. The Act covers all UK waters except Scottish internal and territorial waters which are covered by the Marine (Scotland) Act 2010 which mirrors the MCAA powers. The licensing provisions in relation to MCAA came into force on 1st April 2011. MCAA will replace and merge the requirements of FEPA Part II (environment) and the Coast Protection Act 1949 (navigation). The following activities are exempt from MCAA as they are controlled under different legislation: Activities associated with exploration or production / storage operations that are authorised under the Petroleum Act 1998 (as amended) and Energy Act 2008 Additional activities authorised solely under the BEIS environmental regime, such as chemical and oil discharges The offshore oil and gas activities that will require an MCAA licence are as follows: Deposits of substances or articles in the sea or on the seabed, e.g. pipeline crossing works prior to use of pipeline authorisation works (PWA) or related Direction, or deposit of materials associated with abandonment operations Removal of substances or articles from the seabed, e.g. pre-sweep dredging with disposal of material at a remote location, or removal of seabed infrastructure during abandonment operations Disturbance of the seabed, e.g. pre-sweep dredging using a levelling device or by side-casting material, or disturbance of sediments or cuttings pile by water jetting during abandonment operations Installation of certain types of cable that cannot be covered by a PWA e.g. communication cables Deposit and use of explosives that cannot be covered under an application for a Direction, e.g. during abandonment operations Licences will be valid for a maximum period of one year however, applications for licence renewals can be made.

Pending Legislation		
Issue	**Legislation**	**Regulator and Requirements**
Chemical Discharges	OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that are, or which Contain Substances Identified as Candidates for Substitution - UK National Plan	**Regulator: BEIS** In line with OSPAR Recommendation 2006/3, contracting Parties to OSPAR should have phased out the discharge of offshore chemicals that are, or which contain substances, identified as candidates for substitution, except for those chemicals where despite considerable efforts, it can be demonstrated that this is not feasible due to technical or safety reasons. This should be done as soon as is practicable and not later than 1 January 2017. A UK National Plan for a phase out of chemicals to meet the requirements of the OSPAR Recommendation is being developed. This will involve continuation of the production permit review process and annual reporting to BEIS, extending the scheme to term permits and development of a prioritised National List of Candidates for Substitution.

Note: It is recognised that for many of the regulations identified there are more than one regulator or competent authority to which they apply. For the purposes of this summary, the most relevant regulator with respect to offshore oil and gas activities has been identified. This does not mean that there are no other authorities that would be consulted as required.

APPENDIX B

B.1 Scotland's National Marine Plan

Scotland's NMP (Marine Scotland, 2015) covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). The aim of the NMP is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the NMP areas. The Alligin Field Development activities have been assessed against each of the NMP objectives, details of which can found in Table B-1.

Table B-1 The proposed Alligin Field Development assessed against Scotland's National Marine Plan principles.

Scotland's National Marine Plan Principle Number	Applicable?	Assessment Against Principle
GEN 1 General planning principle		
There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	✓	The Alligin Field Development is a tieback to existing infrastructure. The EIA assesses potential impacts to the environment and to other sea users.
GEN 2 Economic benefit		
Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.	✓	The Alligin Field Development will provide jobs and tax revenues to the Scottish economy.
GEN 3 Social benefit		
Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.	✓	The Alligin EIA considers impacts to other sea users in decision making e.g. fisheries and pipelines. Lifecycle of the project is assessed for environmental and economic implications.
GEN 4 Co-existence		
Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.	✓	Tie-back to existing infrastructure. Minimising infrastructure footprint. Consult other sea users e.g. fisheries and other oil and gas operators.
GEN 5 Climate change		
Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	✓	Fuel use associated with vessel movements and the drill rig as well as flaring for well clean up and testing will be minimised as far as possible.
GEN 6 Historic environment		
Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.	✓	Extensive surveys of The Greater Schiehallion Area. No heritage assets identified to date.
GEN 7 Landscape/seascape		
Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account	×	Subsea Development
GEN 8 Coastal process and flooding		
Developments and activities in the marine environment should be resilient to coastal change and flooding, and	×	Offshore Development

Scotland's National Marine Plan Principle Number	Applicable?	Assessment Against Principle
not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.		
GEN 9 Natural heritage		
Development and use of the marine environment must: a) Comply with legal requirements for protected areas and protected species. b) Not result in significant impact on the national status of Priority Marine Features. c) Protect and, where appropriate, enhance the health of the marine area.	✓	Environmental surveys undertaken in the Alligin Field Development area. Design and installation method of the subsea infrastructure informed by these surveys. Within a designated protected area.
GEN 10 Invasive non-native species		
Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	✓	All vessels will follow IMO regulations. All vessels, including the drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GEN 11 Marine litter		
Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	✓	Contractor management plans will be in place. All vessels will follow IMO requirements.
GEN 12 Water quality and resource		
Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.	✓	Discharges to sea have been identified and assessed. Alligin will not result in the deterioration of water quality in the Alligin area.
GEN 13 Noise		
Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.	✓	No significant sources of marine noise identified. The appropriate mitigation measures will be adopted in relation to vessel and drill rig noise.
GEN 14 Air quality		
Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.	✓	Emissions to air quantified in the EIA. Assessment concludes that they will present a low environmental risk to air quality the duration of which will be minimised as far as possible.
GEN 15 Planning alignment A		
Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea.	×	Offshore tieback to existing infrastructure.
GEN 16 Planning alignment B		
Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so.	×	Applies to inshore waters only.
GEN 17 Fairness		
All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.	×	Competent Authority responsibility.
GEN 18 Engagement		

Scotland's National Marine Plan Principle Number	Applicable?	Assessment Against Principle
Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes.	✓	The Alligin EIA is subject to public and informal consultations. An EIA Scoping Report was submitted to BEIS and consultees in February 2017.
GEN 19 Sound evidence		
Decision making in the marine environment will be based on sound scientific and socio–economic evidence.	✓	Environmental Baseline prepared with reference to available literature and site-specific survey data.
GEN 20 Adaptive management		
Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy.	✓	BP decision making takes into account best understanding of the marine environment through surveys and using latest available scientific data.
GEN 21 Cumulative impacts		
Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.	✓	Cumulative impacts considered in the Alligin EIA and are considered proportionate to the size of the development.

B.2 Marine Strategy Framework Directive (MSFD)

The aim of the European Union's Marine Strategy Framework Directive (MSFD) is to protect more effectively the marine environment across Europe. The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities which supports the sustainable use of marine goods and services. The overarching goal of the Directive is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment.

The MSFD does not state a specific programme of measures that Member States should adopt to achieve GES, except for the establishment of Marine Protected Areas (MPAs). The MSFD does however outline 11 high level descriptors of GES in Annex I of the Directive. The Alligin Field Development activities have been assessed against each of the GES descriptors details of which can found in Table A-2.

Table A-2 The proposed Alligin Field Development assessed against the Marine Strategy Framework Directive (MSFD) Good Environmental Status (GES) descriptors.

Marine Strategy Framework Directive: Good Environmental Status Objectives	Applicable?	Assessment Against Objective
GES 1		
Biological diversity is maintained and recovered where appropriate. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	✓	Linked to GEN 9. Environmental surveys undertaken in the Alligin area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 2		
Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.	✓	Linked to GEN 10. All vessels will follow IMO regulations. All vessels, including drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GES 3		
Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	✓	Linked to GEN 9. Environmental surveys undertaken in the Alligin area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 4		
All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	✓	Linked to GEN 9. Environmental surveys undertaken in the Alligin area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 5		
Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters.	✓	Linked to GEN 9. Environmental surveys undertaken in the Alligin area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 6		
Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	✓	Linked to GEN 9. Environmental surveys undertaken in the Alligin area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 7		
Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	✓	Linked to GEN 12. Seabed disturbance and potential impact on marine ecosystems assessed in EIA.

Marine Strategy Framework Directive: Good Environmental Status Objectives	Applicable?	Assessment Against Objective
GES 8		
Concentrations of contaminants are at a levels not giving rise to pollution effects.	✓	Linked to GEN 12. Alligin will not result in the deterioration of water quality in the Alligin area.
GES 9		
Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.	✓	Linked to GEN 12. Alligin will not result in the deterioration of water quality in the Alligin area.
GES 10		
Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	✓	Linked to GEN 11. Contractor management plans will be in place. All vessels will follow IMO requirements.
GES 11		
Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	✓	Linked to GEN 13. No significant marine noise sources identified. The appropriate mitigation measures will be adopted.

B.3 Oil and Gas Marine Planning Policies

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

Table A-3 The proposed Alligin Field Development assessed against the Oil and Gas Marine Planning Policies.

Oil and Gas Marine Planning Policies	Applicable?	Assessment Against Policy
Oil & Gas 1		
The Scottish Government will work with BEIS, the new Oil and Gas Authority and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	✓	Environmental risks addressed/assessed in the EIA.
Oil & Gas 2		
Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	×	Alligin is a new subsea development tied back to existing topsides facilities.

Oil and Gas Marine Planning Policies	Applicable?	Assessment Against Policy
Oil & Gas 3		
Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.	✓	Alligin will be an offshore subsea development. Seabed disturbance and physical presence of the infrastructure have been assessed.
Oil & Gas 4		
All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.	×	Alligin will be a subsea development.
Oil & Gas 5		
Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	✓	Alligin will be incorporated into the existing Glen Lyon OPEP and Safety Case. A drilling OPEP will be in place during drilling operations.
Oil & Gas 6		
Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.	✓	Alligin will be incorporated into the existing Glen Lyon OPEP. A drilling TOOPEP will be in place during drilling operations.

APPENDIX C- ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT IDENTIFICATION

Key			
Negligible	Minor	Moderate	Major

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
VESSELS: DRILLING, INSTALLATION AND COMMISSIONING								
Physical presence of vessels	Vessel support for survey, construction and installation (FPSO covered in production section). Drilling rig transit and on location and associated supply vessels.	Navigation hazard, restriction of fishing operations, disturbance to birds / cetaceans.	P	1	4	Minor	Kingfisher notice to mariners prior to operations starting. 500 m exclusion zone in place during drilling activities. Optimised vessel use reducing vessel time spent in field. Alligin activities are within the designated Schiehallion and Loyal Offshore Development Area.	Negligible
Emissions to air	Exhaust emissions from combustion engines (i.e. burning of diesel) and generation of power during vessel operations resulting in emissions of various combustible gases.	Emissions to atmosphere result in a minor contribution to climate change, acidification and photochemical smog (compared to overall activity in the North Sea).	P	1	4	Minor	Minimise use of vessels through efficient journey planning. Vessel assurance conducted to ensure that contracted vessels meet BP marine standards and demonstrate relevant compliance requirements for IMO/MARPOL, e.g. IAPP certification.	Negligible
Discharges to sea	Discharge of domestic sewage and food waste from the vessels.	Organic enrichment and chemical contaminant effects in water column and seabed sediments. Potential food chain impacts, however may have positive effect in that nutrients are provided for fauna.	P	1	2	Negligible	Minimise use of vessels through efficient journey planning and use of relevant vessels for each activity. Vessel assurance conducted to ensure that contracted vessels meet BP marine standards and demonstrate relevant compliance requirements for IMO/MARPOL.	Negligible

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Discharges to sea	Ballast/ drains water discharge.	Water quality in immediate vicinity of discharge may be reduced, but effects are usually minimised by rapid dilution in receiving body of water and non-continuous discharge. Possible introduction of invasive species depending on vessel routes.	P	1	2	Negligible	BP audit procedures will ensure that the contracted vessels ballasting procedures are in line with the International Maritime Organisation (IMO). All discharges shall be monitored and records maintained as per regulatory requirements.	Negligible
Noise and visual impact	General vessel noise from operations, including Dynamic Positioning (DP), generating elevated sound levels.	Noise from DP has the potential to cause disturbance to marine mammals and fish in the form of temporary displacement from the area. Marine mammals and fish are expected to return once the vessel(s) has left the area.	P	1	4	Minor	Minimise use of vessels through efficient journey planning.	Negligible
Waste	General operational hazardous and non-hazardous waste.	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	P	1	4	Minor	All wastes to be properly segregated for recycling / disposal / treatment. Waste will be dealt with in accordance with regulatory requirements. Monthly reporting of waste sent to shore. Vessels will conform with their own Waste Management Plans. Minimise use of vessels through efficient journey planning. Vessel audits to ensure that they meet BP's marine assurance standards. Vessels will be MARPOL compliant.	Minor
Use of resources	Diesel usage for power generation.	Resource use – energy use.	P	1	4	Minor	Minimise use of vessels through efficient journey planning and use of relevant vessels for each activity. Vessel audits to ensure that they meet BP's marine assurance standards and relevant compliance requirements, i.e. contracted vessels shall be MARPOL compliant.	Negligible

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Unplanned event	Release of helifuel to sea as a result of a helicopter ditch/crash during vessel transit.	Water quality deterioration, impact on marine flora and fauna.	U	3	2	Moderate	Under regional logistics services, assurance and auditing of contracted helicopter services to ensure compliance with relevant safety requirements.	Minor
Unplanned event	Minor chemical / hydrocarbon release from vessels e.g. from drains.	Water quality deterioration, impact on marine flora and fauna.	U	1	4	Minor	Vessels shall comply with applicable IMO/ MARPOL requirements and have associated SOPEPs in place. COSHH, Task Hazard Assessments are completed and MSDS sheets will be available on the vessel. Standard operating procedures adhered to, e.g. bunkering in good light, regular hose inspection, correct storage and segregation of chemicals etc. Spill kits shall be available on board.	Negligible
Unplanned event	Major oil / chemical (e.g. fuel oil and diesel) release (potentially due to vessel collision).	Pollution of water column, Threat to biodiversity Harm to surrounding ecosystems, flora and fauna. Fishing impact assessment has been completed with no significant risks identified.	U	4	2	Moderate	Construction is within Schiehallion and Loyal Offshore Development Area. Emergency response plans in place including vessel SOPEPs. Simultaneous Operations (SIMOPS) will be managed through bridging documents and communications (e.g. if vessels are within the 500m zone). Vessels shall comply with applicable IMO/ MARPOL requirements Kingfisher bulletins shall be updated with vessel activities. Vessels shall abide with International Collision Regulations Vessels are not expected to enter the Glen Lyon FPSO 500m zone BP subscribes to Oil Spill Response Limited in the event of a Tier 2/3 event. ERRV vessel located in field.	Minor
Unplanned event	Failure of ROV installation equipment connection resulting in loss of hydraulic fluid to sea.	Local water quality deterioration, impacts on marine flora and fauna.	U	1	4	Minor	Follow standard operating procedures, maintenance and checklists for ROVs. Inventories on ROVs are relatively small.	Negligible

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Unplanned Events	Dropped objects resulting in damage to subsea infrastructure and seabed.	Local water quality deterioration should existing pipeline be damaged.	U	3	2	Moderate	Vessels will follow SIMOPs plans and lifting procedures which include assessment/ risk of dropped objects. Dropped objects retrieved where possible. Subsea infrastructure designed within NORSOK U001 / ISO 13628-1 dropped object standards.	Minor
DRILLING OPERATIONS								
Physical presence of semi-submersible drilling rig	Physical presence of the Deepsea Aberdeen drilling rig at the project location.	Navigation hazard, restriction of fishing operations, disturbance to birds / cetaceans.	P	1	4	Minor	A Consent to Locate will be submitted for the Deepsea Aberdeen. The rig will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. The rig will be located within a 500 m exclusion zone. Prior to mobilisation of the drilling rig the coastguard will be notified.	Negligible
Emissions to air	Exhaust emissions from combustion engines (i.e. burning of diesel) and generation of power during vessel operations resulting in emissions of various combustible gases.	Emissions to atmosphere result in a minor contribution to climate change, acidification and photochemical smog (compared to overall activity in the North Sea).	P	1	4	Minor	Optimise use of vessels through efficient journey planning and use of appropriate vessels for the activities. Deepsea Aberdeen is reviewed under BP's marine assurance standards and subject to rig recertification audits. Deepsea Aberdeen will be MARPOL compliant with International Air Pollution Prevention (IAPP) requirements.	Negligible
Discharges to sea	Deliberate discharge to sea of brine, cement and completion chemicals required in the drilling and well construction process.	Short term impact on local water quality. Impact on species occurring in the water column.	P	2	4	Moderate	All chemicals used offshore will be subject to the Offshore Chemicals Regulations requirements, and will be risk assessed as part of the application for use/ discharge. Cement will be subject to fly-mixing to meet demand, rather than batch-mixing, to minimise inventory of mixed cement. Excess dry cement will be shipped to shore and not discharged to sea.	Minor

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Discharges to sea	Deliberate discharge to sea of WBM and WBM contaminated cuttings including those associated with the $8^1/_2$" section which contain reservoir oil.	Short term impact on local water quality. Smothering of benthic organisms, suspended solids, Cuttings piles may be contaminated with chemicals and reservoir hydrocarbons. Impact on sponges within the Faroe-Shetland Sponge Belt.	P	2	4	Moderate	All chemicals used offshore will be subject to the Offshore Chemicals Regulations requirements, and will be risk assessed as part of the application for use/ discharge. Estimate of quantities of reservoir oil will be captured in oil discharge permit.	Moderate
Discharges to sea	Discharge of domestic sewage and food waste from the drilling rig.	Local water quality deterioration, enrichment. High BOD may have immediate local impact on water quality (deoxygenation), resultant impacts on marine flora and fauna. Potential food chain impacts through introduction of an anthropogenic food source, however may have positive effect in that nutrients are provided for fauna.	P	1	2	Negligible	The Deepsea Aberdeen shall comply with relevant regulatory (i.e. MARPOL) requirements for discharge of food and sewage wastes. In the event that food waste is not able to be macerated, this will be returned to shore.	Negligible
Discharges to sea	Machinery space drainage. Discharge of hydrocarbons / chemicals to sea.	Local water quality deterioration, impact on marine flora and fauna.	P	1	2	Negligible	Oil in Water separator will discharge under the Offshore Chemical Regulations. Deepsea Aberdeen rig is equipped with a Rena treatment system.	Negligible
Seabed disturbance	Impacts of anchors, and anchor chains on the seabed, as part of positioning of the drilling rig.	Seabed disturbance in a small area due to anchors and anchor chains resulting in potential impact to benthic flora and fauna. Environmental surveys in the area identified no Annex I or II habitats or species.	P	2	4	Moderate	Pre anchor lay surveys. Deepsea Aberdeen will be skidded between Alligin well locations using existing anchor system.	Minor
Noise and visual impact	Noise and vibration during drilling operations.	Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area.	P	1	4	Minor	Minimise use of vessels through efficient journey planning.	Negligible

