2019

Pickerill Alpha (A) & Bravo (B) Installations Decommissioning Programme (Removal Phase) Environmental Appraisal

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ABBREVIATIONS, ACRONYMS AND UNITS

ABBREVIATION	MEANING
ACOP	Approved Codes of Practice
ALARP	As Low As Reasonably Practicable
AWMP	Active Waste Management Plan
BEIS	Business, Energy and Industrial Strategy
BOD	Biological Oxygen Demand
CA	Comparative Assessment
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CoP	Cessation of Production
CPR	Continuous Plankton Reader
cSAC	candidate Special Area of Conservation
DEA	Danger and Exercise Area
DEFRA	Department for Environment Food and Rural Affairs
DP	Decommissioning Programme
DTI	Department of Transport and Infrastructure
EA	Environmental Appraisal
ES	Environmental Statement
ESDVs	Emergency Shutdown Valves
EU	European Union
EUNIS	European Nature Information System
FOCI	Features of Conservation Importance
GYCC	Great Yarmouth Control Centre

ABBREVIATION	MEANING
HCF	Hydrocarbon Free
HL	Heavy Lift
HOCI	Habitat of Conservation Importance
HSE	Health and Safety Executive
ICES	International Council for the Exploration of the Sea
ITOPF	International Tanker Owners Pollution Federation
JNCC	Joint Nature Conservation Committee
Km	Kilometre
Mancheplan	Anglo-French Joint Maritime Contingency Plan
MAT	Master Application Template
MCA	Marine and Coastguard Agency
MCZ	Marine Conservation Zone
MEI	Major Environmental Impact
MIS	Marine Information System
NE	Natural England
NM	Nautical Mile
NMPi	National Marine Plan Interactive
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NUI	Normally Unattended Installation
OCR	Offshore Chemical Regulations
OPEP	Oil Pollution Emergency Plan

ABBREVIATION	MEANING
OPOL	Oil Pollution Operator's Liability Fund
OPPC	Offshore Pollution Prevention Control
OPRED	Offshore Petroleum Regulator for the Environment and Decommissioning
OSDR	Offshore Safety Directive Regulator
OSEA	Offshore Energy Strategic Environmental Assessment
OSRL	Oil Spill Response Ltd.
PAH	Polycyclic Aromatic Hydrocarbon
PETS	Portal Environmental Tracking System
PLANC	Permits, Licences, Approvals, Notifications and Consents
POMS	PUK Operating Management System
PUK	Perenco UK Limited
PWA	Pipeline Works Authorisation
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SAC	Special Area of Conservation
SAHFOS	Sir Alister Hardy Foundation for Ocean Science
SAT	Subsidiary Application Template
SBP	Sub Bottom Profiler
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCI	Site of Community Importance
SEMS	Safety and Environmental Management System

ABBREVIATION	MEANING
SMRU	Sea Mammal Research Unit
SNS	Southern North Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Area
TGT	Theddlethorpe Gas Terminal
THC	Total hydrocarbon concentrations
TOC	Total Organic Carbon
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association

NON-TECHNICAL SUMMARY

This summary outlines the findings of the Environmental Appraisal (EA) conducted by Perenco UK Limited (PUK) for the proposed decommissioning of the Pickerill Alpha (A) and Bravo (B) installations (Removal Phase) located in the southern North Sea Blocks 48/11b and 44/11a, respectively (Figure i).

This assessment considers the potential for, and the significance of, environmental and societal impacts resulting from the installations during the proposed decommissioning activities.

It is proposed that the Pickerill A and B installations be removed using a heavy lift (HL) offshore decommissioning vessel. This EA assesses the worst case environmental option which involves the following activities at the Decommissioning Programme (DP) location;

- Removal of topsides infrastructure (topsides, jacket and footings) at each installation using a large HL vessel;
- Removal of topsides and jacket executed in independent vessel deployments (i.e. four deployments in total – two per installation);
- Cutting of jacket piles using high pressure water abrasion and removal to approximately 3 m below the seabed;
- Excavation of area around each jacket pile using a remotely operated vehicle (ROV);
- HL vessel supported on the seabed by six spud cans and four positioning anchors; and
- Stabilisation of HL vessel using approximately 6,000 te of contingency rock material.

Any future updates to the worst case removal phase process described above will seek to make environmental improvements in order to reduce the magnitude of the environmental impact of operations. For example, in the future, it may become possible to conduct the removal of topsides and jackets at both the Pickerill A and B installations in a single vessel sailing, reducing the requirement for rock stabilisation material, as well as decreasing seabed impacts. In addition, although this EA relates to environmental effects from activities at the DP location only, a reduction in overall environmental emissions as a result of reduced vessel transit is in line with Perenco's Environmental Management System (EMS).

The EA concludes that the significance of planned impacts, following the adoption of control and mitigation measures, would be 'low'. The appraisal also assessed the significance of accidental events, concluding that the significance of all risks was low, with the exception of the risk associated with an accidental large hydrocarbon release as 'medium'. However, the existing control and mitigation measures including the Oil Pollution Emergency Plan (OPEP) (PUK, 2018a) and marine procedures manage this risk to a level that is 'as low as reasonably practicable'.

This report supports the Pickerill A and B Installations DP (PUK, 2018b).