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Waste	Hazardous and non-hazardous waste. Drilling rigs generate a number of wastes during routine operations including waste oil, chemical and oil contaminated water, scrap metal, etc.	Effects associated with onshore disposal are dependent on the nature of the site or process - land take, nuisance, emissions (methane), possible leachate, limitations on future land use.	P	1	4	Minor	All wastes to be properly segregated for recycling / disposal / treatment. Waste will be dealt with in accordance with applicable regulatory requirements and in line with BP waste hierarchy. Monthly reporting of waste data, including volumes sent to shore/ landfill etc. Deepsea Aberdeen shall maintain Waste Management Plan and Waste Record Book.	Minor
Waste	OBM mud and OBM contaminated cuttings.	Additional emissions from transport. Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	P	3	3	Moderate	All OBM sections will be shipped onshore for disposal.	Minor
Use of resources	Diesel usage for power generation.	Resource use – energy use.	P	1	4	Minor	Use of anchors reduces load on dynamic positioning systems and therefore power requirements for vessel stability. Deepsea Aberdeen power generators subject to maintenance programs and applicable compliance requirements.	Negligible
Use of resources	Utilities. Freshwater - potable supply.	Resource use.	P	1	4	Minor	No significant impacts or mitigations determined.	Negligible
Unplanned discharge to sea	Loss of containment of oil-based mud (potentially through a burst hose) resulting in a release to sea.	Local water quality deterioration, impact on marine flora and fauna, localised smothering of seabed and associated biota.	U	3	2	Moderate	Bulk transfers and hoses managed according with Deepsea Aberdeen maintenance strategy and procedures.	Minor
Unplanned discharge to sea	Release of hydrocarbons / chemicals to sea (e.g. from drains, bunkering operations etc.).	Impacts depend on release size, prevailing wind, sea state, temperature and sensitivity of environmental features affected.	U	2	3	Moderate	Deepsea Aberdeen will have an approved OPEP in place. Rig assurance and recertification audits include review of applicable maintenance and safety	Moderate

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
		Birds are most sensitive offshore receptor. Also affected are plankton, fish / fisheries, seabed animals and marine mammals.					requirements upon rig. ERRV will be located in field. BP is a member of Oil Spill Response Limited in the event of Tier 2/3 incident. Procedures in place for bulk transfers and maintenance strategies for hoses. Standard operating procedures adhered to, e.g. bunkering in good light, regular hose inspection, correct storage and segregation of chemicals etc.	
Unplanned discharge to sea	Major release to sea of drilling rig fuel hydrocarbon inventory in the result of a vessel collision.	Local water quality deterioration, impact on marine flora and fauna.	U	3	2	Moderate	Exclusion zone in place whilst rig is on station. ERRV will be located in field. The rig will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. Notice will be sent to the Northern Lighthouse Board of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the drilling rig.	Moderate
Unplanned discharge to sea	Influx of hydrocarbons into wellbore (loss of hydrostatic overbalance). Controlled hydrocarbon flow to surface / controlled venting of hydrocarbon e.g. via diverters.	Local water quality deterioration, impact on marine flora and fauna.	U	2	2	Minor	Wells designed and drilled as per BP GWO safety standards and practices, e.g. Well design notification/ examination schemes. Regular BOP testing. Training and competency of drill crews, including regular well control drills and well control self verification processes.	Negligible
Unplanned discharge to sea	Well blowout (uncontrolled hydrocarbon release in the event of loss of well control).	Damage to commercial fisheries, sediment and water quality impairment and release of atmospheric emissions. Impacts on marine flora and fauna.	U	4	2	Major	Wells designed and drilled as per BP GWO safety standards and practices, e.g. well design notification/ examination schemes. Use of blowout preventer with testing and maintenance programs. Relief well planning, and well capping device available. Training and competency of drill crews, including regular well control drills and well control self verification processes. Deepsea Aberdeen is subject to rig assurance and recertification requirements. Approved OPEP in place.	Major

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
							Member of Oil Spill Response Limited in the event of a Tier 2/3 event.	
Unplanned seabed disturbance	Dropped objects from drilling rig resulting in physical damage to subsea environment.	Loss of seabed habitat, smothering of benthic organisms.	U	2	3	Moderate	Lifting risk assessments shall be conducted prior to equipment transfer, including potential risk of dropped objects and/or potential impact to existing infrastructure.	Minor
SUBSEA INSTALLATION								
Physical presence of subsea infrastructure	Physical presence of all subsea infrastructure (includes Wells, Manifolds, SSIVs, flowlines, umbilicals, tie-in spools, rock dump, mattresses, grout bags etc.).	Navigation hazard, restriction of fishing operations, snagging risk to fishing nets. Seabed disturbance, loss of habitat, temporary suspended solids, loss of benthic organisms.	P	1	4	Minor	Infrastructure will be subject to Pipelines Works Authorisations (PWA) requirements. Pipeline routes shall be added to admiralty charts, Kingfisher database, etc. Infrastructure will be designed as fishing friendly (not overtrawlable). 500m exclusion zones shall apply at the Alligin drill centre. Use of rock cover and mattresses will be optimised. Pipeline installation methodology has been assessed for environmental and social impacts as part of analysis for alternatives.	Minor
Discharges to sea	Discharge of chemicals (e.g. MEG) during leak testing of pre-filled pipelines.	Local water quality deterioration, impacts on marine flora and fauna.	P	2	3	Moderate	Chemical selection process shall comply with relevant regulations. The use and/or discharge of all chemicals will be subject to risk assessment and permitting. Low toxicity and/or PLONOR chemicals will be used where possible and deemed technically feasible.	Minor
Discharges to sea	Release of hydraulic fluid during subsea valve operation and maintenance.	Local water quality deterioration, impacts on marine flora and fauna.	P	1	3	Minor	Hydraulic fluid selection for the Alligin Field Development will be aligned with the existing Schiehallion and Loyal subsea infrastructure processes and chemical permits. Use of water-based hydraulic fluid.	Minor
Seabed disturbance	Disturbance associated with installation of subsea infrastructure e.g. manifolds, FTA, pipelines, umbilicals, jumpers, stabilisation features etc,		P	2	4	Moderate	Environmental baseline and Habitat surveys have been completed. Use of rock cover and mattresses will be optimised. Pipeline installation methodology has been assessed for environmental and social impacts as part of analysis for alternatives.	Moderate

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Waste	General waste from pipelay and installation of infrastructure.	Pipelay and installation generate a number of wastes during routine operations including scrap metal, wooden crates etc. Impacts associated with onshore disposal are dependent on the nature of the site or process. Landfills – land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants- nuisance, atmospheric emissions etc.	P	1	4	Minor	All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with applicable regulatory requirements and in line with BP waste hierarchy.	Negligible
Use of Resources	Consumption of finite materials (e.g. steel) during construction of pipelines and other subsea infrastructure.	Use of non-renewable resources.	P	1	4	Minor	Scrap metal wastes to be properly segregated for recycling / disposal onshore.	Negligible
TOPSIDE MODIFICATIONS								
Topsides modifications	Installation of Alligin subsea control system modifications	The Alligin development will constitute only minor modifications to the existing Glen Lyon subsea control system. As such there will be no significant change in Aspects or Impacts as a result of the Alligin Field Development.						
PRODUCTION								
Physical Presence	Vessel requirements.	Relative to existing requirements there will be no increase in vessel requirements at the Glen Lyon FPSO or Quad204 development during production as a result of the Alligin Field Development.						
Emissions to Air	Emissions to air as a result of flaring and power generation.	Relative to existing emissions to air from the Glen Lyon FPSO, there is no anticipated increase in total flaring, power generation or helicopter trips during production as a result of the Alligin Field Development.						
Noise and Visual Impact	Change to noise and visual impact as a result of the Alligin Field Development.	Relative to existing impacts at the FPSO, there is no anticipated increase in noise and visual impact during production as a result of the proposed Alligin Field Development.						
Waste	Change to waste generation as a result of the Alligin Field Development	Relative to existing waste production at the Glen Lyon FPSO, there is no anticipated increase in waste as a result of the Alligin Field Development.						

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Discharges to sea	Produced water discharge (includes associated hydrocarbons, production chemicals and naturally occurring heavy metals).	Local water quality deterioration, possibly impacting on marine flora and fauna.	P	2	4	Moderate	Existing capacity of Glen Lyon installation produced water system is sufficient to managed fluids produced from the Alligin Field. Reference case for produced water management on the Glen Lyon is PWRI. Any PW subjected to be overboarded, will be treated to maintain OIW content below 30 mg/l and compliant with OPPC Regulations, Oil Discharge application (including associated BAT assessment).	Minor
Discharges to sea	Produced sand discharge.	Smothering of benthic organisms, suspension of solids.	P	1	4	Minor	Alligin Field production will not exceed the current capacity of Glen Lyon's existing produced sand handling package.	Minor
Unplanned Events	Alligin flowline rupture and subsequent release of hydrocarbons to sea.	Local water quality deterioration, impacts on marine flora and fauna.	U	4	2	Major	Design of lines and materials selection. Integrity management system, inspection and maintenance. Structural and cathodic corrosion protection will be implemented. Follow standard operating procedures and checks. Use of Emergency Shutdown System. Design Hazard Management Plan Pipelines Integrity Management System	Moderate
Unplanned Events	Snagging or dragging of Alligin wellheads, flowline or umbilical resulting in seabed disturbance.	Local water quality deterioration, impacts on marine flora and fauna.	U	1	3	Minor	Exclusion zone at the drill centre. Pipeline routes added to admiralty charts, Kingfisher database, etc. Alligin wellheads designed within NORSOK U001 / ISO 13628-1 trawl load standards.	Negligible
Unplanned Events	Alligin subsea control system failure resulting in a minor release to sea of hydraulic/control fluid.	Local water quality deterioration, impacts on marine flora and fauna.	U	1	3	Minor	Integrity management systems, inspection and maintenance. Design and materials selection. Follow standard operating procedures and checks. Chemical risk assessment undertaken as part of the Production Operations MAT submission. Use of water-based hydraulic fluid. Use of Engineered Installation Procedures.	Negligible

Aspect	Activity Description	Impact / Potential Impact	Planned/ Unplanned	Impact Severity	Freq/Dur/ Likelihood	Significance of Risk	Mitigation / Prevention / Control	Residual Risk
Unplanned Events	Alligin subsea system failure resulting in a small release of liquid and/or gas hydrocarbons to sea.	Local water quality deterioration, impacts on marine flora and fauna.	U	1	1	Negligible	Integrity management systems, inspection and maintenance. Design and materials selection. Follow standard operating procedures and checks. Chemical risk assessment undertaken as part of the Production Operations MAT submission. Use of Engineered Installation Procedures.	Negligible

APPENDIX D OIL SPILL MODELLING

This Appendix describes the modelling undertaken in order to determine the environmental risk associated with the accidental release of hydrocarbons at the proposed Alligin Field Development site. A single well blowout scenario has been modelled using the Oil Spill Contingency and Response (OSCAR) model developed by The Foundation for Scientific and Industrial Research (SINTEF). The aims of the modelling were to understand:

- where the hydrocarbons are likely to travel;
- how the hydrocarbons are likely to disperse over time (both on the sea surface and in the water column);
- the extent to which hydrocarbons are likely to arrive on any shoreline;
- where hydrocarbon concentrations could exceed certain thresholds on the sea surface, in the water column and in sediments; and
- the significance of the potential environmental impacts.

D.1 Introduction to the OSCAR Model

When crude oil is spilled on the surface of the sea it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation. The fate and effect of crude oil are dependent on the chemical and physical properties of the oil, and the physico-chemical changes to which the oil is subjected vary depending on the oil type, volume spilled and the prevailing weather and sea conditions. Some of these changes lead to its disappearance from the sea surface while others, for example emulsification, may cause it to become more persistent. The various processes that oil is subjected to after a release at sea are highlighted in Figure D-1. These processes are all modelled in the OSCAR oil spill modelling software to predict the fate and behaviour of discharged hydrocarbons over time.

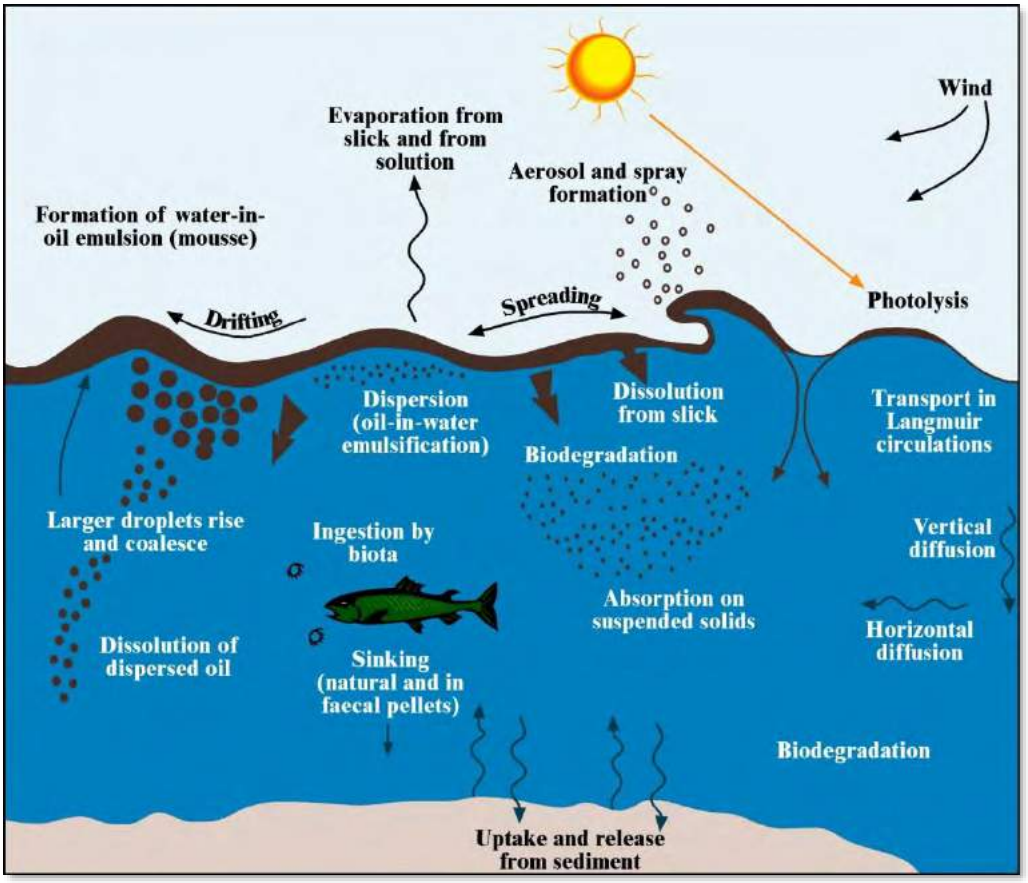

Figure D-1: Fate and behaviour of spilled hydrocarbons at sea (adapted from Koops *et al*., 1985).

OSCAR supports two different types of model runs, which are known as stochastic modelling runs (a.k.a. probabilistic modelling) and deterministic modelling runs. The stochastic modelling feature of OSCAR allows for a spill scenario to be modelled multiple times over different weather conditions, with the results from each individual stochastic run being aggregated, and a number of statistical parameters computed. The stochastic modelling results presented in this Appendix examine:

- the probability of oil above a predefined threshold appearing on the sea surface;
- the probability of oil above a predefined threshold being present throughout the water column; and
- the probability of oil above a predefined threshold arriving on the shoreline.

It is important to appreciate that the stochastic modelling results do not represent a single spill scenario but rather show the aggregation of results computed by running the spill scenario multiple times over different weather conditions. To analyse a single spill scenario, the deterministic mode of OSCAR allows for the spill scenario to be modelled over a single specified time interval and outputs can be presented in terms of e.g. oil thickness on the sea surface, concentrations on the shoreline, in the sediment and in the water column. The deterministic model results presented in this Appendix examine:

- the maximum thickness of oil appearing on the sea surface;
- the maximum concentrations of oil present in the water column;
- the maximum concentrations of oil reaching the shoreline; and
- the maximum concentrations of oil being deposited in the sediment.

D.2 Modelling Methodology

This section details the model input data for the single well blowout scenario. The specific release parameters and hydrocarbon characteristics that have been used to model the spill scenario are discussed, along with the various environmental and physical factors that have been accounted for in the modelling.

D.2.1 Release Parameters

The main release parameters for the well blowout scenario are summarised in Table D-1. In the unlikely event of a blowout, the release would likely be subsurface (i.e. the drill rig would quickly detach from the well at the emergency disconnect package at the seabed). For the purpose of assessing the impact of this event a release at seabed was modelled as this represented a worst-case scenario in terms of impacts on water column and sediments, while having little influence on the ultimate fate of the hydrocarbons on the sea surface and at coastal areas.

The well blowout scenario was modelled using the same estimated release duration as was used for the Schiehallion Field due to the proximity of these two fields. The release duration was based on the upper estimated time to source and mobilise a rig, drill a relief well, and kill and cement the well. The anticipated times to complete these activities are shown in Table D-2 and is estimated to be 144.5 days in total. The model was run for an additional 30 days after the blowout was terminated to determine the ongoing fate of the hydrocarbons following cessation of the release.

The discharge rate was based on an unconstrained release from the single producer well while drilling the 8.5-inch reservoir section through an oil leg – the release would occur through the 9.625-inch production casing. This represented a worst-case for quantity of crude hydrocarbon released. The initial oil discharge rate is 33,600 bpd, declining to 20,100 bpd after one month. A step-wise method was used to represent this declining discharge rate as an average of the rates at the start and end of each step-wise discharge period. Table D-3 details the declining average discharge rates used in the modelling.

As required by BEIS, the model described in Table D-1 assumed no intervention (i.e. no response efforts were included in the modelling). The results in terms of estimated impacts can therefore be considered to be conservative.

Table D-1: Release parameters.

Scenario and location	Hydrocarbon type	Initial release rate[1]	Release duration[2]	Total quantity released	Release depth	Release temperature
Seabed blowout 60º22’26.12” N 4º11’32.32” W	Crude with associated solution gas	33,600 bpd oil plus 11.75 MMscfd gas	144.5 days	2,626,075 bbls	467 m	52.6 ºC

1. Release rate declines over time, see Table D-3.
2. Total model duration included an additional 30 days following the end of the discharge.

Table D-2: Estimated timeline to kill well and terminate blowout.

Event	Duration (days)
Mobilise Rig	21.0
Prepare for drilling	1.8
Drill relief well and reach target	118.7
Kill and cement well	3.0
Total	**144.5**

Table D-3: Step-wise declining blowout rate used in model.

Release step duration (days)	Average oil release rate during step (bpd)	GOR (scf/bbl)
5	31,300	349
10	25,200	347
10	21,050	344
10	20,550	341
10	19,950	335
10	19,200	331
10	18,550	332
10	17,900	332
10	17,200	327
10	16,500	322
10	15,800	316
10	15,000	317
10	14,300	316
10	13,550	314
9.5	12,850	307

D.2.2 Hydrocarbon Characteristics

When oil is released in the sea it is subjected to a number of processes including spreading, evaporation, dissolution, emulsification, natural dispersion, sedimentation and biodegradation. The fate and effect of oil are dependent on the chemical and physical properties of the oil, which are taken into account in the modelling. OSCAR includes a database with various oil types that can be used in the modelling. A suitable analogue was selected from the OSCAR database to represent the Alligin blowout crude properties.

Key hydrocarbon properties of the Alligin crude that were applied to the model are shown in Table D-4. While some Alligin crude properties were unavailable, a fluids review concluded that the fluids from Schiehallion are analogues for Alligin fluids, hence the Schiehallion oil type was considered to be a close match for the main weathering characteristics of the Alligin oil type. It should be noted that Alligin is considered as an infill to Schiehallion. The properties of the selected analogue are shown in Table D-4.

Table D-4: Oil properties of Alligin crude and selected OSCAR analogue.

Oil type	API (°)	Viscosity (cP)	Pour point (°C)	Wax content (% wt)	Asphaltene content (% wt)
Alligin crude	27.1	-	-	< 5	-
OSCAR analogue Schiehallion	25.9	180.0	3.0	7.00	0.36

D.2.3 Metocean Data

The OSCAR model takes into account the effect of various environmental factors such as bathymetry, current and wind speed and direction, water column salinity and temperature, as well as seabed and coastal sediment types. Such metocean data, specific to the environment surrounding the proposed Alligin Field, has been obtained from a variety of sources as discussed here.

D.2.3.1 Bathymetry data

The bathymetry data used in the OSCAR model is based on the General Bathymetric Chart of the Oceans (GEBCO) database available from the British Oceanographic Data Centre (BODC).

D.2.3.2 Current data

Three-dimensional water column current data was supplied by BPEOC in the form of the ROMS model, which covers the timeframe from 2004 – 2008 inclusive. The dataset contains 3D ocean currents with a temporal resolution of 3 hours (i.e. the currents change speed and direction at 3-hourly intervals) and a spatial resolution of 3 – 4 km. The data is depth layered with 10 hybrid vertical layers. Surface forcing is obtained from the Climate Forecast System Reanalysis datasets.

D.2.3.3 Wind data

Wind data was sourced from the National Centres for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) database. Differing from the current data, the wind data is two dimensional (i.e. there is no vertical component) since only winds directly above the sea surface will influence oil transportation. The wind data is used in the OSCAR model to generate wave height and period information using a fetch calculation, which is subsequently utilised to calculate turbulent mixing on the sea surface. For the region of interest, the longitudinal and latitudinal resolutions of the wind data set are *c*. 4.5 km in both directions. The temporal resolution of the data is six hours (i.e. the wind speed and direction change in the model every six hours).

D.2.3.4 Temperature and salinity data

The variation in salinity between surface and seabed is taken from the Marine Scotland National Marine Plan interactive (NMPi) database, which are provided as annual mean values. In the region of interest this average value was 35.25 parts per thousand both at the sea surface and near the seabed. The sea temperature profile was also taken from the NMPi, and was set to 10 °C at the sea surface, decreasing to 8.7 °C at the seabed.

D.2.4 Output Thresholds

The foundation of a Lagrangian particle model is the movement and behaviour of individual particles in a 3D spatial environment over time. Each particle represents a body of oil that is either dispersed in droplets, dissolved, or in the form of a surface layer. Each particle represents a bulk mass that is a fraction of the overall release, but which behaves according to the properties of the individual droplets, dissolved components or surface layer that it represents. During the simulation, these particles tend to lose mass to evaporation, decay or deposition processes and the model ceases recording particles when the oil property

represented falls below a specified threshold. Normally these are values of concentration or surface thickness that are chosen to reflect a level of insignificance.

The following thresholds have been adopted in the modelling:

- Sheen thickness above 0.3 µm (i.e. minimum sheen thickness expected to produce negative impacts on sea life encountering oil at the sea surface, see Table D-5).
- Total water column concentrations above 25 ppb are considered. This is based on BPEOC guidelines "based on the conclusion in the OLF (Norwegian Oil Industry Association) guideline for risk assessment of effects on fish from acute oil pollution. This threshold is based on the potential effects on fish eggs and larvae that are considered among the most sensitive organisms in the water column".
- Mass of oil of 50 mg per 1 kg of sediment (50 mg/kg), above which toxic effects on benthic fauna may begin to be discernible. This threshold was adopted by OSPAR in the context of Oil Based Mud (OBM) contamination. Given that deposition will distribute vertically through the surface of the seabed, this equates to 5 g of oil per 1 m^2 of seabed (5 g/m^2) assuming that the oil will distribute through a 5 cm sediment layer and assuming a sediment density of 2.0 t/m^3. Thus, 5 g/m^2 is adopted as the threshold above which toxic effects are considered to begin to be discernible.
- Mass of oil on the shoreline above 100 g/m^2. This is considered to be an impact threshold for oiling of birds by the US Army Corps of Engineers (2003) and is reinforced by French McCay (2009) who notes that 100 g/m^2 would be enough to coat benthic epifaunal invertebrates living on hard substrates in intertidal habitats, thus compromising the animals. It also inferred from the level of 'light' oiling defined by ITOPF Technical Information Paper 6 (ITOPF, 2014).

Table D-5: Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009).

Code	Appearance description	Layer thickness (µm)	Litres per km^2
1	Sheen (silver/grey)	0.04 – 0.3	40 – 300
2	Rainbow	0.3 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous true oil colour	50 – 200	50,000 – 200,000
5	Continuous true oil colour	> 200	> 200,000

D.3 Results

This section presents the results obtained from OSCAR modelling of the blowout scenario at the seabed detailed in the previous Section.

D.3.1 Oil on the Sea Surface

The probability of a visible surface sheen with a thickness greater than 0.3 µm is shown in Figure D-2 for the seabed blowout scenario. The results were obtained from the stochastic modelling simulations and represent the aggregation of results from 100 different stochastic runs of the subsea well blowout scenario. This visible surface sheen is predicted to extend as far as 490 km East and 915 km NE with 90-100 % probability.

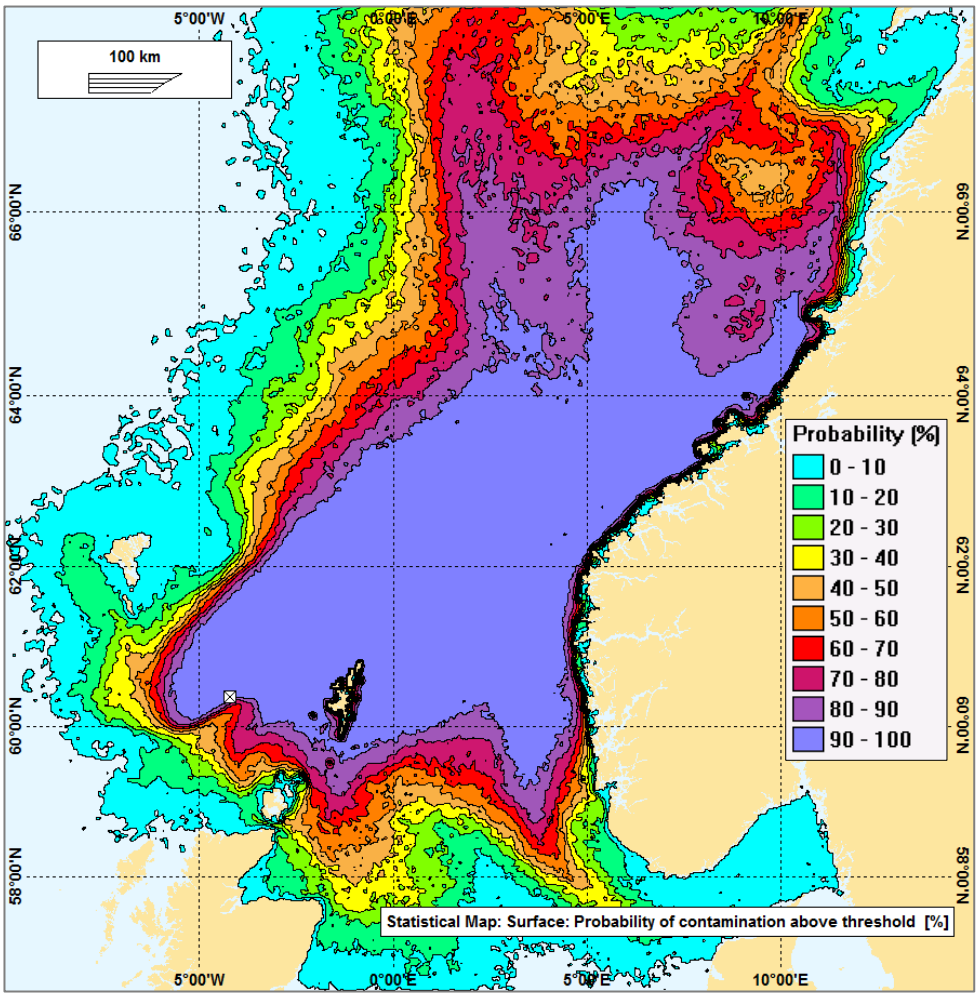

Figure D-2: Probability of a surface sheen >0.3 microns at some point during the well blowout scenario.

A deterministic model was run for the subsea well blowout scenario in order to assess the impact to the sea surface. Figure D-3 shows these results for the total sea surface area impacted by oil over the duration of the whole model which exceeded the thickness threshold of interest of 0.3 µm (i.e. minimum thickness expected to produce negative effects in sea life at the sea surface). It should be noted that, although Figure D-3 shows large areas of continuous oil coverage at a thickness of less than 1 µm, in actuality these will be discontinuous patches of oil at least 1 µm thick since the oil is not predicted to spread thinner than this based on the expected minimum film thickness for the specific type of oil modelled here. The approximate extent shown is, however, still an accurate representation of the total impacted sea surface area.

The modelling predicted that the total sea surface area impacted by oil above a thickness of 0.3 µm would be *c*. 446,000 km^2. The modelling also predicted that a visible surface sheen would still be present at least 30 days after the cessation of hydrocarbon release from the blowout.

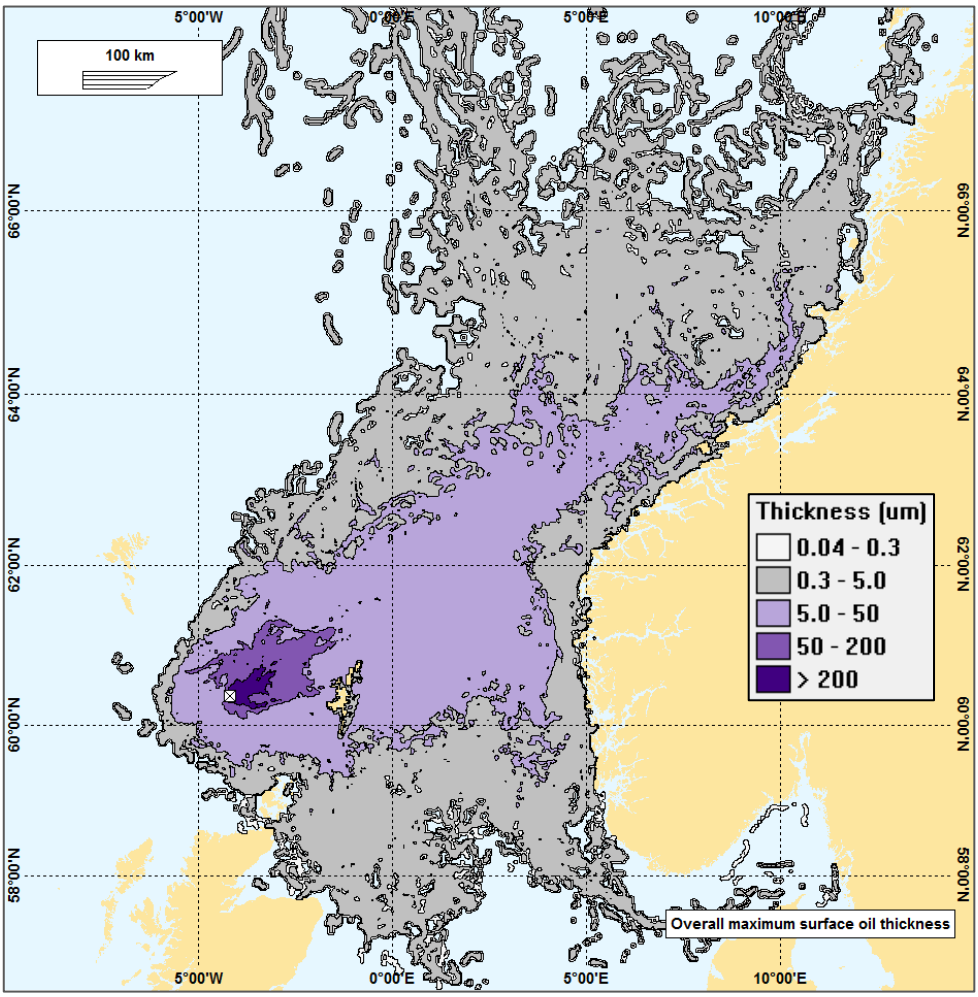

Figure D-3: Total impacted sea surface area.

Note: thicknesses below 0.3 microns are not necessarily visible and will likely represent isolated patches of emulsified oil separated by unaffected sea surface.

D.3.2 Shoreline Beaching

The probability of oil beaching on shorelines at a concentration ≥ 100 g/m^2 (see Section D.2.4) is shown in Figure D-4. There is a possibility that oil could beach (at a concentration ≥ 100 g/m^2) on UK, Faroese, Norwegian, Swedish and Danish shorelines. The maximum probability of beaching at some location on each affected country's shoreline is presented in Table D-6.

Beaching (at a concentration ≥ 100 g/m^2) is likely across Scotland – very likely across all of Shetland, while being only somewhat likely across most of Orkney (isolated areas of higher likelihood) and the Scottish mainland. Beaching across the Faroe Islands, Sweden and Denmark is less likely. Beaching across the whole Western shoreline of Norway varies widely, with the highest probability existing along the whole shoreline between Bergen and Trondheim where it is very likely. The most significant areas of beaching (at a concentration ≥ 100 g/m^2) are on the shores of Shetland (> 50 % for the majority of the shoreline) and Norway where there are extensive stretches of shoreline with a 40+ % probability of beaching.

The modelling predicted that, following a blowout, first oil would beach on Shetland after 4 days and Orkney just under 12 days. First oil is predicted on Norway within 14-15 days, the Scottish mainland within 20-21

days, the Faroe Islands just under 27 days, and for both Sweden and Denmark would take more than 50 days.

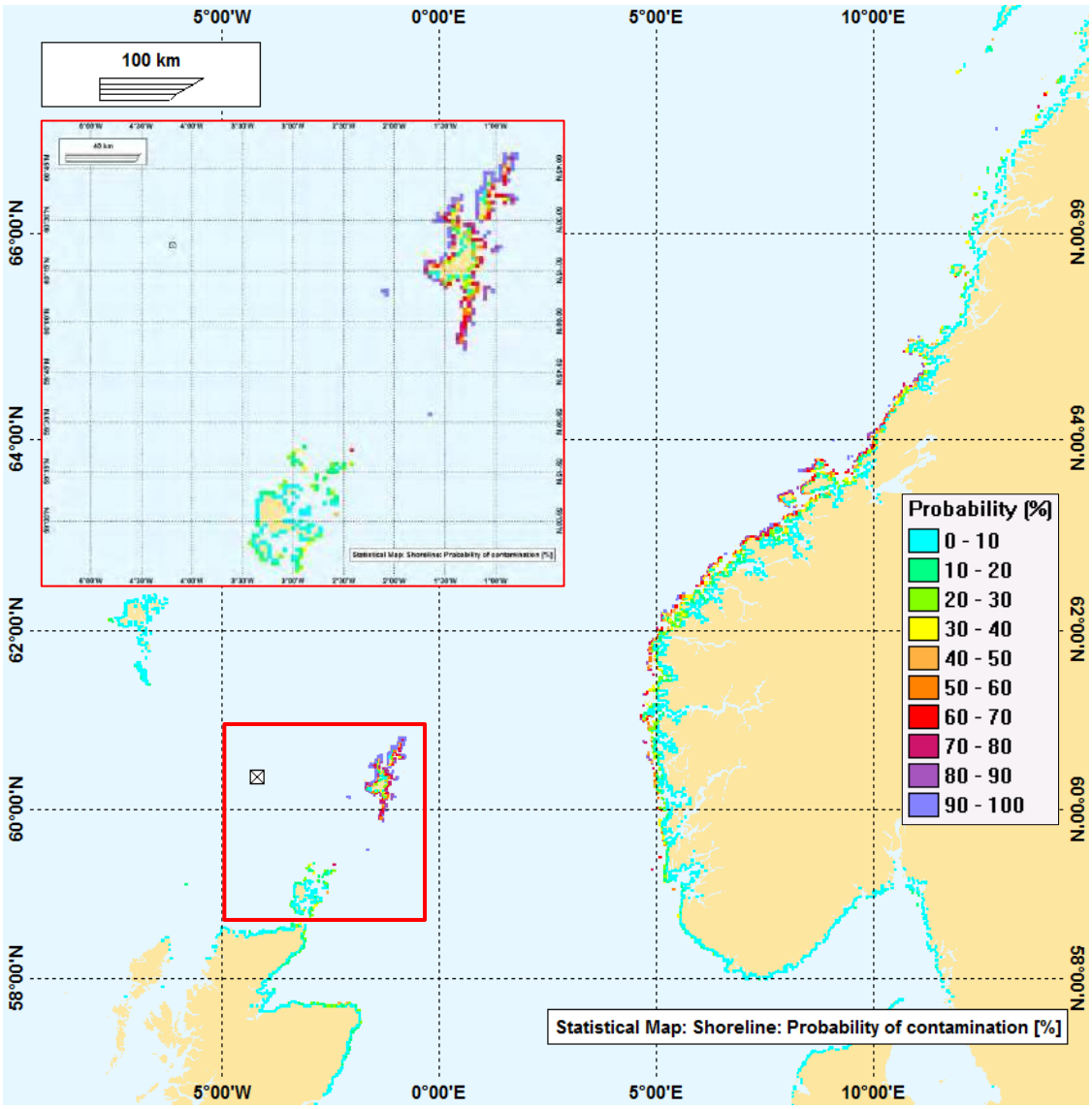

Figure D-4: Probability of oil beaching at a concentration ≥ 100 g/m^2.

It was also observed that first oil was not seen in 90 % of the stochastic scenarios until after 6 days (see Figure D-5), suggesting oil spill response would be able to mitigate beaching if mobilised within 6 days. This exceedance chart essentially shows the variation in minimum arrival time on any beach area under the influence of the different weather conditions present at different times of the year based on the results of the stochastic modelling simulations.