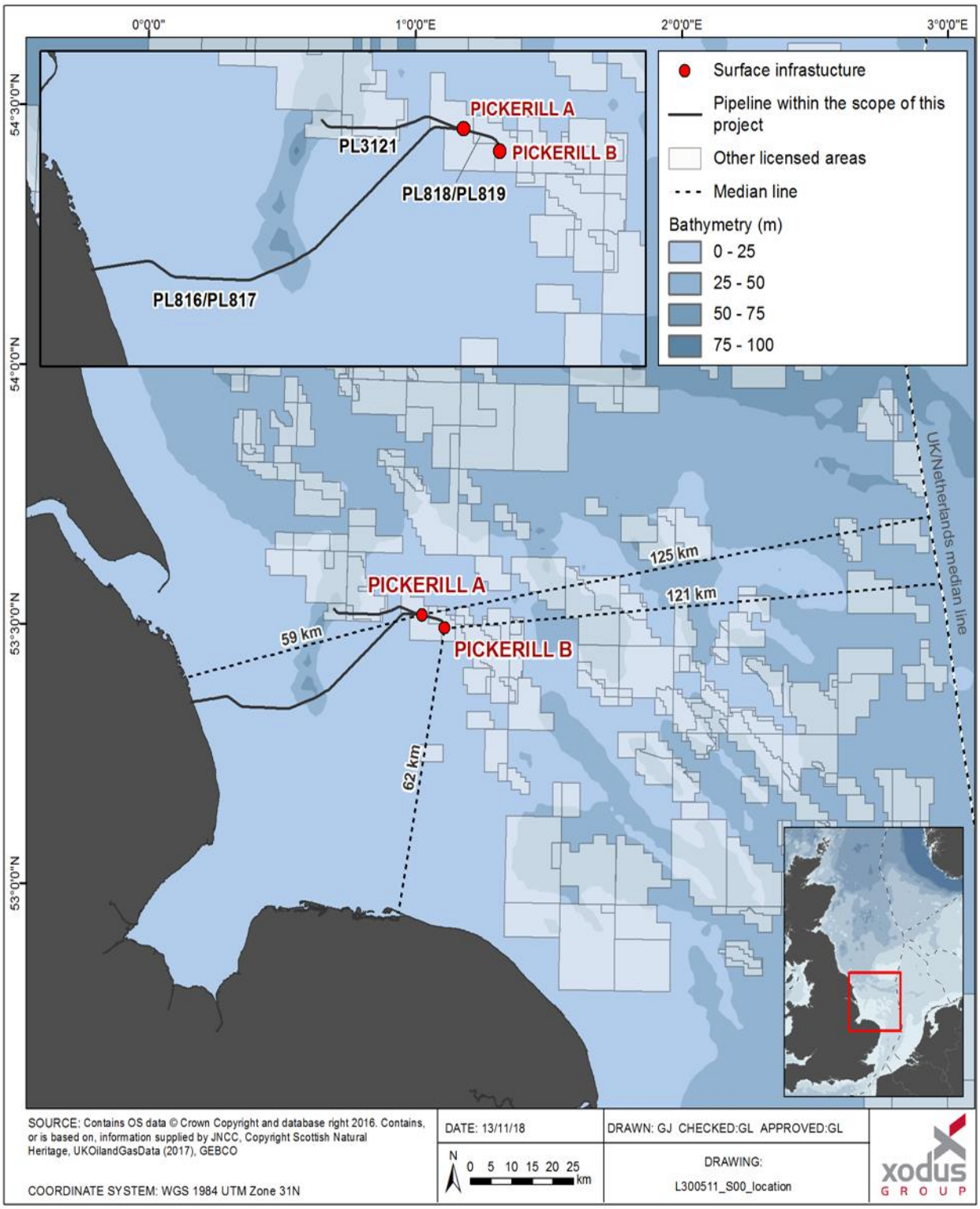

Figure i: Location of Pickerill A & B field infrastructure

Background to the Project

Pickerill gas field is located 65km offshore from the Theddlethorpe Gas Terminal (TGT). The field was discovered in 1984 and gas development commenced in 1992. The field was unitised in 1989 to resolve the ownership issues across the four blocks: 48/11a, 48/11b, 48/12c and 48/17f (within licences P460, P37, P461 and P463). In 2003, the field operatorship was handed over from Britoil Public Limited Company (BP) to Perenco Gas (UK) Ltd (PUK), 94.78%. The remaining field equity partner is Marubeni Oil and Gas (U.K.) Limited (5.22%).

The field consists of two normally unmanned installations (NUI), Pickerill Alpha (A) in the west and Pickerill Bravo (B) in the east (Figure i). Gas from Pickerill B flows via a 16'' pipeline to Pickerill A, and once comingled, the gas flows to the TGT via a 24'' pipeline where the gas is processed and compressed for input to the gas grid. The Pickerill field is part of PUK's Central Hub operations and is proximal to the Lancelot Area Pipeline System.

Third party gas (Neptune Energy) flowed from the Juliet field since the end of 2013 and has now ceased production. The gas from the Juliet wells 47/14b-GW and 47/14b-GE, was produced via a 12" pipeline to Pickerill A, where it was commingled with Pickerill gas for onward transportation to the TGT (see Figure i).

For the purpose of preparing the DP for the Pickerill field, Perenco has sub-divided activities into two groups; the Installations DP, which covers the NUI platforms (jacket and topsides) and the Pipelines DP, covering the infield and export pipelines (PL818 and PL819; PL816 and PL817, respectively). The scope of this EA report will cover the Removal Phase of the Pickerill A and B installations aspects DP only (Figure ii). PUK have reached an agreement with OPRED that the aspects associated with the pipeline decommissioning will be covered at a later date, in a separate EA report.

Since cessation of production (CoP), Phases 2 (Warm Phase) is ongoing, and Phase 3 (Cold Phase) will commence once a Hydrocarbon Free (HCF) state has been achieved. A Master Application Template (MAT) and the supporting Subsidiary Application Templates (SATs) have been submitted in support of the decommissioning works carried out to date. An assessment of any associated environmental impacts from Phases 2 and 3 has previously been made and assessed during the permit application process, and as such are not considered in this EA.

A Permits, Licences, Approvals, Notifications and Consents (PLANC) register is maintained to track submissions and approvals relating to the proposed decommissioning of the Pickerill A and B installations. The relevant permits required by legislation are covered in the PUK Standard - Environmental Regulations and Permits Compliance, PUK-SMS-COM-005.

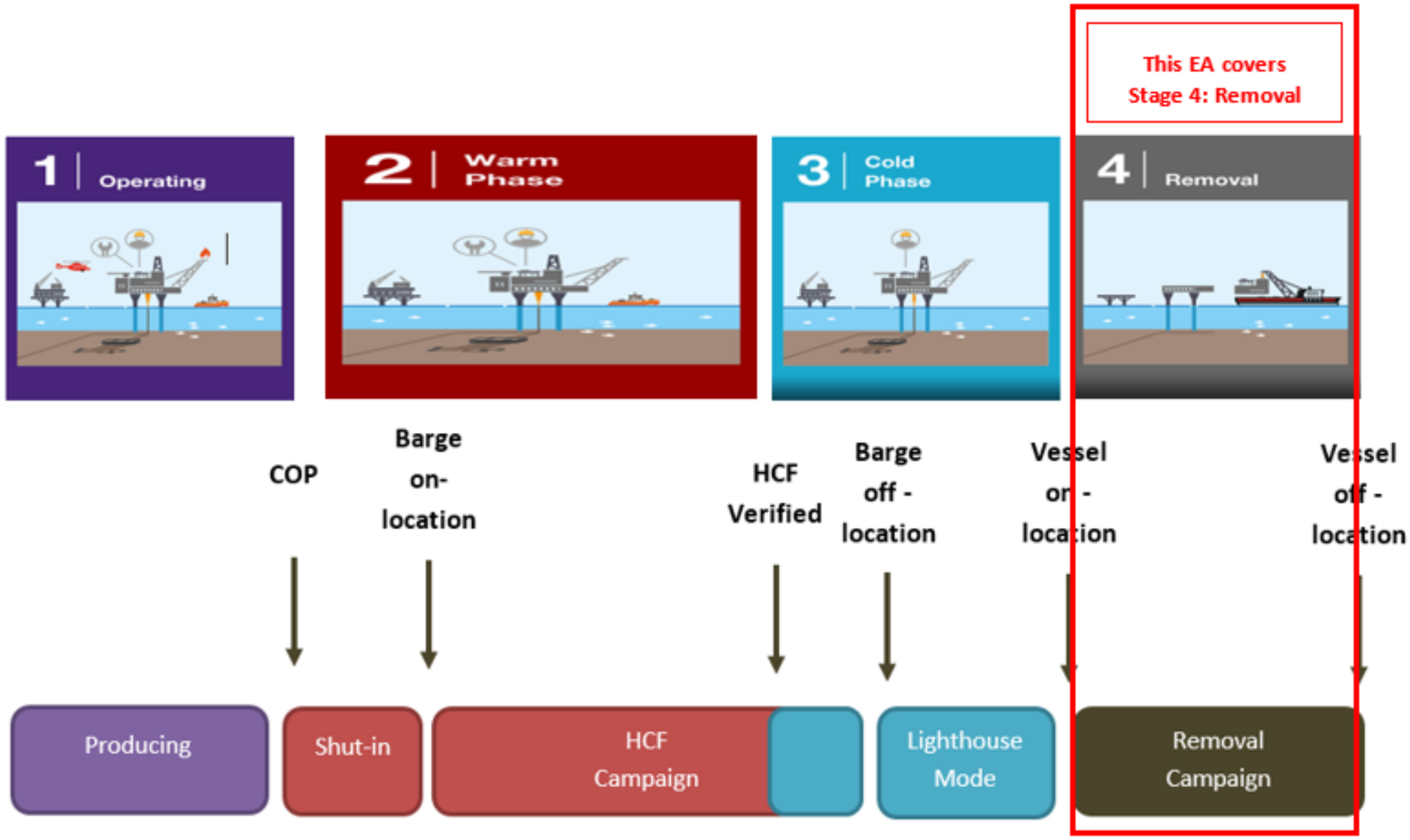

Figure ii: Phase of PUK Pickerill Decommissioning Covered by this Environmental Appraisal

Impact Assessment

As required by the Petroleum Act, 1998 and OSPAR Decision 98/3, PUK have undertaken an environmental and societal risk assessment, to identify and rank the potential hazards resulting from the Pickerill installations decommissioning activities. The EA process presented in this report considers the impact of the planned activities associated with the dismantlement and removal of the Pickerill A and B installations. Impact was determined via an Aspects / Impacts Review which considered each of the planned activities and the characteristics of the receiving environment to categorise the significance of the interaction as either 'low', 'medium' or 'high'. Following this assessment, those activities that could potentially present an impact to the environment other than 'low' were assessed further, and appropriate control and mitigation measures identified to reduce the impact to a level that is 'as low as reasonably practicable'.

The risks presented by accidental events were also considered in terms of their likelihood and their impact on the receiving environment. This provided a risk level of 'low', 'medium' or 'high'. Impacts that were perceived to be 'low' were screened out of further assessment.