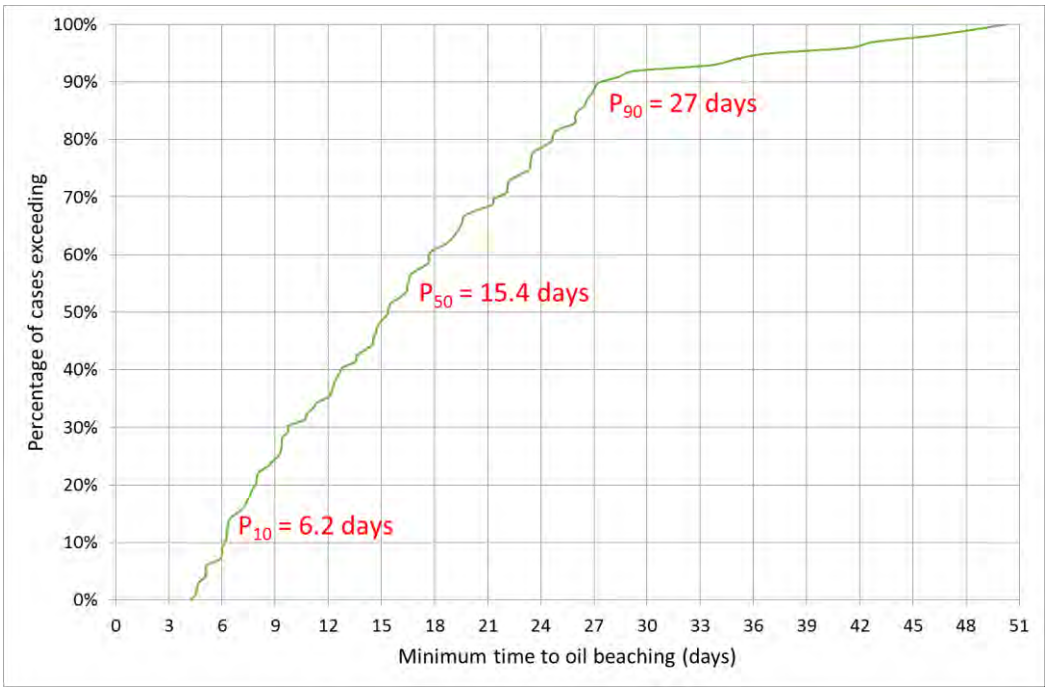

Figure D-5: Exceedance chart for first oil beaching probability for the subsea well blowout scenario.

Table D-6: Maximum probabilities of beaching on each affected country.

Country	Maximum probability of beaching
Scotland (mainland)	45 %
Orkney	73 %
Shetland	100 %
Faroe Islands	22 %
Norway	100 %
Sweden	17 %
Denmark	8 %

A single deterministic run was conducted for the subsea well blowout scenario in order to investigate the worst case shoreline oil concentrations. The blowout starting time for this deterministic scenario was selected to correspond to the individual stochastic simulation that resulted in the greatest mass of oil arriving onshore. This maximum oil on shorelines is shown in Figure D-6.

The peak mass of oil in this worst case was 7,315 tonnes of oil. Based on the properties of the selected oil type, the modelling showed a high degree of emulsion of the oil (i.e. *c*. 73 %) even at long distances from the point of release. The impact of this is that the total mass of emulsion is likely up to 73% higher than the mass of oil indicated on the shoreline. For the peak mass in this case, that would translate into *c*. 27,100 tonnes of emulsion.

The modelling predicted that the highest concentrations of oil arriving on the Shetlands would be as high as 12 kg/m^2 (heavy oiling) although most oiling is moderate to light. Orkney and Scottish shorelines would experience maximums of *c*. 0.35 kg/m^2 and 0.14 kg/m^2 respectively, both light oiling. Along the Faroe Islands,

Norwegian, Swedish and Danish shorelines the mass of oil is less than the light oiling category, with the exception of a number of dispersed areas of light and moderate oiling on Norway peaking at 1.1-2.1 kg/m^2 as highlighted in Figure D-6.

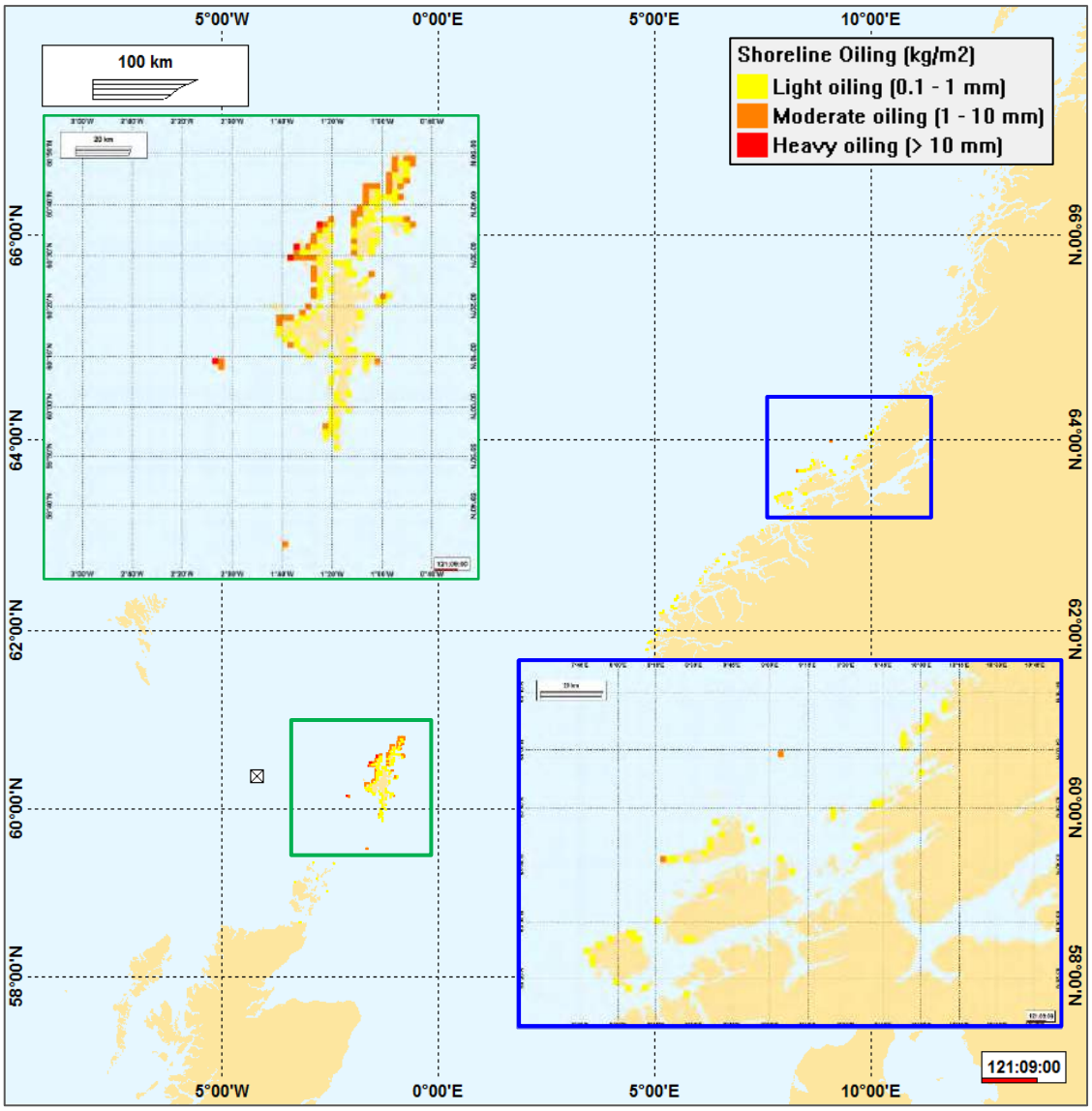

Figure D-6: Maximum shoreline hydrocarbon concentrations.

D.3.3 Water Column Concentrations

The probabilities of hydrocarbon concentrations ≥ 25 ppb (see Section D.2.4) in the water column are shown in Figure D-7 for the subsea well blowout scenario. The modelling predicted that there is a 90-100 % probability that the oil could travel as far as 325 km Northeast.

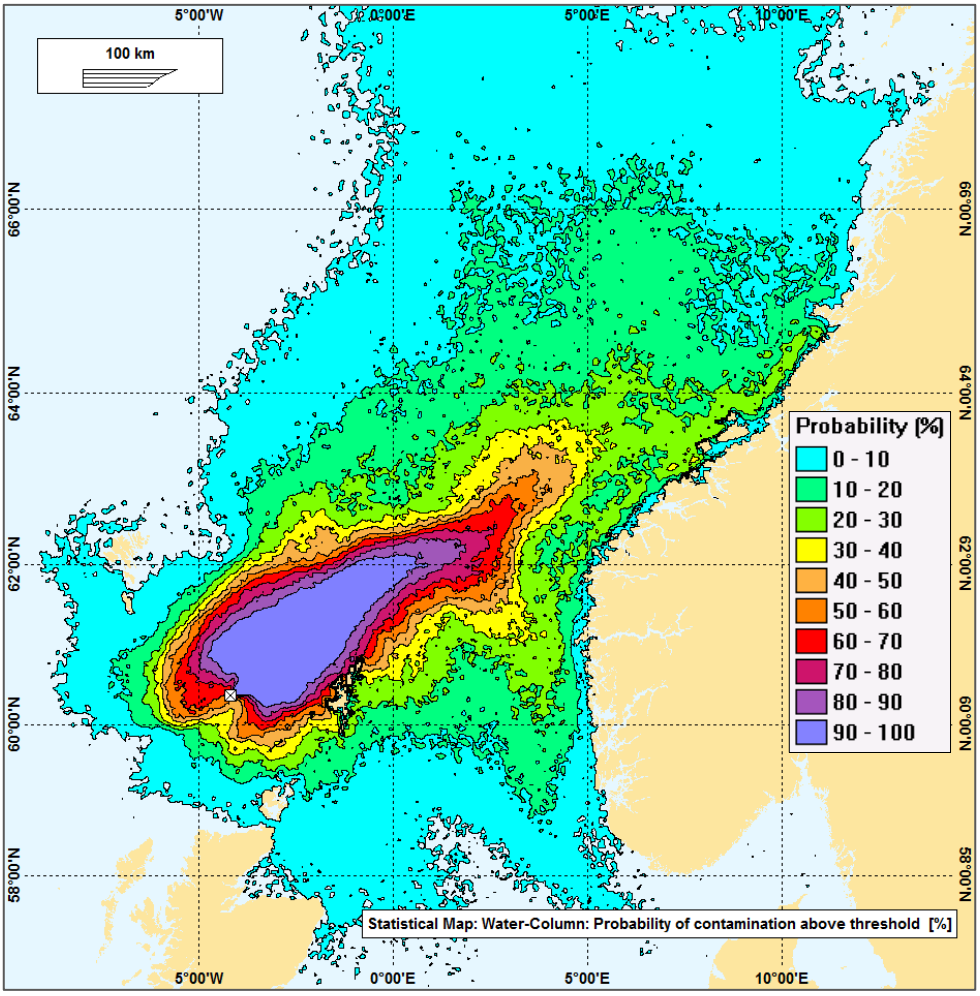

Figure D-7: Probability of water column impacts at concentrations ≥ 25 ppb.

The results shown in Figure D-7 were obtained from the stochastic modelling simulations and represent the aggregation of results from 100 different stochastic runs of the subsea well blowout scenario. A deterministic model was run for the subsea well blowout scenario in order to assess the impact to the water column. Figure D-8 shows the maximum total water column concentrations above the threshold of 25 ppb that were observed through the water column for the subsea well blowout scenario.

The modelling predicted that the total water column volume impacted by oil above a concentration of 25 ppb would be *c*. 11,800 km^3. The modelling also predicted that water column concentrations ≥ 25 ppb would likely still persist up to 2.5 days after the cessation of hydrocarbon release from the blowout.

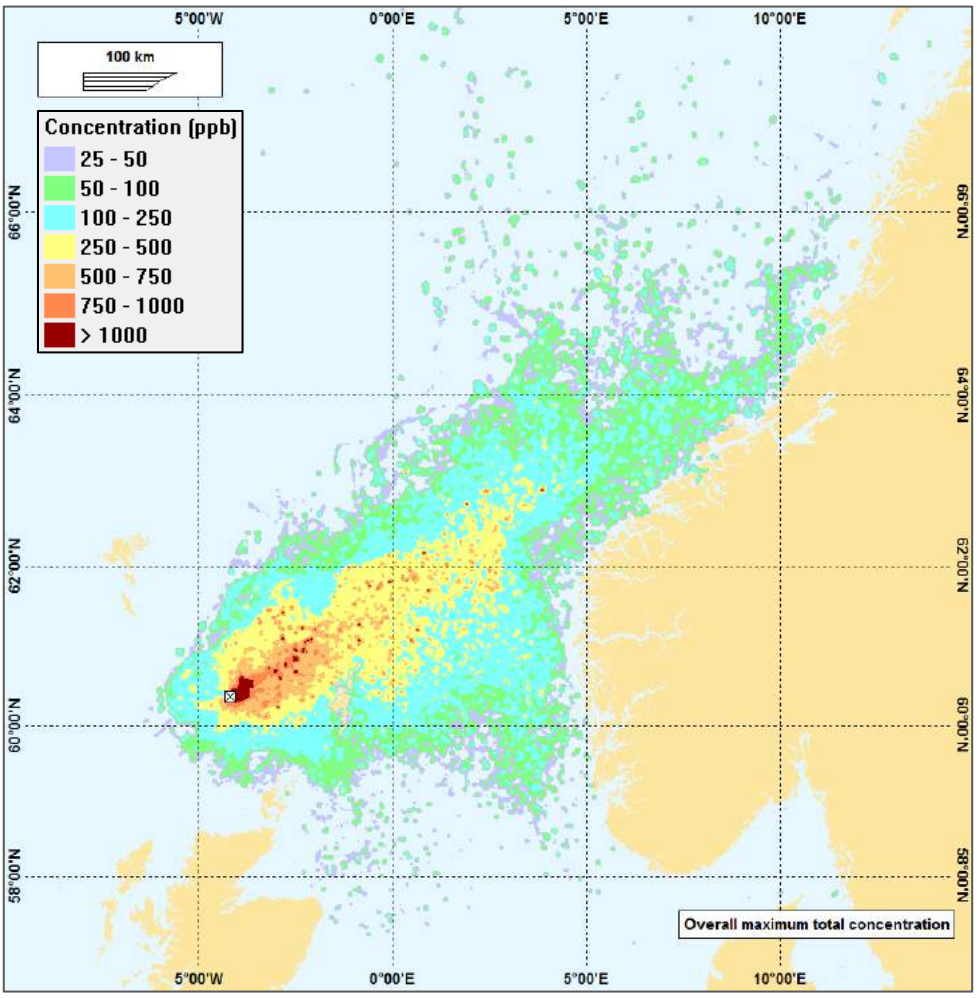

Figure D-8: Maximum total water column concentrations.

D.3.4 Deposition of Oil in the Sediment

The levels of oil deposited in the seabed sediments due to the blowout scenario are shown in Figure D-9. Only concentrations above the threshold of 5 g/m^2 are shown since this is the threshold at which point toxic effects are expected to occur (see Section D.2.4). Significant deposition was shown to the Northwest (peaking at 25 g/m^2) and Northeast (peaking at 39 g/m^2) of Shetland with less concentrated areas of deposition indicated around the Northern, Western and Eastern coastal areas of Shetland.

The modelling predicted that the area of sediment within which the threshold of 5 g/m^2 (i.e. 50 mmg/kg) would be exceeded (as shown in Figure D-9) is *c*. 2,000 km^2.

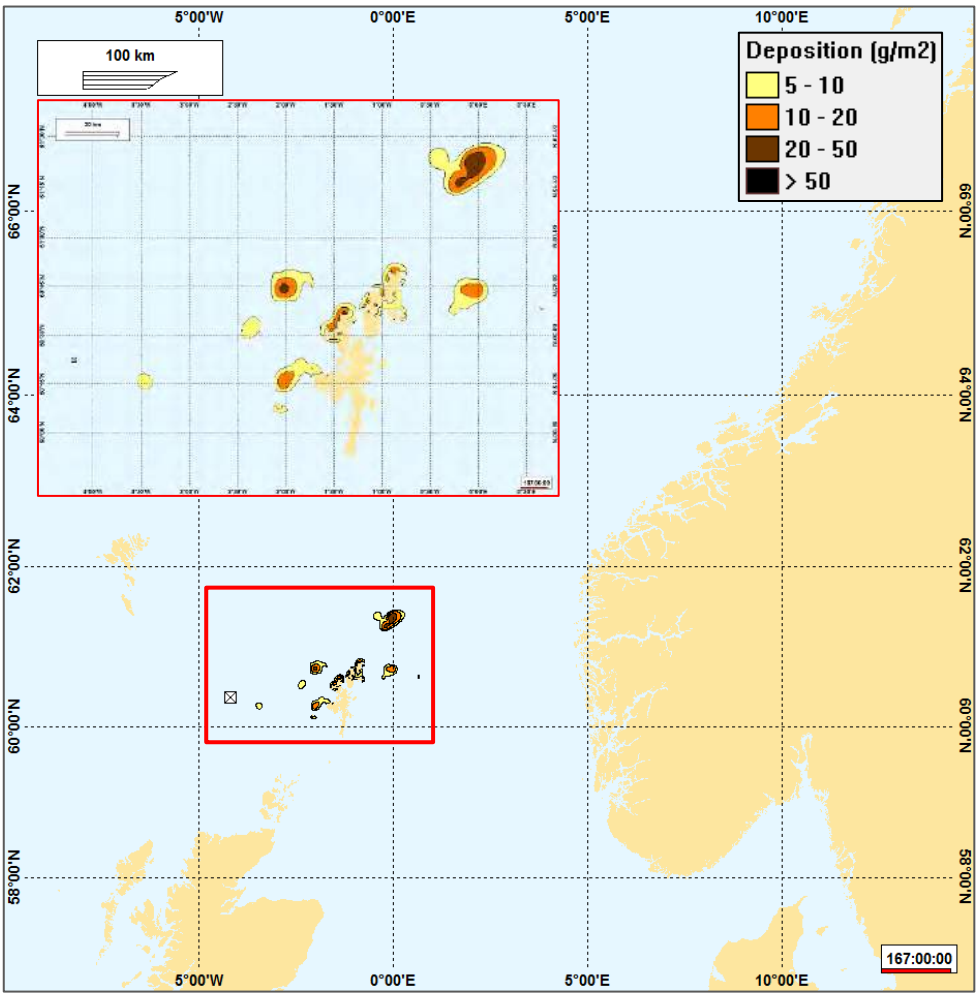

Figure D-9: Deposited oil in the sediment.

Figure D-10 below summarises the fate of the spilled oil for the single deterministic run as it moves throughout the environment over the full course of the simulation. This illustrates how oil degrades, deposits in sediments and strands on beaches over time under the influence of weather conditions that are predicted to result in the worst-case shoreline oil concentrations.

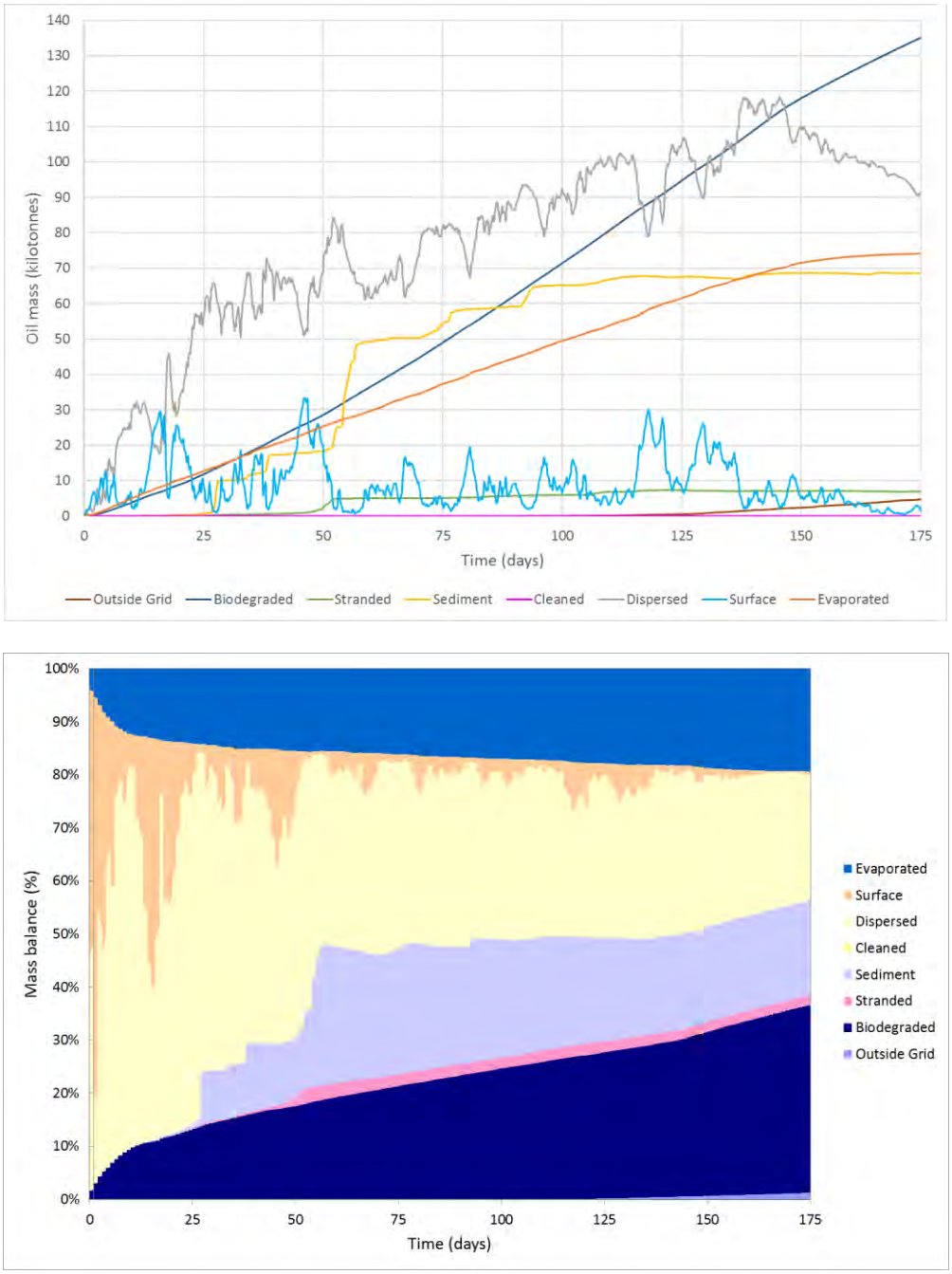

Figure D-10: Mass balances displaying oil mass (top) and percentage of total mass (bottom) for oil fate for the subsea well blowout scenario.

D.4 Blowout Prevention and Contingency Planning

BPEOC's commitment to ensuring protection of the environment are set out in the corporate HSE policy, a copy of which is provided in Section 1. BPEOC is certified to the international ISO 14001 standard, and has an externally verified Environmental Management System (EMS). BPEOC's EMS covers all aspects of BPEOC activities including exploration, drilling and production and will be applied to the proposed Alligin Field Development Project. The EMS governs those aspects of the environment that can be controlled, such as discharges, and establishes a subsequent auditing process.

The activities associated with the proposed development are also covered in a project specific Health, Safety and Environment (HS&E) plan which ensures that the project is managed in such a way that all of BPEOC's HS&E policies are adhered to throughout all phases of the proposed project. Particular emphasis will be paid to having a robust design, quality equipment, quality construction and operational best practices.

Oil spills can occur at any phase of a project, including drilling, completion, production and export. The following provides a high level overview of proposed areas of planning and preparation that either reduce the probability and / or consequence of a spill / release, including failure of well control.

BPEOC will take measures to minimise the risk of a blowout through well design and well control measures. These include a well control barrier and BOP equipment.

In the event of a blowout, the drilling rig will try to disconnect from the well by means of the Lower Marine Riser Package, and move away from location. A second rig or intervention vessel (sourced either from other BPEOC operations or wider industry) would be mobilised to location with the intention of placing a second BOP or a capping device on the flowing well or by drilling a relief well and re-establishing well control. It is envisaged that sourcing and mobilising a second rig would take a maximum of 16 days.

BPEOC have in place a call off contract with Wild Well Control (WWC), for the provision of well control services. As a member of Oil Spill Response Limited (OSRL), BPEOC will have access to well capping devices to contain the well.

If primary and secondary well control is lost by way of a blowout, and oil flows uncontrollably from the well to the environment, then a relief well may be required to stop the flow of oil and bring the well back under control. A suitable rig would be sourced from the UK market. The wells being drilled would take time to suspend, and, as a result, it has been estimated that a relief well would be drilled and the blowout well could be suspended, at worst 144.5 days (see Table D-1). An inventory is maintained by BPEOC and their contractors to ensure that stocks of all materials required for a relief well are available at short notice. BPEOC has insurance provisions in place to cover well control / re-drill situations as well as legal liabilities, and BPEOC is a member of the Oil Pollution Liability Association Limited (known as OPOL) which provides rapid compensation to parties directly affected by a spill.

D.4.1 Oil Spill Contingency Planning

BPEOC's oil spill contingency plans will be fully documented in the OPEPs that will accompany the development and operational phases.

BPEOC recognises three tiers of oil spill incident and response activities as summarised in Table D-7. BPEOC have contracted the services of OSRL as the oil spill contractor to provide Tier 2 and Tier 3 response resources.

Table D-7: Three tiers of oil spill incident and BPEOC's response.

	Type of spill	Nature of response	Resources and mobilisation times
Tier 1	Minor spill e.g. Diesel spill; vast majority of operational spills	Resources in the field are able to tackle the spill without outside assistance. Response will be short in duration. The preferred option is to observe the oil until complete dispersion.	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored and allowed to disperse naturally. If spill is relatively small 'prop washing' may aid dissipation. The ERRV holds 5 te of Type 2/3 dispersant. Dispersant is available for use immediately (within 1 hour) if safety is threatened, otherwise following agreement with Marine Scotland (MS-ML). Aerial surveillance can be on scene within 4 to 6 hours to monitor the spill.
Tier 2	Serious spill e.g. Pipeline rupture	Requires the mobilisation of external resources to monitor the spilt oil, including possible use of aerial chemical dispersant treatment if sensitive areas threatened. If coastline is threatened, mobilise to Tier 3 response.	Aerial surveillance and aerial dispersant application capability provided through OSRL. Aerial surveillance service utilising aircraft equipped with infra-red (IR), ultra violet (UV) etc. sensing equipment and Satcom. Aerial surveillance can be on scene within 4 to 6 hours. Dispersant could be available within 6 hours. Separate UKCS dispersant aircraft and dispersant pod and stocks.
Tier 3	Major spill e.g. Blowout Requires national resources.	May require rapid mobilisation of regional / international resources to effectively tackle the spill. Response may be of long duration (weeks / months).	Access to all Tier 2 resources plus aerial chemical dispersant treatment from OSRL. Dispersant stocks to be supplemented by O&G UK stocks held by OSRL. Access to well containment device and well control expertise. If shoreline is threatened: Specialised mechanical containment and recovery equipment and skilled technicians to lead clean-up operations held by OSRL. 'Unskilled' labour mobilised locally together with general purpose equipment and transport. Response to major spills (10,000 te) within 48 hours. Aerial surveillance can be on scene within 4 to 6 hours to monitor the spill.

APPENDIX E DRILL CUTTINGS MODELLING

E.1 Introduction

This Appendix describes the modelling undertaken to determine the environmental risk associated with the discharge of cuttings resulting from the drilling of the Alligin production and water injection wells. As described in Section 2.5.5 of the ES (and detailed in Section E.2.1 of this Appendix), WBM contaminated drill cuttings will be discharged both at the sea floor and near the sea surface. This appendix predicts the fate of the discharged materials using the ParTrack model and assessment protocol developed and validated by SINTEF in the Environmental Risk Management System Joint Industry Project (www.sintef.no/erms).

The aims of the modelling are to understand:

- Where the cuttings are likely to travel;
- How the cuttings are likely to disperse over time (both on the seabed and in the water column);
- Where stressors could exceed certain thresholds in the water column and in sediments;
- The recovery of the seabed; and
- The significance of the potential environmental impacts.

E.2 Modelling Methodology

This section details the model input assumptions. The specific release parameters and characteristics used in the model are described, along with the various environmental and physical factors that have been accounted for in the modelling.

The discharges were modelled using DREAM (Dose-related Risk and Effect Assessment Model) published by SINTEF, which incorporates the ParTrack sub-model used for modelling the dispersion and settlement of solids, which was substantially developed during the Environmental Risk Management System (ERMS) Joint Industry Project (www.sintef.no/erms). The ParTrack model within the Marine Environmental Modelling Workbench version 9.0.1 and 7.0.1 was used The model predicts the fate of materials discharged to the marine environment (their dispersion and physico-chemical composition over time) and it can also calculate an estimate of risk to the environment using a metric known as the Environmental Impact Factor (EIF). The EIF is based on taking a threshold of 5% risk to the environment based on well-established principles for assessing the acceptability of chemical discharges (e.g. ECB, 2003) by comparing a predicted environmental concentration (PEC) to a predicted no-effect concentration (PNEC). An EIF of one in sediments occurs when an area of 100 m x 100 m is judged to exceed a 5% risk on the basis of grain size change or burial thickness. Sensitivity curves used to derive these 5% risk levels can be found in the technical reports at www.sintef.no/erms/reports and the risk levels are based on scientific studies of sensitivity to grain size change, burial thickness and other stressors such as described in Trannum (2004) and Kjeilen-Eilertsen (2004).

The model has been developed to calculate the spreading and deposition on the seabed of drilling mud and cuttings as well as the spreading of chemicals in the free water masses. The calculations are based on the `particle' approach, combined with a near field plume model and the application of external current fields for the horizontal advection of the particles. The model consists of a plume mode and a far-field mode. The plume mode takes into account effects from water stratification on the near-field mixing, ambient currents and geometrical configuration of the outlet. Once the plume has been trapped in the water masses, particles are free to fall out of the plume and deposit on the bottom. Downwards (or rise) velocity of the particles is dependent on size and particle density. The far-field model includes the downstream transport and spreading

of particles and dissolved matter, once the plume mode is terminated. The processes involved are illustrated in Figure E-1.

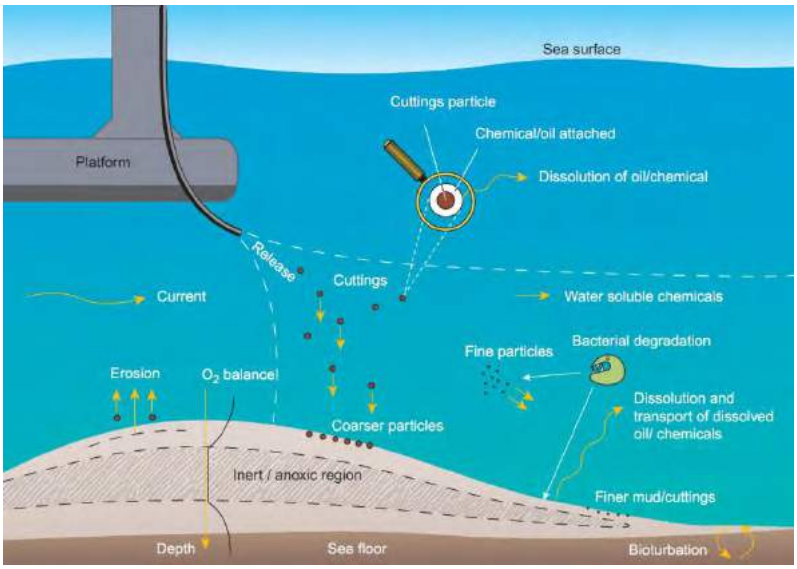

Figure E-1: Processes involved in DREAM/ParTrack model. *Note: the figure shows a typical discharge from a drilling rig, but the modelling processes are the same for releases e.g. from tophole cuttings at the seabed.*

The model was used to produce five main outputs:

1. Depositional thickness on the seabed;
2. Oil content in the surficial sediments;
3. Environmental risk on the seabed resulting from burial thickness, particle size change, toxicity and oxygen depletion;
4. Predicted recovery of the sediments;
5. Concentrations of suspended solids in the water column.

The nearest sediment analyses to the Alligin wells show the prevailing sediments to be a very fine sand and a prevailing reference particle size of 0.913 mm for seabed sediments was taken based on Gardline (2013).

Model parameters were chosen with a grid size of 10 m. For the majority of model outputs, a model time step of 2 minutes was adopted, using 40,000 solid particles to represent the discharges. In order to examine water column risks, a time step of 1 minute was used.

After the discharges have ceased, the time development of the risk is calculated by the model. The model combines assumptions around biodegradation, bioturbation depths relevant to the depth, oxygen profiles in the sediment, expected recovery times from burial and grain size change and changes in chemical and oil toxicity over time. This gives a forecast of the reduction in environmental risk to the sediments over time. This approach is discussed in more detail in Rye *et al.* (2006) together with laboratory and field research to supporting and validating the approach listed at www.sintef.no/erms/reports.

E.2.1 Input Data

E.2.1.1 Mud and Cuttings Details

WBM will be used to drill four of the sections of each well and the cuttings and associated mud from these sections will be discharged either at the seabed or at the sea surface (Table E-1).

Table E-1: Key input data for modelling.

Input	Data used
Prevailing sediment grain size	0.913 mm (sandy), quoted in Foinaven and Schiehallion Environmental Survey. (Gardline, 2013).
Discharge location and diameter of the release pipe in meters	Discharge points for the 46" and 26" sections are 30" and 20" respectively at 1 m above the seabed (discharge diameters are the width of the sections less the approximate size of the drilling string). Discharge points for the 17.5" and 8.5" sections is 14" diameter above the water surface. It is assumed that the discharge spreads out to 1 m when it reaches the sea surface.
Particle size distribution of the solids (drill cuttings)	Default size distribution from ParTrack model based on North Sea wells

Section diameter (")	Mud type	Depth of shoe (m below mud line)	Section length (m)	Mass (te)				Discharge location
				Bentonite	Barite	Hydrocarbons	Mud	
46	Gel sweeps	103	103	16.26	-	-	231	Seabed
26	Gel sweeps	238	135	21.40	-	-	197	Seabed
17.5	KCl polymer	1,209	971	5.00	47.50	-	500	Sea surface - from rig
12.25	LTOBM - no discharge	2,292	1,083	-	-	-	-	No discharge
8.5	High performance WBM	4,323	2,031	-	-	11.59	471	Sea surface - from rig

Note: the producer and water injector wells are assumed to be identical in terms of discharges.
Rock density of 2.4 has been assumed (model default).

The drilling of the tophole sections will comprise the discharge of drill cuttings and gel sweeps at the seabed. Gel sweeps is typically a mud composed largely of water with bentonite and a small amount of chemicals. Subsequent sections will be drilled with WBM consisting mainly of water, barite, bentonite and added chemicals. The reservoir section is expected to be drilled with a high-performance WBM that does not contain these solids. The components most relevant to deposition are the cuttings and the barite and bentonite minerals.

The well section through the reservoir ($8^1/_2$" section) will contain oil and some oil will be discharged with the cuttings. As a worst case it is estimated that 11.59 te of oil will be returned to the rig with the WBMs and cuttings for discharge. This oil content has been included in the modelling. It is assumed that this oil is contained in the rock matrix, however in reality, the mud pressure while drilling will drive much of this oil from the rock before it is returned to surface, such that this is a conservative estimate.

E.2.1.2 Profile of Reservoir Oil

To calculate toxicity, partitioning and biodegradation, an oil profile must be included in the model for the conservatively estimated 11.59 te of oil assumed to be discharged with the cuttings and WBMs from the $8^1/_2$" section. The Schiehallion oil type has been used in this assessment to represent the oil expected from the Alligin well. The Schiehallion oil has undergone weathering tests that are incorporated in the OSCAR database. Within the OSCAR database the majority of the Schiehallion oil type is assigned to the fraction

C25+. This has been chosen as being representative of the oil in the cuttings. This is conservative in respect of toxicity, as C25+ has the lowest no-effect concentrations in the database (5 ppb chronic and 50 ppb acute toxicity values), and amongst the highest persistence, compare to other components such as benzene, toluene, xylene and ethylbenzene, naphthalenes, low and medium soluble PAHs and phenols.

E.2.1.3 Volume of Reservoir Oil Associated with the 8½" Section

As mentioned in Section E.2.1.1, the volume of oil accounted for in the model is 11.59 te for each well. The approach used to determine the mass of hydrocarbons associated with the cuttings from the reservoir section of the well have used the existing methodology applied to the Deepsea Aberdeen drilling operations and associated Greater Schiehallion Area wells permit applications. This calculation is based on a standard industry method whereby it is assumed that 100% of the oil in the reservoir column, through which the 8 ½" well section is drilled, is subsequently released to sea via discharge of the cuttings.

To give a worst-case oil discharge, maximum values for parameters such as porosity and oil saturation have been assumed from the anticipated range within the reservoir.

These parameters include:

- Maximum length of reservoir section (specific to well profile);
- Drill bit diameter – 8½" (0.1127m); assumed hole diameter – 8⅜" (0.225m);
- Cuttings volume – 34 m^3;
- Drilling rate: 15 m/hr;
- Porosity of Palaeocene reservoir sand – Expected Range: 26% - 32% (note 32% was used in calculations as worst case);
- Net to gross (sand / shale) ratio – Expected Range: 0.33 – 0.92 (note 0.92 was used in calculations as worst case);
- Maximum oil saturation – 86%; and
- Oil density = 0.895 SG (26.6° API).

The calculation assumes that 0.6 m^3/hr of drill cuttings is discharged at the sea surface for the full duration of the drilling the 8½" reservoir section. This is known to not be reflective of the true hydrocarbon discharge as no sheens have been detected when discharging cuttings from this section at other wells in the Greater Schiehallion area. It is possible that this oil is contained in the rock matrix, however in reality the mud pressure whilst drilling will drive much of this oil from the rock before it is returned to the rig.

Within the model run the calculated mass of hydrocarbons has been assumed for both the production and the water injection well. This is believed to contribute to the conservative assumption for determining hydrocarbon release volumes, as the WI well profile will target water bearing sections of the reservoir therefore resulting in lower volumes of potential hydrocarbon returning to the rig through drilling operations.