The risk assessment concluded that, post-mitigation, there is one 'high' risk decommissioning activity and several 'medium' risks. These risks are:

- Seabed impacts;
- Accidental Events; and
- Risk to other users of the sea.

Following further assessment and implementation of additional control and mitigation measures the level of impact from these aspects was reduced to 'low' and therefore not significant. These control and mitigation measures are an essential component of the PUK decommissioning project Environmental Management Plan.

These aspects, as well as aspects which were screen out from further assessment, are fully assessed in Section 5.

Summary of Assessment

The following sections summaries the key conclusions for the aspects which were carried forward for full assessment in the EA.

Seabed Impacts

The contract for the topsides and jacket removal is yet to be awarded and it is possible that a jack-up HL vessel could be utilised. The removal approach involves deployment of a jack-up HL vessel to undertake the removal of the topsides and jackets at each of the Pickerill A and B installations. As a worst case scenario, independent vessel deployments for topsides and jacket removal at each installation have been assessed (i.e. four deployments in total – two per installation). This EA has therefore considered the seabed impacts attributed to four deployments of jack-up legs and rock stabilisation material, as well as anchors to aid vessel positioning prior to the vessel jacking up.

The placement of such a vessel would impact a maximum total combined seabed area of 0.042 km^2. Recovery of the seabed and associated fauna following the removal of a jack-up HL vessel is

expected to be rapid (<5 years). A consideration of a worst-case contingency for the deposit of stabilising rock to support of the jack-up legs has been assessed, the associated seabed impact would be approximately 0.032 km^2. All anchors would be removed from the seabed following decommissioning operations and recovery of the seabed and associated fauna is expected to be rapid (<5 years).

Should this contingency stabilisation material be required for locating the jack-up HL vessel safely, there may be potential to impact the seabed sediment through the long-term, localised modification of the seabed over an estimated area of approximately 0.032 km^2 and the short-term physical disturbance caused by suspension of material into the water column during the deposition activities. This impact will be mitigated by controlled placement of the rock material to minimise the seabed footprint. However, it should be noted that there are patches of cobbles in the wider area so the small addition of a hard substrate would not be significantly different than the natural substrates present.

The rate of colonisation of new material such as rock in the installation area is difficult to predict, but as organisms associated with hard substrates will be naturally present in the area and water column, the mattresses and areas of rock-placement provide a relatively small additional habitat for epibenthic rock-dwelling organisms. Overall, the removal phase of the Pickerill facilities decommissioning is expected to impact a maximum area of seabed of 0.042 km^2.

The cutting and lifting of the Pickerill jackets will create a temporary, short-term disturbance to the seabed sediments, over an estimated area of 0.0012 km^2. This disturbance will be relatively small and occur due to the seabed excavation (where required), the ROV manoeuvring, and the use of cutting equipment. These activities will be controlled to minimise vessel movements, excavation activity and to ensure the accurate placement of cutting and lifting equipment, thereby minimising the risk of sediment disturbance.

Accidental Events

Hydrocarbon Release

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

- A worst-case scenario (complete loss of HL vessel diesel fuel inventory, equating to the 450m^3 of condensate modelled in the Pickerill Field OPEP) release at the Pickerill installations would result in spilt diesel fuel potentially reaching/travelling through designated protected sites;
- Diesel is a light fuel which evaporates and disperses rapidly in the marine environment.
- The probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area; and
- The approved OPEP response will provide the direction and strategies required to effectively manage the spill in the case of an accidental event.

Other Users

Due to the temporary nature of the vessel operations and that the majority of activities will be undertaken within the current 500 m safety exclusion zone, impacts on other users of the sea are considered to be not significant.

Control and Mitigation Measures

PUK will adopt industry routine environmental management measures when carrying out the decommissioning activities at the Pickerill facilities. These include those presented in Table ii.

Table ii: Control and mitigation measures

Control and mitigation measures
General and Existing
• Lessons learnt from previous decommissioning scopes will be reviewed and implemented as appropriate; • Vessels will be managed in accordance with PUK's existing marine procedures; • The vessels' work programme will be optimised to minimise vessel use; • The OPEP is one of the controls included in a comprehensive management and operational control plan developed to minimise the likelihood of large hydrocarbon releases and to mitigate their impacts should they occur; • All vessels undertaking decommissioning activities will have an approved Shipboard Oil Pollution Emergency Plan (SOPEP) for use outside of the installation 500 m zones; • Existing processes will be used for contractor management to assure and manage environmental and social impacts and risks; • PUK's management of change process will be followed should changes of scope be required; • All mitigation measures will be incorporated into contractual documents of subcontractors; and • Vessel activities will be of relatively short duration.
Seabed Disturbance
• All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised; • Where possible, the decommissioning activities will be undertaken outside the spawning periods of the potentially affected species; • A debris survey will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from oil and gas activities will be recovered from the seabed where required after consultation with OPRED; and • The area that requires an overtrawl assessment will be optimised through discussion with the relevant fishing organisations and regulators.

Control and mitigation measures
Large-scale Releases to the Sea
• Any release will be managed under the existing OPEP; • All vessel activities will be planned, managed and implemented in such a way that vessel durations in the field are minimised; • PUK's existing marine procedures will be followed to minimise risk of hydrocarbon releases; • Risk of a complete inventory loss from a vessel is very low given that the majority of vessels have compartmentalised or distributed fuel tanks, making complete containment loss highly unlikely.
Risk to other users
• Any potential snagging hazards identified will be discussed with regulators and remediated where required; • All offshore decommissioning activities will be notified to stakeholders prior to vessels undertaking these activities. Notifications will be sent out via kingfisher navigation bulletins and direct notification with the fishing industry; • A 500 m safety exclusion zone will remain in operation during the decommissioning activities limiting exposure of other sea users to the presence of these decommissioning vessels; and • All decommissioning vessels will operate a manned bridge policy and have active AIS positioning in operation so other vessels can identify the decommissioning vessels via radar.

1 INTRODUCTION

1.1 Overview of the Infrastructure

The Pickerill gas field is located 65km offshore from the Theddlethorpe Gas Terminal (TGT). The field was discovered in 1984 and gas development commenced in 1992. The field was unitised in 1989 to resolve the ownership issues across the four blocks: 48/11a, 48/11b, 48/12c and 48/17f (within licences P460, P37, P461 and P463). In 2003, the field operatorship was handed over from BP to Perenco Gas (UK) Ltd (PUK), 94.78%. The remaining field equity partner is Marubeni Oil and Gas (U.K.) Limited (5.22%).

The field consists of two Normally Unmanned Installations (NUI), Pickerill Alpha (A) in the west and Pickerill Bravo (B) in the east (Figure 1.1). Gas from Pickerill B flows via a 16'' pipeline to Pickerill A, and once comingled, the gas flows to the TGT via a 24'' pipeline where the gas is processed and compressed for input to the gas grid. The Pickerill field is part of PUK's Central Hub operations and is proximal to the Lancelot Area Pipeline System.

Third party gas (Neptune E&P UK Ltd) flowed from the Juliet field since the end of 2013 and has now ceased production. The gas from the Juliet wells 47/14b-GW and 47/14b-GE, was produced via a 12" pipeline to Pickerill A, where it was commingled with Pickerill gas for onward transportation to the TGT (Figure 1.1).

For the purpose of preparing the Decommissioning Programme (DP) for the Pickerill field, PUK has sub-divided this into two groups; the Installations DP, which covers the NUI platforms (jacket and topsides) and the Pipelines DP, covering the infield and export pipelines (PL818 and PL819; PL816 and PL817, respectively) and associated pipeline stabilisation features. The scope of this EA report will cover the Installation aspects DP (Removal Phase) only. The pipeline decommissioning aspects will be covered in a separate EA report.