Based on measurements taken from cuttings returned at other Greater Schiehallion Area wells it is expected that the total reservoir oil returned will be *c*. 60-80 % less than is assumed within the calculation methodology. Based on measurements in field, hydrocarbon discharge associated with cuttings discharge is more likely to be below 3 te for the production well and even less for the water injection well.

On this evidence, BPEOC determine that the modelling conducted as part of this ES (captures a total hydrocarbon discharge of 23.18 te) is reflective of worst-case assumptions for hydrocarbon discharge associated with drilling of the reservoir section. The standardised industry methodology has been acknowledged as an overly conservative estimate. BPEOC are in ongoing discussions with BEIS regarding the standard methodology for calculating the volumes of reservoir oil returned in the cuttings and are investigating methods of refining the estimates to reflect a more realistic discharge outcome. Once completed, and with discussion and agreement with BEIS, the output from this assessment will be used with future Deepsea Aberdeen drilling permit applications. For the Alligin Field Development ES it was determined

that for consistency the standard methodology currently being applied to the Greater Schiehallion Wells would be used. The impacts described in this ES are therefore considered highly conservative such that the volume of oil released is over estimated and the areas at risk from oxidation in reality will be much smaller than presented.

E.2.1.4 Metocean Data

The metocean data used for currents has been generated for BP by Imperial College for a five-year period over the North Sea and north-east Atlantic. The data is based on their proven hydrodynamic models of ocean currents and circulation and is at a spatial resolution of approximately 5 km in two dimensions, illustrated in Figure E-2, and at 10 layers through the water column down to the seabed. The data used for the specific model runs presented here relates to June 2004 i.e. slightly more quiescent summer conditions, which is arbitrary, but prevailing current patterns at this location are relatively consistent year-round in being strongly driven to the northeast with little or no reversal due to tides, so the choice of time period is not thought to be a significant variable. Wind driven forcing of the surface currents is included in the model, although surface currents have little effect on the deposition of drill cuttings.

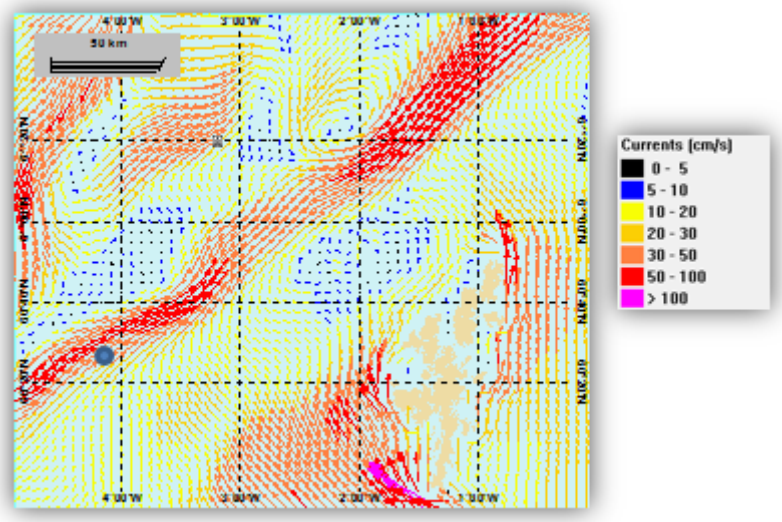

Figure E-2: Example of current data resolution used in the model.

The model assumes a sea surface temperature of 10°C and seabed temperature of 4°C as typical values at this location. The model is not particularly sensitive to these parameters.

E.2.1.5 Bathymetry

The location of the Alligin wells and the local bathymetry used in the model are shown in Figure E-3 (taken from the model default SeaTopo 8.2 database).

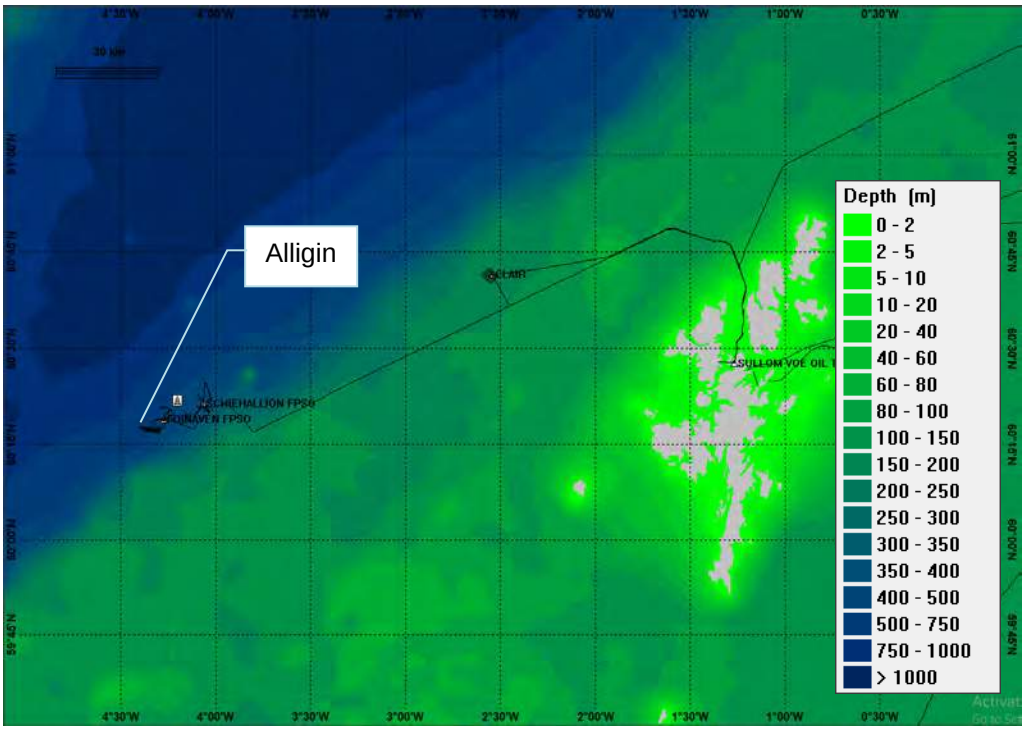

Figure E-3: Location of Alligin showing model bathymetry.

E.2.2 Release Parameters

Discharge timings and rates are based on model default rates of progress between 10 - 25 m per hour depending on the section diameter being drilled. Discharges are run in close succession in the model with a period of 6 hours in between sections and 12 hours in between the two wells, whereas in reality there are pauses for running in and pulling out of hole, running and cementing casing, downtime and other activities. However, as the tidal effects are relatively slight in relation to prevailing currents and the period of operations is relatively short, the net effect is that the results will be very similar whether the discharges are spaced out or run consecutively.

E.2.3 Output Thresholds

The following thresholds of significance have been adopted in the modelling:

- Pineda *et al.* (2017) showed that some sponge species exposed to high Suspended Sediment Concentrations (SSC) i.e. ≥23 mg/l for extended periods (28 days) have lower survival, increased necrosis and depletion of energy reserves. In contrast, SSC of ≤10 mg/l caused few, if any, negative effects and is thus suggested as a prudent sub-lethal threshold for sponges.
- Environmental risk to the seabed of 5% based on a cumulative PEC:PNEC approach based on grain size change (57.2 µm change in median size), burial thickness (0.65 cm deposited layer), chemical toxicity and oxygen depletion (20% reduction of integrated oxygen content), as described in the ERMS project.
- Mass of oil of 50 mg per 1 kg of sediment (50 mg/kg), above which toxic effects on benthic fauna may begin to be discernible. This threshold was adopted by OSPAR in the context of Oil Based Mud (OBM) contamination. Given that deposition will distribute vertically through the surface of the seabed, this equates to 5 g of oil per 1 m^2 of seabed (5 g/m^2) assuming that the oil will distribute through a 5 cm sediment layer and assuming a saturated sediment density of 2.0 t/m^3. Thus, 5 g/m^2 is adopted as the threshold above which toxic effects are considered to begin to be discernible.
- Thresholds of 88 ppb and 200 ppb concentrations in the water column are used as 5% risk-onset levels for bentonite and barite respectively from Smit *et al.* (2006).

E.3 Results

This section presents the results obtained from ParTrack modelling carried out. The model was run for 20 years in order to determine the impact of the discharges over time.

E.3.1 Water Column Concentrations

A snapshot of the water column concentrations during discharges of cuttings at the seabed and from the drilling rig are shown in Figure E-4 and Figure E-5. These are relatively consistent during the duration of the model run and reflect the steady and strong currents to the northeast in this location. Since the mud components used are all solids the concentration key is equivalent to the concentration of suspended solids (note the reservoir oil associated with the cuttings from the $8^1/_2$" section is trapped within the rock particles).

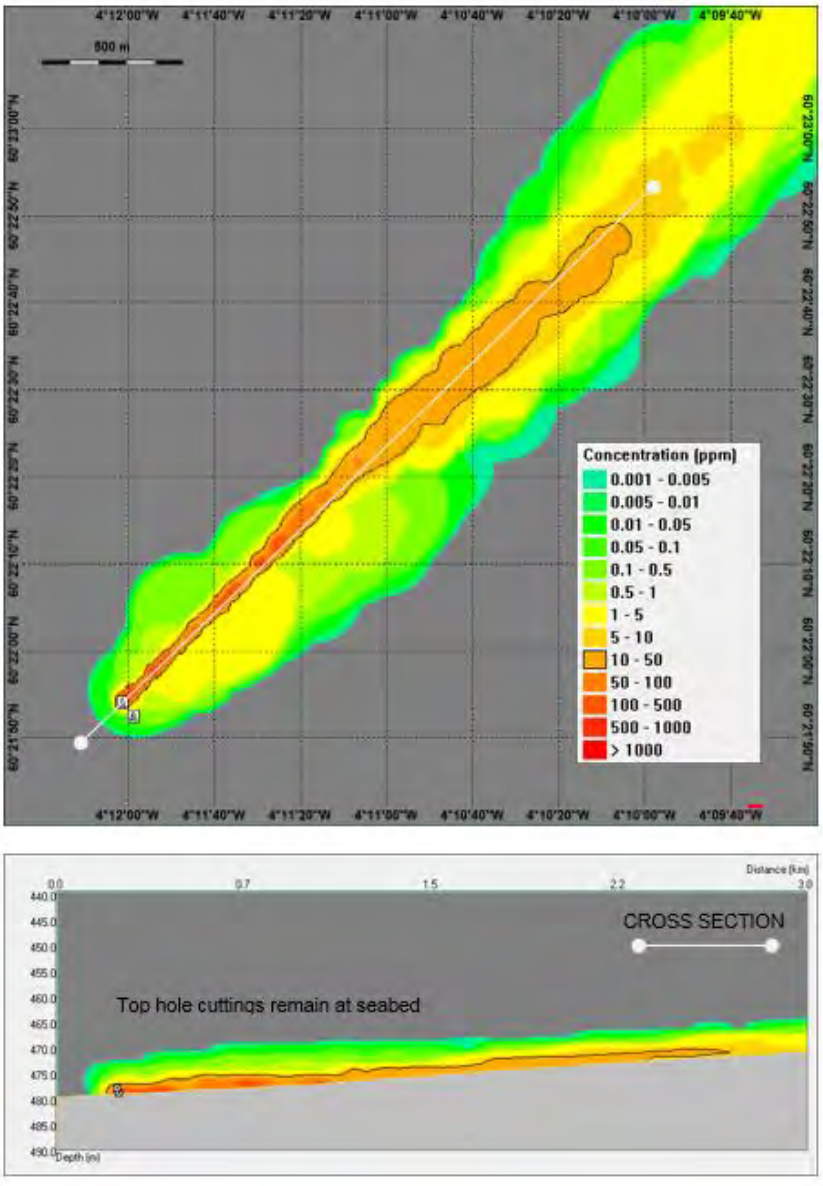

Figure E-4: Typical water column concentrations during tophole drilling.

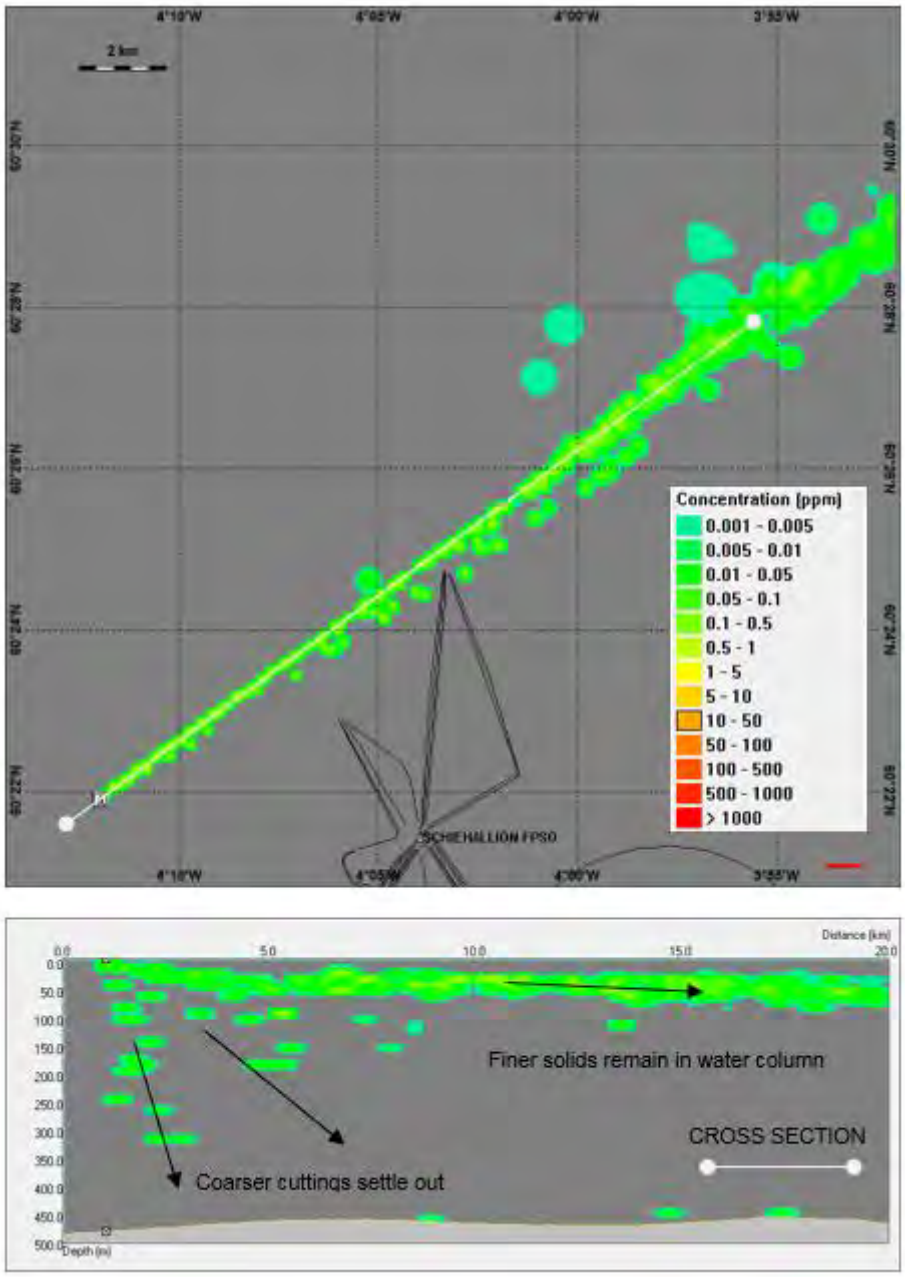

Figure E-5: Typical water column concentrations during discharges of WBM cuttings from rig

The discharge of the cuttings from the top hole sections (at the seabed) gives rise to the highest seabed concentrations of suspended solids. These exceed 10 mg/l in a narrow area of *c*. 2.5 km long by 90 m wide for a number of hours while this operation takes place. The tophole discharge is not expected to occur for more than 18 hours continuous drilling per well. While it exceeds the precautionary level of 10 mg/l suspended solids, this threshold is based on observations where effects were observed over a 28-day exposure. In this respect it is unlikely to give rise to a significant impact in terms of sponge filter feeding activities. Concentrations also exceed the PNEC levels of 88 ppb for bentonite and 200 ppb for barite identified in the ERMS project (Smit *et al.*, 2006) which relates to a 5% risk of a random biota being exposed to a level above its PNEC, and this could extend in the order of 10 km from the well. The exposure is however

very short term and stops almost immediately on cessation of drilling, and is not considered to cause a significant impact.

The discharges of WBM cuttings from the rig remain mainly in the upper water column where currents are much faster and benefit from a greater degree of initial dilution. Although coarser cuttings are predicted to descend to the seabed, including those containing residual reservoir oil, at no point is a water column concentration of suspended solids predicted to be above 10 mg/l, so significant effects on sponges from suspended solids are not predicted. Concentrations of suspended solids exceed the PNEC levels of 88 ppb for bentonite and 200 ppb for barite (identified in Smit *et al.*, 2006) in a small area in the upper water column which relates to a 5% risk of a random biota being exposed to a level above its PNEC. The exposure is however very short term and not considered to cause a significant impact.

E.3.2 Sediment Deposition

Predicted deposition thickness over an area of *c*. 6 km from the release point is shown in Figure E-6. This shows that a small proportion of the solids discharged is expected to distribute over a wide area to a very low thickness. Beyond 500 m of the release point, thicknesses are predicted to be 0.2 mm or less. The predictions reflect the dominant prevailing currents in the area that are northeast. Kjeilen-Eilertsen *et al*., (2004) concluded that, in general, a thickness of 6.5 mm can be adopted as a threshold at which 5% of the most sensitive species would be affected, which is deemed a tolerable risk level (Commission Directive 93/67/EEC). In addition, the scientific program “Coral Risk Assessment, Monitoring and Modelling” (CORAMM) has indicated that sedimentation in the order of 6.5 mm may cause adverse effects on *Lophelia pertusa* (Larsson and Purser, 2011). The modelling shows that the area impacted by the discharged cuttings at a depth of 6.5 mm or more is *c*. 0.44 km^2.

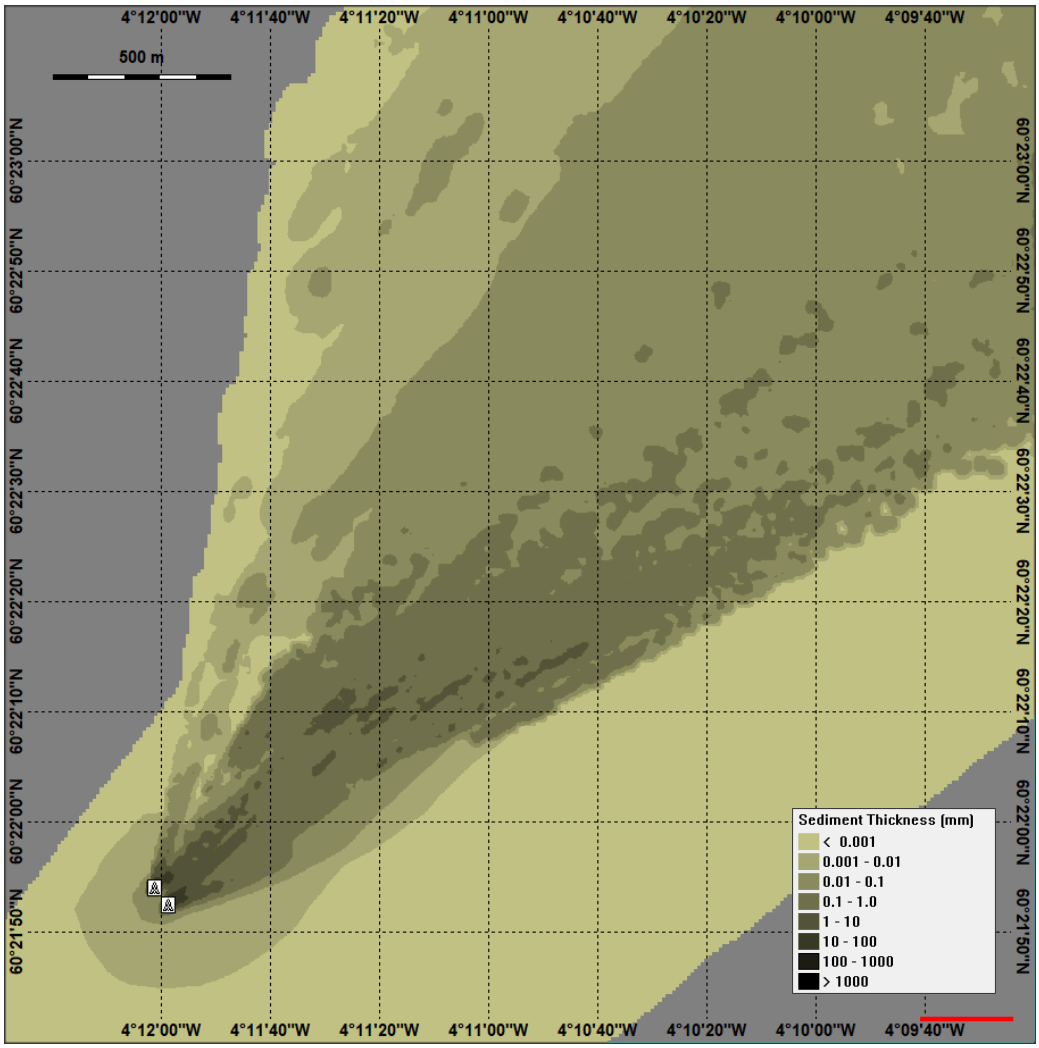

Figure E-6: Deposition thickness of solids.

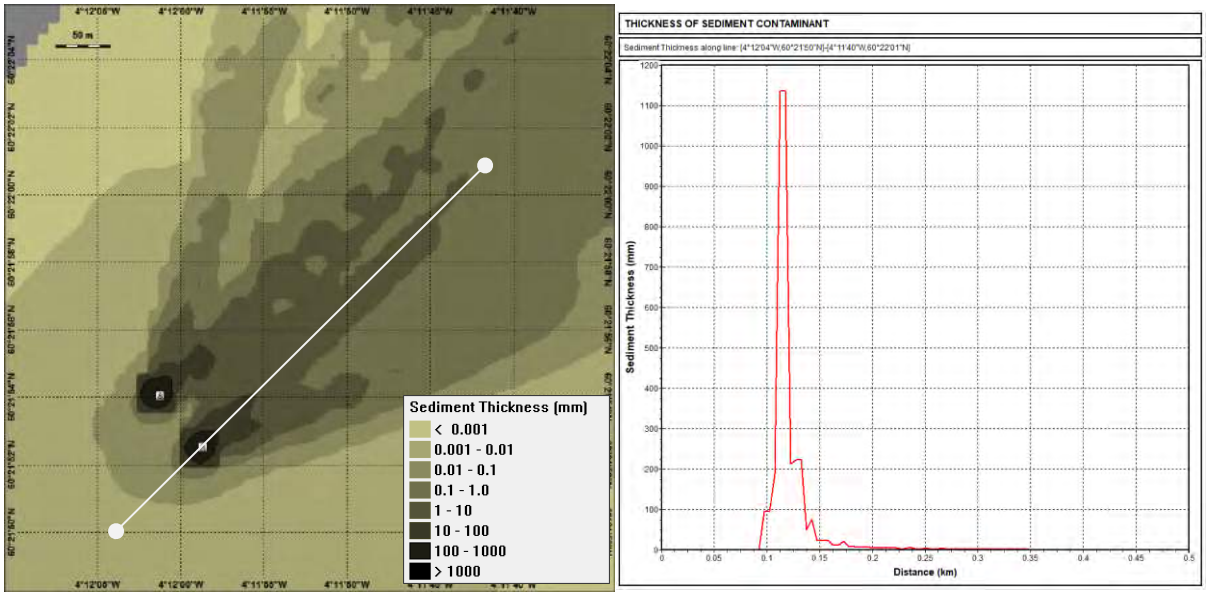

Figure E-7: Deposition thickness of solids locally and cross section through pile.

The greatest accumulation of cuttings is immediately to the northeast of the release point. The output is shown in Figure E-7 along with and a cross section of the resulting cuttings pile. The peak thickness of deposition is approximately 1,200 mm and this is predicted to occur within 20 m of the release point. The model averages the thickness over the grid size, which is 10 m by 10 m in this analysis, and thicknesses may vary within each cell, but this resolution is considered by experience to give a reasonable reflection of real deposition patterns. Thicknesses rapidly diminish with distance; at a distance of 500 m, the maximum depositional thickness is predicted to be 0.2 mm along the dominant current axis, and 0.1 mm at 500 m perpendicular to this axis.

The areas of very thin deposition reflect the presence of very fine solids. The particle size distribution used includes 60 % of particles below 0.1 mm, and 10 % below 0.01 mm, and the barite and bentonite particles in the mud are between 0.001 and 0.05 mm. These fine particles will travel much further than the majority of rock cuttings which will deposit near to the well, with the majority of the deposition occurring within 50 m.

E.3.3 Environmental Risk to the Seabed

Figure E-8 shows the >5% environmental risk to the seabed based on a cumulative PEC:PNEC approach after cessation of drilling. As described in Section E.2.3 the cumulative PEC:PNEC includes grain size change, burial thickness, chemical toxicity and oxygen depletion. Figure E-9 shows the same cumulative impact 12 months, 5 years, 10 years and 20 years after cessation of drilling.

Following cessation of drilling the initial area of risk is low (Figure E-8) and is primarily associated with changes in grain size and burial, close to the well location. The shape of the risk contours shown reflect the depositional pattern and it can be seen that areas where the risk is >5 % are contained within *c*. 200 m of the well following cessation of drilling. The output is calculated on a 10 m grid.

However, over time the oil content in the sediments causes deoxygenation to occur, which results in the area of risk 'growing' (to a maximum of 0.72 km^2) in the first 12 months before it starts to decrease in area again (Figure E-9). The low temperatures at the seabed and the toxicity of the oil that inhibits microbial activity, slows recovery such that a small area of risk >5 % is predicted to remain after 20 years.

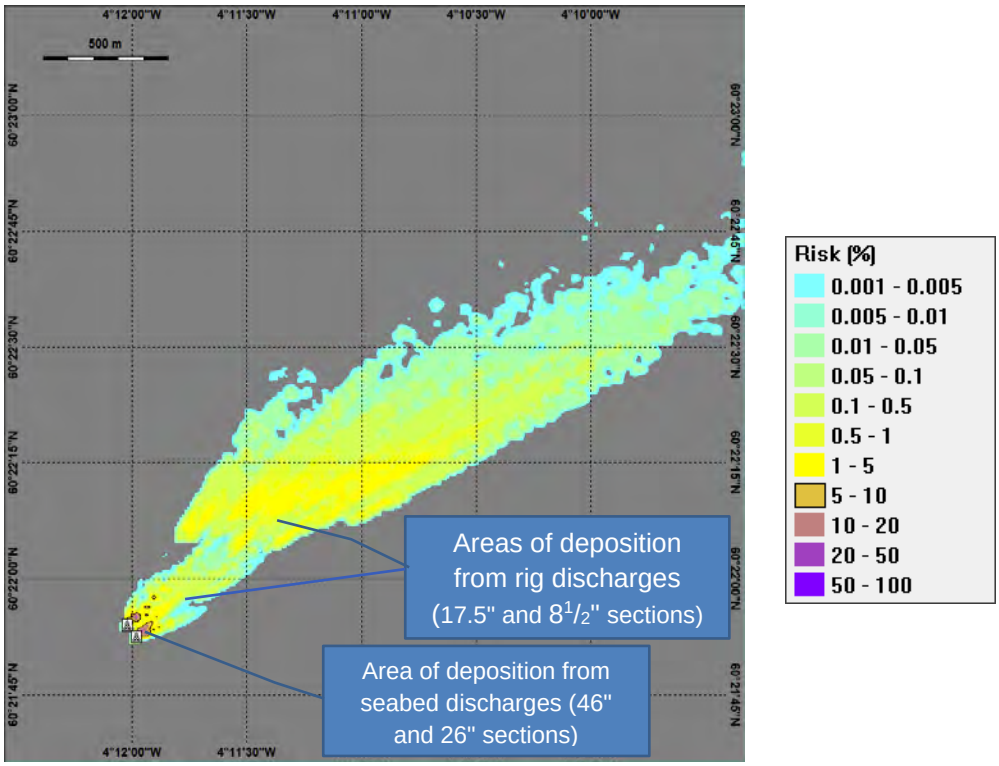

Figure E-8: Sediment risk after cessation of drilling.

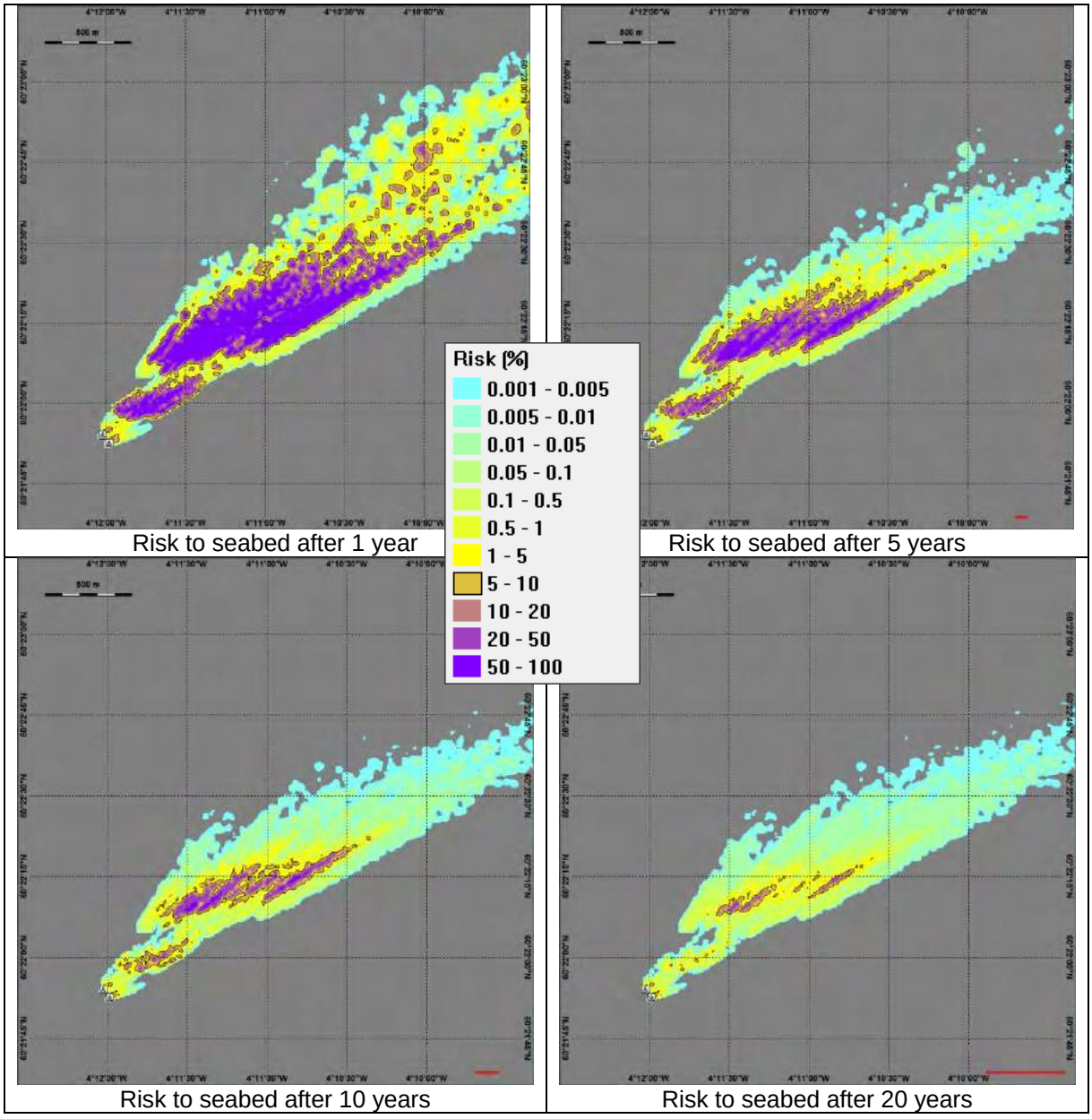

Figure E-9: Time development of risks to seabed.

The contributions to the risk from the various stressors are shown in Figure E-10. This shows that oxygen depletion is the main stressor (though not initially as described above), and burial thickness and grain size change are relatively small.

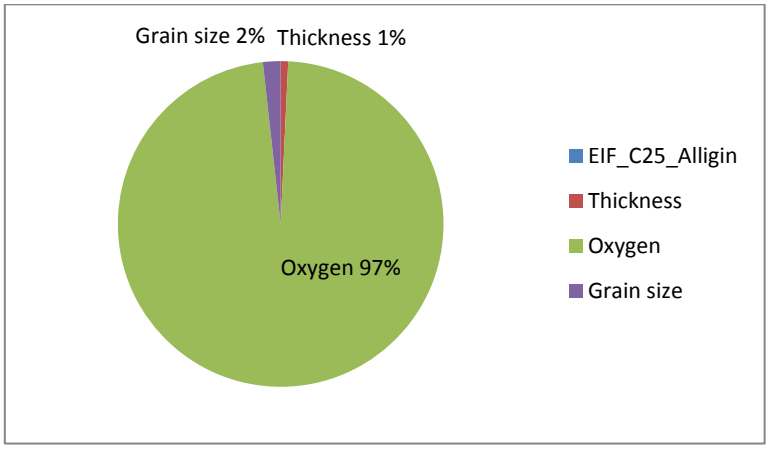

Figure E-10: Contributions to environmental risk to sediments.

The maximum risk levels can be plotted over time as shown in Figure E-11, expressed as EIF, where one EIF is equal to a risk >5 % over an area of 100 m x 100 m (i.e. 10,000 m^2) (note the time scale is not linear). Risk (stress) due to deoxygenation dominates and peaks at around 1 year post-discharge, and then recovers over time. The other stressors are clearly far smaller, and on their own would be very small.

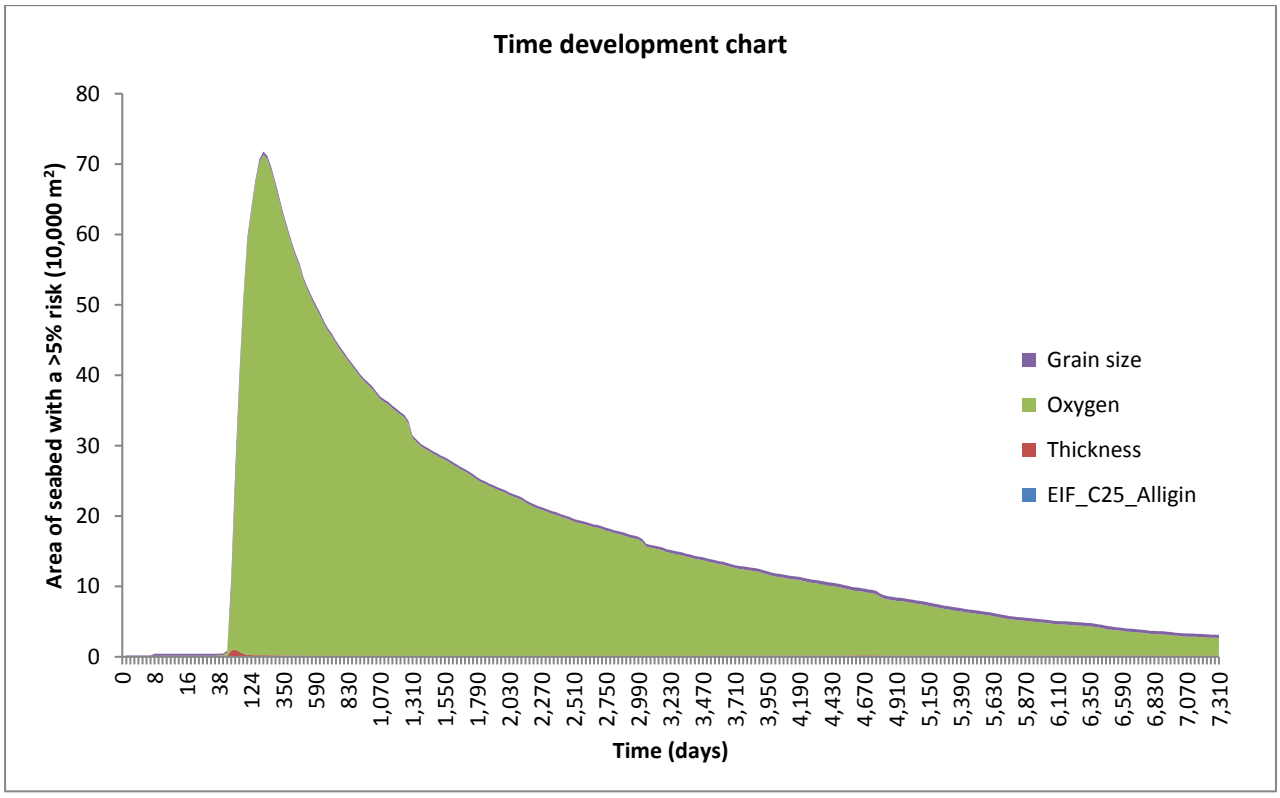

Figure E-11: Time development of maximum risk to seabed expressed as EIF.

The modelling predicted that the area of sediment within which the hydrocarbon threshold of 5 g/m^2 (i.e. 50 mg/kg) would be exceeded (as shown in Figure E-12) is *c*. 650 m^2 located *c*. 500 m from the wells.