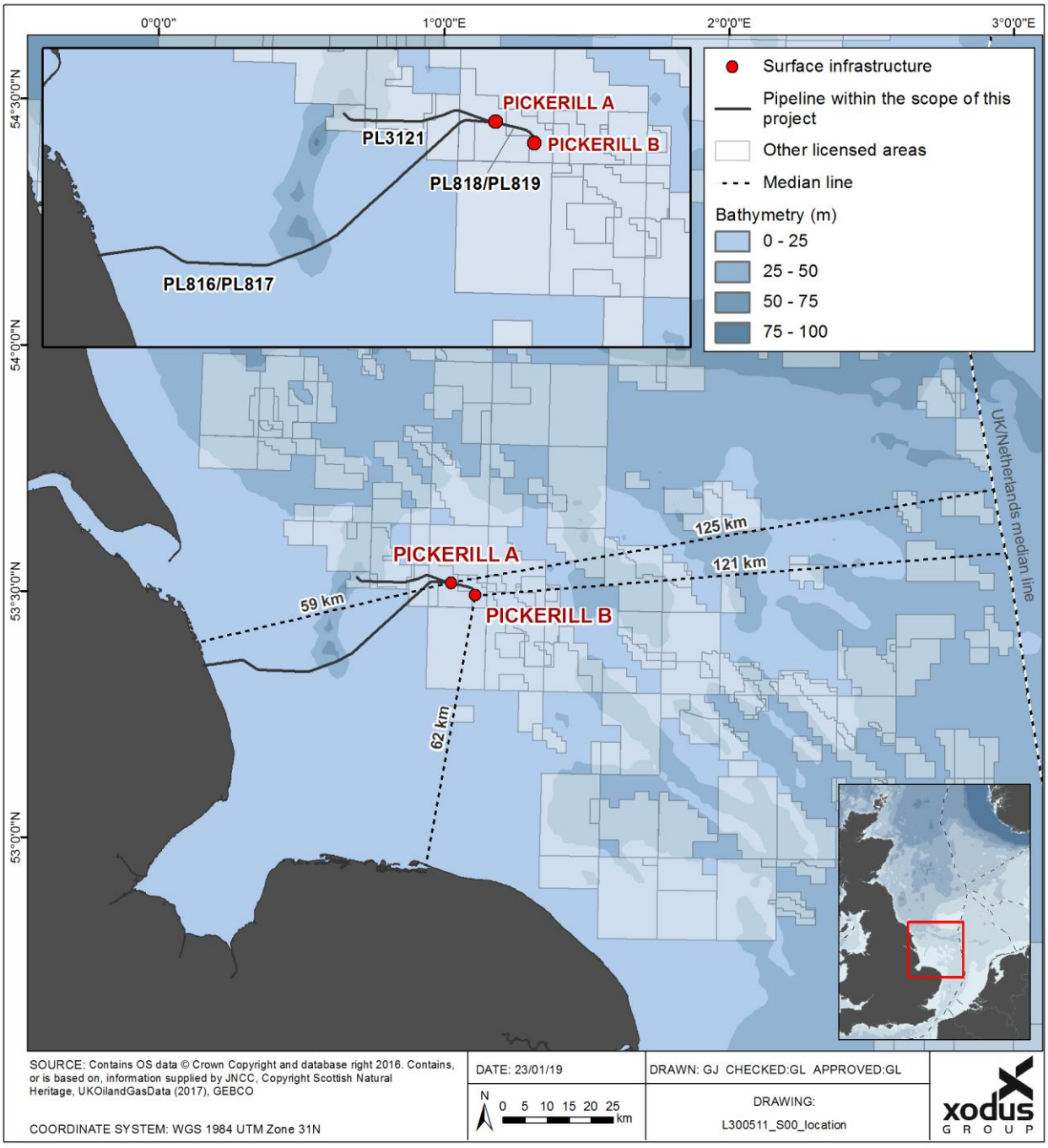

Figure 1.1: Location of Pickerill A & B field infrastructure

1.2 Purpose of Document

This EA Report sets out to describe, in a proportionate manner, the potential environmental impacts of the proposed activities associated with Pickerill A and B installations decommissioning and to demonstrate the extent to which these will be mitigated and controlled to an acceptable level. The key components and structure of this report are laid out as follows:

- Introduction to the decommissioning project for the Pickerill A and B installations, the regulatory context and guidance for undertaking a decommissioning EA, plus a description of the EA Report scope and structure (Section 1);
- A summary of the stakeholder engagement process and activities carried out by PUK to date (Section 2);
- An outline of the options considered for decommissioning and the decision-making process undergone by PUK to arrive at the selected decommissioning strategy (Section 3);
- A description of the proposed decommissioning activities (Section 3);
- A summary of the baseline sensitivities relevant to the activities taking place and the assessments that support this EA (Section 4);
- A summary of the project Environmental Issues Identification process and findings Section 5);
- An outline of the EA method used, a review of the potential impacts from the proposed decommissioning activities and justification for scoping potential impacts in or out of assessment in this EA Report (Section 6);
- Assessment of key potential impacts (Section 6); and
- Conclusions (Section 7).

Please note that this document will outline the environmental impact assessment covering the Pickerill A and B installation decommissioning only. A separate EA report which covers the impacts associated with the pipeline decommissioning scope will be issued in due course.

1.3 Regulatory Context

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998, as amended by the Energy Act 2008. Decommissioning is also regulated under the Marine and Coastal Act 2009 and Marine (Scotland) Act 2010. The UK's international obligations on decommissioning are primarily governed by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (the OSPAR Convention).

The responsibility for ensuring compliance with the Petroleum Act 1998 rests with Department of Business, Energy and Industrial Strategy (BEIS), formerly the Department for Energy and Climate Change (DECC) and is managed through its regulatory body the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). OPRED is also the Competent Authority on decommissioning in the UK for OSPAR purposes and under the Marine Acts.

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

In the context of marine planning and being located in the English offshore waters of the SNS, the Pickerill field falls within the area of the East Marine Plans (DEFRA, 2014). The East Marine Plan is

currently under development and includes the East Inshore and the North East Offshore marine plan areas. These plans are being developed to help ensure sustainable development of the UK marine area; until the marine plan is adopted, the Marine Policy Statement (HM Government, 2011) should be used when making decisions and proposals. Although the Statement does not specifically address decommissioning of oil and gas facilities, the challenges and opportunities that such activities can bring are noted. The broad aims and policies outlined in the Marine Policy Statement have therefore been considered in this EA Report.

The primary guidance for offshore decommissioning from the regulator (BEIS, 2018), details the need for an EA to be submitted in support of the DP. The guidance sets out a framework for the required environmental inputs and deliverables throughout the approval process. It now describes a proportionate EA process that culminates in a streamlined EA report rather than a lengthy Environmental Statement. The OPRED guidance is supported by Decom North Sea's (Decom North Sea, 2017) Environmental Appraisal Guidelines for Offshore Oil and Gas Decommissioning, which provide further definition on the requirements of the EA report.

2 STAKEHOLDER CONSULTATION

The consultation for the Pickerill installations decommissioning has been largely based on sharing project expectations, approach and specific considerations with key stakeholders including OPRED, JNCC and the NFFO. This is summarised in Table 4.1, and full details of the consultations to date are provided in Section 5 of the DP.

Table 2.1: Stakeholder issues and concerns raised through consultation

Issues/ concerns	Outline response and EA section where addressed
Pickerill Project specific comments	
OPRED	
OPRED note that each EA should relate to the specific decommissioning activities and as the installation decommissioning removal activity will be different to the pipeline decommissioning activity, two separate, proportionate EA's should be submitted along with the respective DP's. Each of the EA's should consider cumulative environmental effects, including from the 'other' DP as well as other projects.	The scope of this EA report will cover the Installation aspects DP only, with a separate EA report covering the pipeline aspects, to follow at a later date. EA Section 2.
The pipeline lengths listed in the Scoping Letter reflect those provided in the PWAV application (PA/2757) however the lengths provided may need to be amended.	A separate EA report covering the pipeline aspects will follow at a later date and incorporate the comments provided by OPRED.
OPRED advise that pipeline burial is now a decommissioning solution and plastics (i.e. polypropylene) should be removed and not left in the water column.	A separate EA report covering the pipeline aspects will follow at a later date and incorporate the comments provided by OPRED.
OPRED note that the environmental sensitivities seem to only relate to the installations and not the pipeline system, therefore the scoping letter can only be considered in relation to the installations DP and EA.	The scope of this EA report will cover the Installation aspects DP only.
OPRED advised that regarding the overtrawl survey, OPRED's preference for debris removal is the use of a ROV, guided by the results of the geophysical surveys. OPRED accepts however, that there may be instances where the location, nature and quantity of debris dictate alternative requirements such as debris recovery using chain mat nets, these should be discussed with OPRED.	An overtrawl survey and ongoing monitoring plan will be agreed with OPRED, however it is expected to be minimal for this scope as the installations will be fully removed EA Section 7.1.8.
OPRED note that Section 12, "Environmental Considerations", of the OPRED Decommissioning Guidance Notes has been updated and provided the relevant URL.	These updated OPRED Guidance Notes have been considered in this EA.
OPRED recommend that EA scoping is discussed in a meeting once the likely decommissioning activities are clearer	Perenco intend to submit a draft DP alongside this EA for statutory and public consultation, and to obtain approval of the DP from OPRED, prior to initiating decommissioning work. EA Section 2.3.

Issues/ concerns	Outline response and EA section where addressed
JNCC and NE (joint response from both consultees)	
JNCC and NE believe a more detailed methodology will be required before they can comment in detail regarding these options.	An in-depth methodology of the environmental impact assessment is given in this report.
Where any pipeline is buried, and a decision is taken not to remove it, JNCC and NE advise that there needs to be evidence for, and confidence in, its long-term burial and that remedial action will not be required to rebury or protect the pipeline in the future that may impact on the marine environment, particularly within Marine Protected Areas. A review of previous decommissioning work is suggested, to understand the optimal depth of burial to ensure permanent burial if decommissioning *in situ* is proposed, taking into account differences in sediment movements for different sites. It is also suggested that mitigation measures should be agreed in the event of pipelines decommissioned *in situ* becoming exposed, should this become the preferred option.	Pipeline decommissioning works will be covered in a standalone DP.
NE requests clarity as to how close to shore decommissioning of the pipeline will take place? NE also request that if onshore decommissioning is expected to take place, any relevant onshore designated sites be considered in any future assessments.	Pipeline decommissioning works will be covered in a standalone DP.
Although both the Pickerill A & B platforms lie outside any Marine Protected Areas, the JNCC requests clarification on any other infrastructure being considered for decommissioning within MPAs, i.e. pipelines. Details should be included on its length and current status (i.e. surface laid/buried/protection).	Pipeline decommissioning works will be covered in a standalone DP.
JNCC and NE would like to highlight to the operator the importance of consideration of all relevant designated sites, including the Southern North Sea (SNS) Site of Community Importance (SCI) and candidate Special Area of Conservation (cSAC). It is requested that this site is included in any future impact assessment relating to this decommissioning operation, alone or in combination.	Full consideration of relevant designated sites has been made, refer to Section 5.3 – Conservation Areas
JNCC advise that the Seabird Oil Sensitivity Index (SOSI) be used as a key part of the accidental oil spill assessment but that it should not form a key part of the seabird baseline. JNCC advise that Kober *et al*., 2010 be considered along with other data sources in the seabird baseline information.	Full consideration of relevant accidental events has been made, refer to Section 7.2 – Accidental Events Full consideration of relevant seabirds has been made, refer to Section 5.3.4 - Seabirds
NE has concerns over toxicological risks to the Inner Dowsing, Race Bank and North Ridge SAC due to the long-term degradation of pipelines, if left *in situ*, and release of residual contaminants and the potential impacts to benthic ecology, in particular to any *Sabellaria spinulosa* with the potential to form reef.	Pipeline decommissioning works will be covered in a standalone DP.
NE highlighted concerns about the potential release of contaminants into the site due to (a) Naturally Occurring Radioactive Material (NORM) scale deposits possibly present on the interior surface of all the pipework	Pipeline decommissioning works will be covered in a standalone DP.

Issues/ concerns	Outline response and EA section where addressed
to be decommissioned; (b) residual contaminants from pipeline construction materials including coal, tar, plastic, steel and concrete; and (c) entrained hydrocarbons being discharged into the water column. Suitable precautions and mitigation should be in place to ensure no significant effect from these contaminants.	
JNCC encourage the operator to continue working to minimise the amount of hard substrate material used. JNCC note that the long-term effect of the introduction of substratum into naturally sandy or muddy sea beds is not fully understood at present and should be carefully considered. If stabilisation material cannot be avoided i.e. MODU stabilisation/spans in pipelines, JNCC welcome detailed commentary on stabilisation operations to allow further understanding of their actual nature conservation impact. This would include: • Location of dump sites • Size / grade of rock to be used • Tonnage / volume to be used • Contingency tonnage / volume to be used • Method of delivery to the seabed • Footprint of rock • Assessment of the impact • Expected fate of deposit after end of production, i.e. will it be left *in situ* or recovered	The Pickerill installations, covered here, will be fully removed. If required for MODU stabilisation or other emergency situation, an application for consent will be made as appropriate As the pipeline decommissioning works will be covered in a standalone DP and supporting EA report, any hard substrate required for these purposes is out-with the scope of this assessment however PUK will consider this feedback during the pipeline decommissioning EA report.
JNCC asked for clarification regarding whether any cuttings piles exist at the Pickerill A and B platform, and if so, what impacts, if any, the proposed decommissioning operations may have on these cuttings piles and assess their impacts accordingly.	The results of a pre-decommissioning survey for Pickerill A will be received in due course. No cuttings were observed during a recent pre-decommissioning survey for Pickerill B. Cuttings discussed in Section 7.1.3.
JNCC highlight the need for consideration to the impacts of the well decommissioning activities on the seabed; specifically, the spudding, anchoring and potential stabilisation of jack-up or semi-submersible drilling rigs.	A Master Application Template (MAT) and the supporting Subsidiary Application Templates (SAT) have been submitted in support of well decommissioning works. Environmental impacts for current and future well decommissioning activities as such are not considered in this EA. An assessment of any associated environmental impacts on the seabed for future operations during the removal phase, are included within this EA.
JNCC advise that the following is necessary for inclusion: • Survey data to at least include the area of proposed operations, unless justification is provided as to why wider area surveys are sufficiently representative of conditions at the site of proposed operations.	A seabed survey was carried out at Pickerill B and the data has been presented in Section 4. Although surveys are being completed at Pickerill A the results of these will not be available for this submission but will be included in future submissions, if

Issues/ concerns	Outline response and EA section where addressed
• Survey data should provide adequate evidence that habitats and species of nature conservation concern (including Annex I habitats) are or are not present. • To include a diagram indicating the surveyed area in the context of the proposed activity and to identify any sample points or the location of photographic evidence. Data provided should also include high resolution acoustic data, video and/ or still images.	required, once the survey reports are available. Agreement has been reached with OPRED to use the Pickerill B survey data and other existing data sources (including nearby studies) to provide a representative description of the seabed. This is due to the close proximity of the platforms to each other and the limited area of perceived impact form the proposed decommissioning activities (i.e. impacts would be concentrated within 500 m of the installations).
JNCC highlight that, in line with JNCC guidelines 2017, any surveys involving the use of airguns or sub-bottom profiling equipment will require marine mammal mitigation. JNCC highlight that updated injury thresholds for marine mammals were published in 2018 (NOAA, 2018), superseding the Southall *et al*., 2007 thresholds and should be used when assessing the risk of auditory injury to marine mammals.	Pre-decommissioning surveys require the use of sub-bottom profiling equipment. Any potential impacts from these surveys have been assessed as part of the application process and approval for the associated marine licences issued by OPRED. No behavioural or injury impacts in response to elevated noise levels resulting from vessels/ DP is expected.
JNCC advise that further evidence should be provided that the levels of noise resulting from cutting activities will not disturb marine mammals, with appropriate monitoring if required.	Noise associated with the cutting operations (jacket, conductors and pipework) fall below NOAA thresholds for injury and would be below the noise generated by the vessels in the area. The noise from vessels is not deemed to be a significant impact due to the short duration and recognising that the marine mammals are acclimatised to the heavy vessel traffic in the area.
JNCC welcomes any future engagement relating to the Comparative Assessment workshop.	Full removal is the only option considered for the Pickerill Installations DP. A CA approach to the Pipeline DP project option consideration will be detailed in a separate EA. Perenco welcomes JNCC's involvement in the Pipeline CA process.
Lessons learned from recent projects	
OPRED	
While it is understood that the pipelines will be the subject of a separate DP; the DP and EA should make reference to the flushing and disconnection of the pipelines including a brief description of how and at what relative stage this work is to take place	The connecting pipelines will undergo flooding and flushing in accordance with Regulation 14 of the Pipeline Safety Regulations 1996. This will be conducted during the HCF portion of the DP. A brief description is provided in EA Section 4.