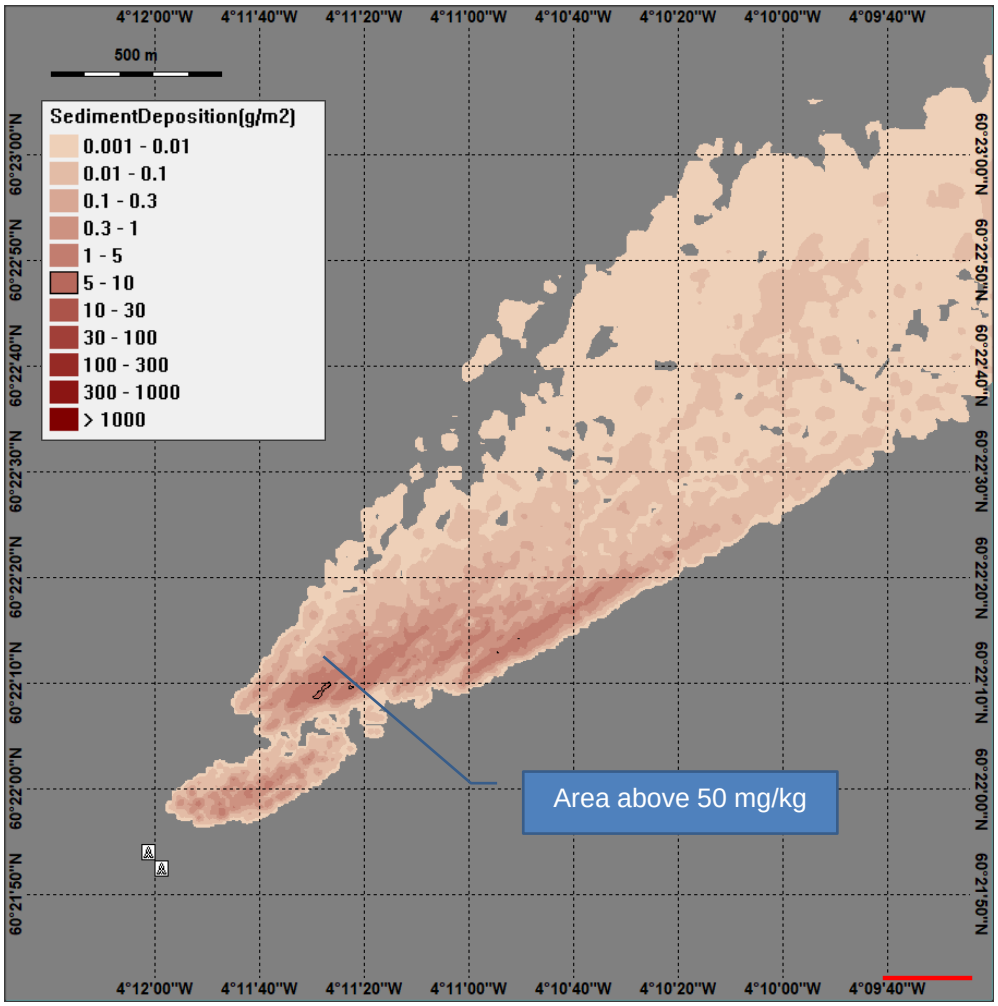

Figure E-12: Deposited oil in the sediment post-drilling.

Therefore, while the precautionary assessment of > 5% of biota being exposed to conditions above their PNEC suggests that an area of *c*. 0.72 km^2 is impacted, the area where harmful effects are actually expected, based on a threshold derived from experience, is far smaller at 0.00065 km^2 (650 m^2). In addition, as discussed in Section E.2.1 a very conservative oil type and volume has been included in the model such that the actual area of impact is considered to be even smaller.

E.4 Model Validation

Model predictions were recently validated through field measurements at the Trolla field in 265 m water depth in the Norwegian Sea, where reasonably good correspondence was obtained between measured and simulated deposition of the cuttings on the sea floor (Rye, 2010 and Jødestøl and Furuholt, 2010). The observed deposition thickness was lower than was predicted by the ParTrack model which suggests that the modelling results are conservative. Validation on the Murchison cuttings pile in the North Sea documented in Hayes and Galley (2013) produced a good correlation for deposition and contaminant concentrations between modelled results using drilling records and surveyed profiles and analyses for a large historic cuttings pile containing WBM and oil-based mud cuttings discharges.

Atif Mirza
Schiehallion Area Business Manager, North Sea Region

BP Exploration Operating Company Ltd
1 Wellheads Avenue
Dyce
Aberdeen AB21 7PB

30th May 2018

Claire Grant
OGA Consents and Authorisations Manager
AB1
Second Floor
48 Huntly Street
Aberdeen
AB10 1SH

Direct 01224 955789
Mobile 07917277124
Atif.Mirza@bp.com
www.bp.com

Dear Madam

PETROLEUM PRODUCTION LICENCE(S) 204/19a P.556: ALLIGIN FIELD DEVELOPMENT PLAN

I refer to the above-mentioned Petroleum Production Licence and the potential field development mentioned above.

Subject to the necessary management and partner approvals, BP Exploration Operating Company would intend to apply for Consent for the development of the said field, and this letter of application to provide preliminary notification of the proposals is made on behalf of:

BP Exploration Operating Company Limited (Operator, 50%Equity)
Shell U.K. Limited (50% Equity)

The primary nature of this project will be for the Alligin Field is a fast-paced subsea tieback to the existing Glen Lyon FPSO and it is proposed this project will comprise of the following:

- A two well (producer plus supporting water injector) development via subsea tieback to the existing Glen Lyon FPSO. Alligin is located in UKCS block 204/19a with a water depth of 450 to 480m, 6km West of the Glen Lyon FPSO (UKCS block 204/20a), and 140km from the nearest coastline in Scotland (Shetland mainland). The nearest international median line is the UK/Faroes median line at a distance of 28km.

- Glen Lyon FPSO is the host facility for the BP operated Schiehallion and Loyal Fields. Alligin will operated within the allocated Loyal fluid constraints. Export of Alligin produced oil and gas will be via the same routes as Schiehallion and Loyal, namely via shuttle tanker for oil and the West of Shetlands Pipeline for gas.

- Production will be tied back to existing Loyal subsea infrastructure through a newly installed 10" flowline. Water and gas lift supply will be tied back to existing Schiehallion infrastructure at the North-West Drill Centre, via newly installed 10" and 6" flowlines respectively.

- Chemical injection and hydraulic fluids will be provided using existing storage and pumping facilities on the Glen Lyon made available to Alligin via subsea tie-in.

- Power and communications will be provided from the existing integrated control and surveillance system (ICSS) and electrical power unit (EPU) via subsea tie-in.

- Drilling of the Alligin development wells are anticipated to take approximately 4 months and will commence in 2Q 2019. Subsea equipment installation will commence 2Q 2019. Activities support a first oil production date of March 2020.

- Alligin is field life is expected to be determined by Glen Lyon CoP in 2037.

BP Exploration Operating Company Limited can confirm that an Environmental Statement ("ES") for the potential development will be submitted to the Environmental Management Team at the Offshore Petroleum Regulator for Environment and Decommissioning ("OPRED") in their capacity as environmental regulator acting on behalf of the Secretary of State for Business, Energy and Industrial Strategy.

Yours faithfully

Atif Mirza
Schiehallion Area Business Manager

cc: Environmental Management Team, OPRED (by e-mail to bst@beis.gov.uk)

Offshore Petroleum Regulator
for Environment & Decommissioning

D/4211/2018

Department for Business, Energy & Industrial Strategy

Offshore Petroleum Regulator
for Environment and
Decommissioning
AB1 Building
Wing C
Crimon Place
Aberdeen
AB10 1BJ

Tel +44 (0)1224 254148

www.beis.gov.uk
EMT@beis.gov.uk

Mr Tom Hardinges
BP Exploration Operating Company Limited

By e-mail:
Tom.Hardinges@bp.com

5th June 2018

Dear Mr Hardinges

THE OFFSHORE PETROLEUM PRODUCTION AND PIPE-LINES (ASSESSMENT OF ENVIRONMENTAL EFFECTS) REGULATIONS 1999 (AS AMENDED) - THE OFFSHORE EIA REGULATIONS

ALLIGIN FIELD DEVELOPMENT

I acknowledge receipt of two hard copies and an electronic copy of the Environmental Statement (ES) submitted in support of your letter of application to the Oil and Gas Authority in relation to the above project. The Department's reference number for your submission is D/4211/2018, and this number should be quoted in all future correspondence relating to the ES.

I enclose a notice given under regulation 9(1) of the Offshore EIA Regulations which identifies the authorities likely to be interested in the project and upon whom you must serve a copy of the notice, a copy of the letter of application submitted to the Oil and Gas Authority and a copy of the ES. The notice confirms that you must also state that representations may be made to the Secretary of State by the date specified in the notice, which must be at least 30 days from the date on which the documents were served on that authority. Where e-mail contact details are provided in addition to the authorities' postal addresses, you may wish to contact the relevant authority to confirm the preferred format for transmission of the information. Once the documents have been served, confirmation of service and the date of service must be sent to the Environmental Management Team (EMT) at the address or e-mail address shown on this letter.

Regulation 9(2)(f) of the Offshore EIA Regulations requires you to publish a notice containing the information set out in that sub-paragraph, and regulation 9(2A) requires you to publish the notice in such newspapers as to be likely to come to the attention of those interested in, or affected by, the proposals. As a minimum, the advertisements must be published in a newspaper with national circulation and a newspaper with local circulation in the area adjacent to the proposed activity. The Secretary of State hereby directs that such notice shall be published in 'The Telegraph' and 'The Shetland Times', although you may also choose to publish the

notice in additional newspapers. A recommended form of the text of the public notice advertisement is annexed to this letter. Regulation 9(2A) also requires that this notice, the letter of application submitted to the Oil and Gas Authority and the ES are published on a public website.

Following publication of the notice, a copy of the letter of application submitted to the Oil and Gas Authority and the ES must be made available for public inspection between the hours of 10 a.m. and 4 p.m. on business days for a period of not less than 30 days, at an address within the United Kingdom that has regard to the whereabouts of any persons likely to interested in, or affected by, the project. Provision must also be made to supply a copy of the ES to any person requesting a copy during that 30 day period, subject to a discretionary charge of £2, as soon as reasonably practicable after receipt of the request.

Following publication of the notice, confirmation of publication (names of newspapers and dates of publication) and copies of the original newspaper advertisements (please provide hard or scanned copies of the relevant pages, where possible to include the names of the newspapers and the dates of publication) must also be sent to EMT at the address or e-mail address shown on this letter. You must also provide a link to the public website on which the items are published. If the Department receives any requests for copies of the ES subsequent to publication of the notice, it will forward you details so that you can provide the requested copies as soon as reasonably practicable following receipt of the requests.

It is your responsibility to ensure that you have fully complied with the requirements of regulation 9 of the Offshore EIA Regulations, and failure to comply with any of the additional requirements detailed in this letter could delay our consideration of the ES.

Yours sincerely

CThomson

Catherine Thomson
Environmental Management Team

THE OFFSHORE PETROLEUM PRODUCTION AND PIPE-LINES (ASSESSMENT OF ENVIRONMENTAL EFFECTS) REGULATIONS 1999 (AS AMENDED) - THE OFFSHORE EIA REGULATIONS[1]

NOTICE PURSUANT TO REGULATION 9(1)

BP Exploration Operating Company Limited

Alligin Field Development

Whereas the Secretary of State has been informed of a letter of application in respect of the above-named project, which was supported by an environmental statement submitted to the Department on 14 May 2018.

1. The Secretary of State gives notice to BP Exploration Operating Company Limited that the Secretary of State considers that those authorities listed in paragraph 2 are likely to be interested in the project by reason of either their particular environmental responsibilities or their local or regional competence. Accordingly, as required under regulation 9(2) of the Offshore EIA Regulations, BP Exploration Operating Company Limited must:

(i) serve on each of those authorities a copy of this notice, a copy of the letter of application submitted to the Oil and Gas Authority and a copy of the above-mentioned environmental statement;

(ii) give notice to those authorities stating that representations may be made to the Secretary of State by a date specified in the notice, being a date at least 30 days after the date on which the notice and the above-mentioned documents are served on the authorities;

(iii) include in the notice that representations to the Secretary of State should be made by letter or e-mail to:

Environmental Management Team
Department for Business, Energy and Industrial Strategy
Offshore Petroleum Regulator for Environment & Decommissioning
AB1 Building
Crimon Place
Aberdeen, AB10 1BJ
E-mail: EMT@beis.gov.uk

(iv) give notice to the Secretary of State of the name of every authority served the above-mentioned documents and the date of such service.

2. The designated authorities referred to in paragraph 1 are:

(a) Joint Nature Conservation Committee, Inverdee House, Baxter Street, Aberdeen, AB11 9QA. E-mail OIA@jncc.gov.uk.

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[1] The latest amendments to the Offshore EIA Regulations now incorporate modifications made by article 2 of the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010.

(b) Marine Scotland Science, Scottish Government, Marine Laboratory, 375 Victoria Road, Aberdeen AB11 9DB. E-mail MS.PON15@gov.scot.

(c) Navigation Safety Branch, Maritime and Coastguard Agency, Bay 2/25, Spring Place, 105 Commercial Road, Southampton SO15 1EG. E-mail Navigationsafety@mcga.gov.uk.

(d) Safeguarding Team, DIO Offshore Safeguarding, Building 49, Defence Infrastructure Organisation, Kingston Road, Sutton Coldfield, B75 7RL.

(e) Navigation Manager, The Northern Lighthouse Board, 84 George Street, Edinburgh, EH2 3DA.

For and on behalf of the Secretary of State

.....

Nienke Mayo
Environmental Manager
Authorised to act in that behalf
Dated 5th June 2018

Annex

PUBLICATION NOTICE

Oil / Gas Field Development / Gas Storage Project

This Annex provides a template for the public notice advertisement to be placed in the newspapers as recommended in the Department's letter of acknowledgement of the Environmental Statement submitted in support of your letter of application to the Oil and Gas Authority.

Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)

Alligin Field Development

The Secretary of State for Business, Energy and Industrial Strategy has been informed that BP Exploration Operating Company Limited has submitted a letter of application to the Oil and gas Authority in relation to the Alligin Field development project located [Insert number of miles] from the [Insert relevant UK area coastline], at [Insert Latitude and Longitude coordinates using format 00° 00' 00.00" N; 00° 00' 00.00" E/W]. In accordance with the above-mentioned Regulations, this letter of application is supported by an Environmental Statement, copies of which may be inspected between 10 am and 4 pm on business days at [Insert full postal address] until close of business on [Insert date using format DD/MM/YYYY, which must be at least 30 days after the date of the last publication of the notice]. Copies of the Environmental Statement may also be obtained from [Insert full postal address or specify 'the address detailed above'] (subject to a discretionary charge of £2), or may be accessed via the internet at [Insert relevant website address].

As it appears to the Secretary of State that the carrying out of this project could have a significant effect on the environment of another EEA State, the Secretary of State would also intend to provide the relevant State with a description of the project together with available information regarding the possible transboundary impact of the project and the nature of the Environmental Statement decision process, so that the relevant State can decide whether it would wish to participate in that process.

Interested parties have until the date specified above to make representations in relation to the submission to the Secretary of State. All representations should quote the Department's reference number ([Insert BEIS reference number]) and may be made by letter or e-mail to:

Environmental Management Team
Department for Business, Energy and Industrial Strategy
Offshore Petroleum Regulator for Environment & Decommissioning
AB1 Building
Crimon Place
Aberdeen, AB10 1BJ
Email: EMT@beis.gov.uk

Copies of representations may be made publicly available. Following receipt of all representations the Secretary of State will either agree to the grant or refusal of the consent (with or without conditions). Notice of the Secretary of State's decision will then be published in the London, Edinburgh and Belfast Gazettes, and on the GOV.UK website.

Within six weeks from the date of publication of the Secretary of State's decision to agree to the grant of consent, an approval as referred to in regulation 11 or the imposition of a relevant requirement in respect of the project as referred to in regulation 11, any person aggrieved by the decision may apply to the Court. The Court may grant an order quashing the grant of consent, the approval or the imposition of the requirement where it is satisfied the action was done in contravention of the requirement to consider the Environmental Statement, any other relevant information or any representations received from relevant authorities or other interested parties. The court may also grant such an order where the interests of the aggrieved person have been prejudiced by a failure to comply with any other requirement of the Regulations. Pending determination of the application by an aggrieved person, the court may by interim order, stay the operation of the consent, the approval or the requirement.

Notes

The period of public notice must be a minimum 30 days from the date of the last advertisement - so where notices are required in more than one newspaper the end date must be 30 days after the later or latest advertisement, and all advertisements should show the same closing date.

The Regulations permit a maximum charge of £2 for a copy of the Environmental Statement, but the text relating to the charge can be removed if you do not intend to request a fee.

PUBLICATION NOTICE

Oil / Gas Field Development / Gas Storage Project

Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)

Alligin Field Development

The Secretary of State for Business, Energy and Industrial Strategy has been informed that BP Exploration Operating Company Limited has submitted a letter of application to the Oil and gas Authority in relation to the Alligin Field development project located 87 miles from the Shetland Islands, at 60° 22' 21.039'' N; 004° 11' 31.918'' W. In accordance with the above-mentioned Regulations, this letter of application is supported by an Environmental Statement, copies of which may be inspected between 10 am and 4 pm on business days at BP Exploration Operating Company Limited, 1 Wellheads Avenue, Dyce, Aberdeen, AB21 7PB until close of business on 23/07/2018. Copies of the Environmental Statement may also be obtained from the address detailed above (subject to a discretionary charge of £2), or may be accessed via the internet at https://www.bp.com/en_gb/united-kingdom/where-we-operate/north-sea/north-sea-portfolio.html.

As it appears to the Secretary of State that the carrying out of this project could have a significant effect on the environment of another EEA State, the Secretary of State would also intend to provide the relevant State with a description of the project together with available information regarding the possible transboundary impact of the project and the nature of the Environmental Statement decision process, so that the relevant State can decide whether it would wish to participate in that process.

Interested parties have until the date specified above to make representations in relation to the submission to the Secretary of State. All representations should quote the Department's reference number (D/4211/2018) and may be made by letter or e-mail to:

Environmental Management Team
Department for Business, Energy and Industrial Strategy
Offshore Petroleum Regulator for Environment & Decommissioning
AB1 Building
Crimon Place
Aberdeen, AB10 1BJ
Email: EMT@beis.gov.uk

Copies of representations may be made publicly available. Following receipt of all representations the Secretary of State will either agree to the grant or refusal of the consent (with or without conditions). Notice of the Secretary of State's decision will then be published in the London, Edinburgh and Belfast Gazettes, and on the GOV.UK website.

Within six weeks from the date of publication of the Secretary of State's decision to agree to the grant of consent, an approval as referred to in regulation 11 or the

imposition of a relevant requirement in respect of the project as referred to in regulation 11, any person aggrieved by the decision may apply to the Court. The Court may grant an order quashing the grant of consent, the approval or the imposition of the requirement where it is satisfied the action was done in contravention of the requirement to consider the Environmental Statement, any other relevant information or any representations received from relevant authorities or other interested parties. The court may also grant such an order where the interests of the aggrieved person have been prejudiced by a failure to comply with any other requirement of the Regulations. Pending determination of the application by an aggrieved person, the court may by interim order, stay the operation of the consent, the approval or the requirement.