3 DECOMMISSIONING ACTIVITIES AND PARAMETERS

3.1 Description of Infrastructure Being Decommissioned

The Pickerill installations consists of two platforms in the Pickerill field; a gathering platform, 'Pickerill A', at the west end of the field and a satellite platform, 'Pickerill B', at the east end. Both platforms are normally unattended installations (NUIs). The platforms have similar specifications, with both topsides mounted on 4-legged jackets (see Figure 3.1 and Figure 3.2). All risers and emergency shutdown valves (ESDVs) are located on the platforms. The Pickerill platforms are normally monitored and controlled remotely from the Great Yarmouth Control Centre (GYCC) through a line-of-sight microwave radio system and landlines.

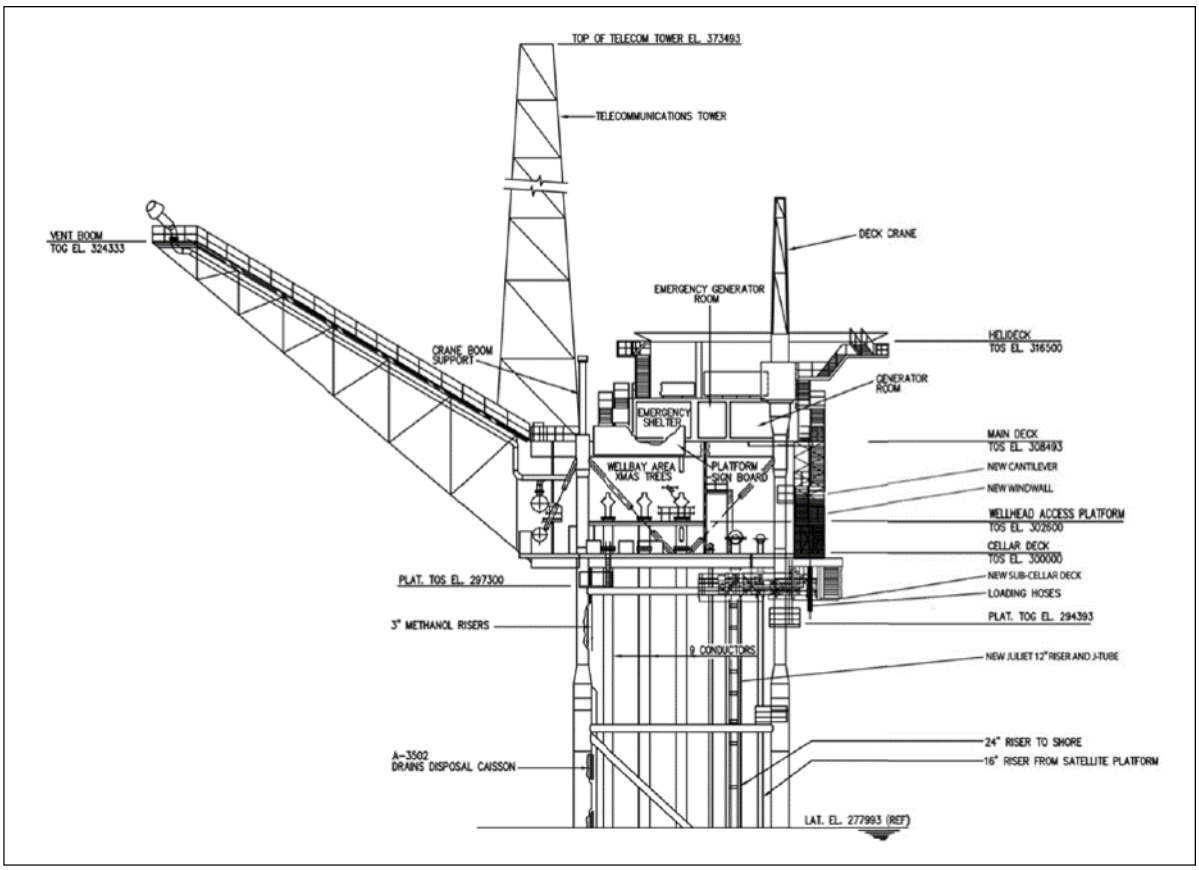

Figure 3.1: Pickerill A schematic

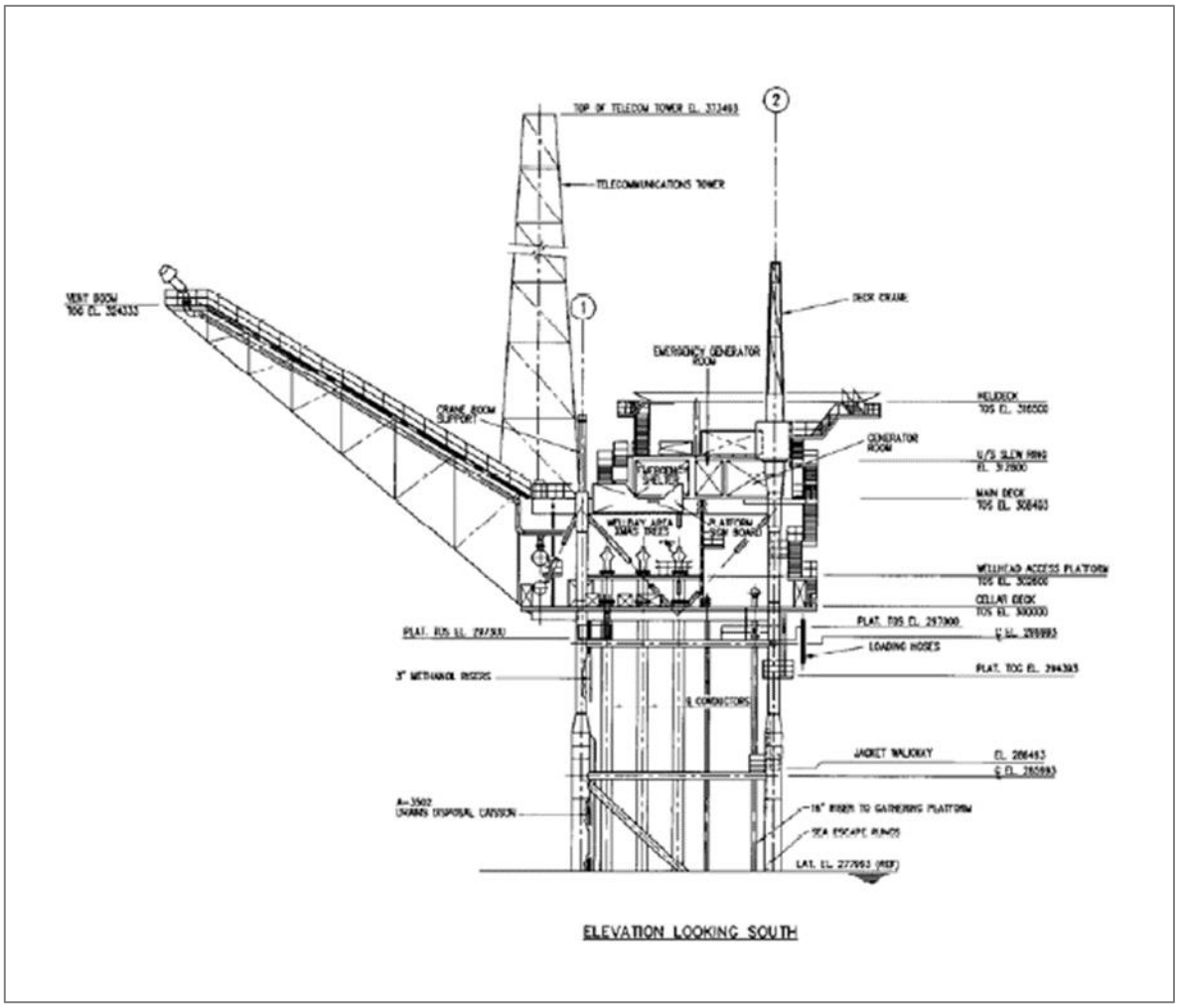

Figure 3.2: Pickerill B schematic

The location coordinates associated with each of the platforms are given in Table 3.1.

Table 3.1: Pickerill A and B locations

Platform	Facility Type	Geographical Location WGS 84
Pickerill A	Fixed steel jacket	53° 32' 59.81" N 01° 04' 37.99" E
Pickerill B	Fixed steel jacket	53° 31' 29.78" N 01° 09' 38.40" E

3.2 Consideration of Alternatives and Selected Option

Perenco have considered the various decommissioning options associated with the Pickerill A and B installations, the resulting decommissioning approaches for each of the aspects associated with the Pickerill A and B installations are outlined in Table 3.2 below.

Table 3.2: Summary of selected decommissioning options

Summary of Decommissioning Programme		
Selected Option	Reason for Selection	Proposed Decommissioning Solution
1. Topsides		
Complete removal, re-use or disposal	Complies with OSPAR requirements and maximises recycling of materials.	Decontaminate and remove the topside and jacket by HL vessel. Re-use followed by recycle and other recovery routes before disposal as a final option is considered.
2. Jacket		
Complete removal, re-use or disposal	Leaves clean seabed, removes a potential obstruction to fishing operations and maximises recycling of materials, to comply with OSPAR requirements.	Jacket legs will be removed and dismantled at an onshore location. Recycle and other recovery methods will be the prioritised disposal options. Piles will be severed at least -3.0m below the seabed. If any practical difficulties are encountered Perenco will consult OPRED.
3. Subsea Installations		
None		
4. Pipelines, Flowlines & Umbilical		
Not covered in this Decommissioning Programme		
5. Wells		
Not covered in this Decommissioning Programme		
6. Drill Cuttings		
No clear evidence of cuttings piles at the Pickerill A and B locations. If cuttings are present, they are not considered to be significant therefore no remediation is proposed.		
7. Interdependences		
Whole of jacket can be removed. Small amounts of sediment and cuttings may have to be displaced to allow pile cutting.		

As outlined in Table 3.2, 'full removal' is the selected decommissioning strategy for the Pickerill A and B topsides and jackets. These recommendations are in line with UK regulatory and OSPAR requirements and since both jackets are below the derogation threshold of 10,000 tonnes, no alternatives to full removal were considered as viable options.

3.3 Description of Decommissioning Activities

PUK are preparing a methodology to recover these installations (topsides, jacket and footings) to shore for subsequent end of life management. This is likely to involve the transfer of the installations to shore via a Jack-up HL vessel for dismantlement, recycling or reuse.

PUK are undertaking a series of preparatory works associated with cleaning and engineering down the facilities in preparation for decommissioning along with the decommissioning of the well system, ensuring the facilities are classed as hydrocarbon free prior to decommissioning activities taking place. These activities fall outside of the scope of this assessment and will be considered as part of the permitting and consenting process; however, a brief description is provided below.

- Pre-decommissioning surveys – Environmental surveys are undertaken prior to commencement of the decommissioning programme.
- Hydrocarbon Free - Activities undertaken to render the installations hydrocarbon free, including:
    - Platform wells decommissioning to Phase 2 as defined in the Oil and Gas UK Well Decommissioning Guidelines;
    - Flushing and flooding of connecting pipelines in line with the approved PWA;
    - Flushing and purging of topsides process equipment; and
    - A structural survey to ensure that the structural integrity of the installations will be maintained throughout the decommissioning process.
- Preparation for Lighthouse Mode – Activities undertaken post- HCF verification to prepare the platform for Lighthouse Mode include:
    - Disconnection of pipelines;
    - Decommissioning of topsides and safety equipment;
    - Platform wells decommissioning to 'Phase 3' as defined in the Oil and Gas UK Well Decommissioning Guidelines; and
    - Sighting and installation of solar powered Nav Aids.
- Dismantlement Preparation: Methodology dependent on the final decommissioning strategy, may include:
    - Pipeline risers cut subsea;
    - Full or partial removal of riser / caisson sections;
    - Reinstatement of lifting points for topsides removal and jacket removal
    - Removal of potential dismantlement obstructions;
    - Installation of jacket leg cutting platforms

3.4 Post-Decommissioning Activities

Once the decommissioning operations have been completed, an as-left survey will be performed. This survey will include chemical and benthic macrofaunal assessments with the findings being

compared to the pre-decommissioning survey data. The findings of the post-decommissioning surveys will be shared with OPRED in the project close-out report.

An ongoing monitoring plan will be agreed with OPRED; however, it is expected to be minimal for this scope as the installations will be fully removed.

3.5 Schedule

The schedule associated with the removal of the Pickerill A and B installations (removal phase) is summarised in the following figure.

The schedule presented below indicates the earliest and latest dates the dismantlement of the topsides and jackets is estimated to take place. The completion dates for the project are driven by the availability of vessels, favourable weather windows and market opportunities.

Year	2018				2019				2020				2021				2022				2023			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Dismantling – Pickerill B																								
Pre-engineering/planning																								
Topside removal																								
Jacket removal																								
Site clearance																								
Dismantling – Pickerill A																								
Pre-engineering/planning																								
Topside removal																								
Jacket removal																								
Site clearance																								
Close-out																								
Post-decommissioning surveys																								
Close out Report Approval																								

Legend

Earliest date task could be completed

Latest task should be completed

Figure 3.3: Summary of Pickerill A and B installations decommissioning schedule

3.6 Summary of Materials Inventory

During the proposed decommissioning operations different types of waste will be generated. These are shown in Table 3.3 and Figure 3.4. Most of the generated waste consists of steel. Material to be decommissioned *in situ* is restricted to the remainder of the pile steel (359 te per platform) which will be cut 3 m below seabed level. PUK's Waste management strategy is described in Section 3.7.

Table 3.3: Summary of the expected wastes that will be generated by the proposed Pickerill decommissioning project

	Pickerill A		Pickerill B		Proposed fate %	
	Weight (tonnes)	Percentage of total weight of material to be removed	Weight (tonnes)	Percentage of total weight of material to be removed	Reuse/ recycle	Disposal
Steel	2522.5	95.9	2235.5	95.5	100%	0%
Other (marine growth, concrete, grout etc.)	111.2	3.7	111.2	4.1	0%	100%
None ferrous material	4.0	0.1	4.0	0.1	100%	0%
Plastic	8.0	0.3	8.0	0.3	90%	10%

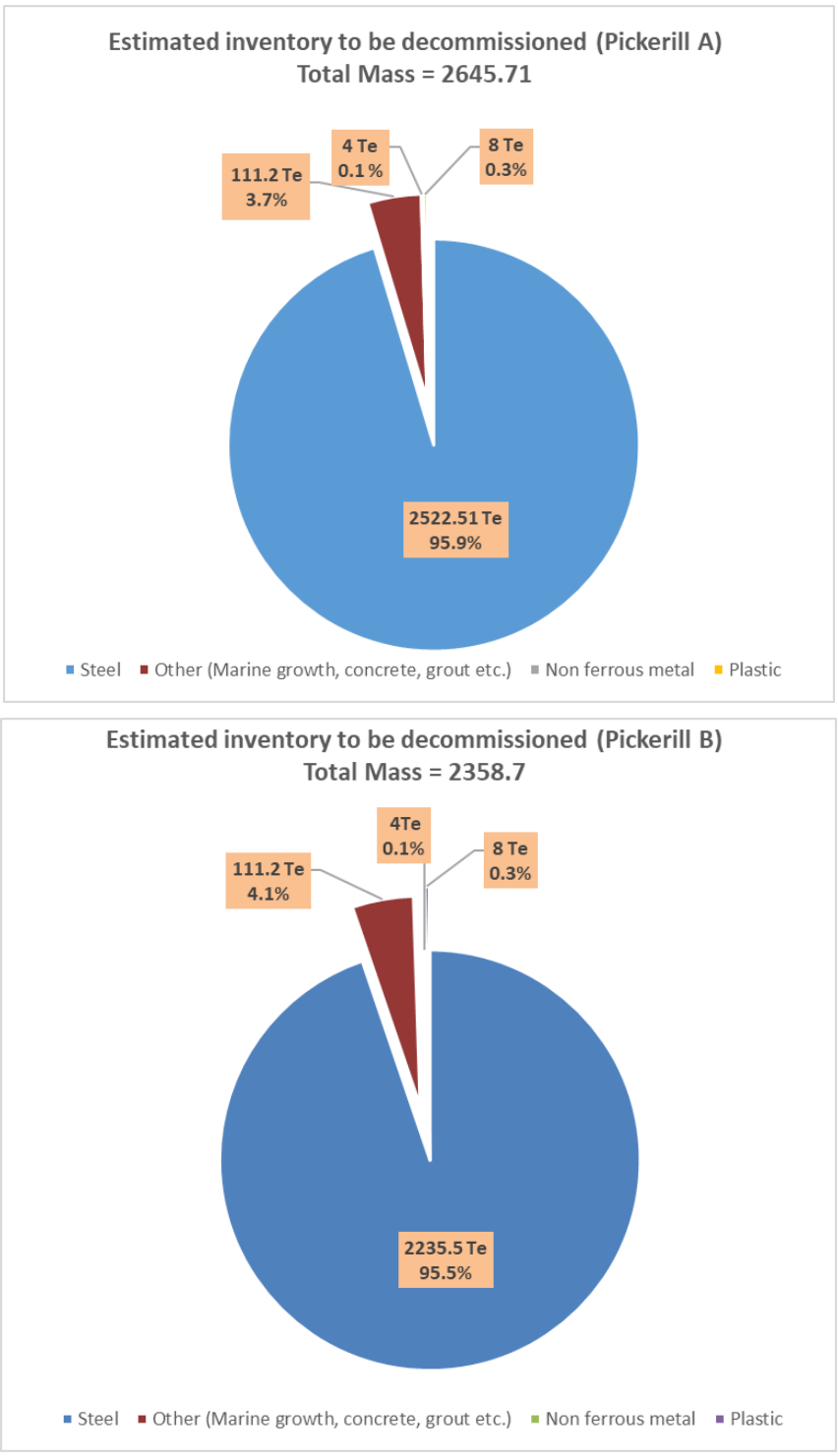

Figure 3.4: Summary of the expected wastes that will be generated by the proposed Pickerill decommissioning project

3.7 Waste Management

PUK recognises that, in line with the waste hierarchy, the reuse of an installation or its components is first in the order of preferred decommissioning options. However, as the Pickerill platforms are in a degraded condition, they are not considered suitable for safe re-use. As such, the topside and jacket will be recycled.

Non-hazardous materials, such as scrap metal, concrete and plastics not contaminated with hazardous material, will be removed and, where possible, reused or recycled (with the exception of the pile steel being decommissioned *in situ*, 3 m below the seabed). Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. The exact fate of the waste is currently not known and as such it may be shipped to either the UK or Europe. Nevertheless, the waste regulations of the receiving country will be followed, and all waste management responsibilities associated with any shipment of waste will be adhered to.

The management of waste generated from offshore activities is governed by PUKs ISO 14001-certified Safety and Environmental Management System (SEMS). The SEMS includes a documented procedure for waste management (PUK, 2016a), which is designed to ensure that all waste generated during the PUK offshore activities are managed according to the Company's Health, Safety and Environment (HSE) policy and relevant legislation. A specific Active Waste Management Plan (AWMP) has been developed for the Pickerill decommissioning project in order to address project specific waste management issues.

3.7.1 Contractor Management

Waste management activities include the handling, storage and treatment of waste offshore, the transfer of waste to a waste treatment or dismantling yard for further storage, handling and treatment as appropriate, and then further transfer to the final disposal or treatment point. These activities will be conducted by contractors and sub-contractors on behalf of PUK using their own waste management systems. These contractors and sub-contractors will also prepare all necessary documentation required for the identification, quantification and tracking of wastes generated per asset in order to provide a transparent audit trail from the offshore location through to the final disposal point. Although PUK will not be undertaking the actual physical work, the legal liability i.e. Duty of Care, for all waste generated from decommissioning remains with PUK for the duration of the programme.

The selection and management of contractors by PUK is managed through existing contractor control processes and procedures. Specific targets to maximise re-use, recycling and minimise waste to landfill will be agreed during the contractor selection process. This will be included in relevant contracts. Actions to support the management and minimisation of waste generated by contractors during decommissioning will include:

- Ensuring that waste management issues are clearly addressed within the contractor interface documents;
- Identifying specific roles and responsibilities within PUK and its contractors within the Pickerill decommissioning AWMP;

- Engaging with contractors to identify effective technical solutions that support waste minimisation and the reuse and recycling of waste, where possible; and
- Establishing specific audit and monitoring schedules within relevant contracts.

3.7.2 Measuring and Monitoring Performance

Measuring and monitoring performance is an important element of PUK's SEMS and a number of mechanisms are in place to do this (PUK, 2016b, 2016c). Specific areas of focus related to waste management during the decommissioning of the Pickerill infrastructures will be:

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

A range of methods will be used to ensure effective monitoring of waste management activities including regular waste statistic tracking and auditing of contractor and disposal sites.

3.8 Environmental Management

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

PUK hold ISO 14001 standard certification and therefore have relevant documentation to support the decommissioning process from the perspective of environmental standards. PUK operate under a Safety and Environmental Management System (SEMS), which forms part of the PUK Operating Management System (POMS). The POMS provides the framework for PUK to achieve safe and reliable operations day-in and day-out and ensures compliance with PUK's HSSE Policy.

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

3.8.1 Scope of SEMS

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

- Clear assignment of responsibilities;

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

3.8.2 Principle of the SEMS

The SEMS comprising of 10 principles; Improvement Programmes and the Management of Change, Roles and Responsibilities, Training and Competence, Communication, Document Control, Records, Monitoring and Audit, Incident Reporting and Investigation, Non-confidence and Corrective Action and Review.

- **Improvement Programmes and the Management of Change** – The purpose of employing an improvement programme is to ensure the continuous development of the PUK policy commitment, and to introduce changes and innovations that ensure that the achievement of performance standards where current performance is below expectations. The SEMS also makes provision for the management of change. Changes may occur for a number of reasons, and at a number of levels. A 'management of change' procedure specifies the circumstances under which formal control of change is required to ensure that significant impacts remain under control and/or new impacts are identified, evaluated and controlled.
- **Roles and Responsibilities** – PUK will review existing environmental roles and responsibilities for staff participating in the Pickerill Decommissioning Program. These will be amended and recorded in individual job descriptions to ensure that they take into account any changes required for the management of the impacts identified in this EA.
- **Training and Competence** – The competence of staff with environmental responsibilities is a critical means of control. The SEMS, in conjunction with the Human Resources department of PUK allows for the appointment of suitably competent staff. The development and implementation of training programmes facilities understanding and efficient application.
- **Communication** – Internal environmental communication generally employs existing channels such as management meetings, minutes, poster displays, etc. External communication with stakeholders and interested parties is controlled through a communication programme. This establishes links between each stakeholder, the issues that are of concern to them, and the information they require to assure them that their concerns and expectations are being addressed. This EA and the consultation process that informed its production will be used to design the ongoing communication programme. Communication and reporting will employ information derived from the monitoring programme.
- **Document Control** – The control of the SEMS documents is managed in the PUK Document Control System.
- **Records** – Records provide the evidence of conformance with the requirements of the SEMS and of the achievement of the objectives and targets in improvement programmes. The PUK

SEMS specifies those records that are to be generated for these purposes, and controls their creation, storage, access and retention.

- **Monitoring and Audit** – Checking techniques employed within PUK's SEMS are a combination of monitoring, inspection activities and periodic audits. The requirement for monitoring and inspection stems from the need to provide information to a number of different stakeholders, but primarily regulators, and PUK management. As such, there is a requirement for the results of monitoring and inspection to be integrated with the PUK internal and external communication programme. Monitoring and inspection activities focus on:
    - Checks that process parameters remain within design boundaries (process monitoring);
    - Checks that emissions and discharges remain within specified performance standards – (emissions monitoring); and
    - Checks that the impacts of emissions and discharges are within acceptable limits (ambient monitoring).
- **Incident Report and Investigation** – The PUK SEMS stipulates documented procedures to control the reporting and investigation of incidents.
- **Non-conformance and Corrective Action** – The checking techniques outlined above are the means of detecting error or non-conformances. PUK's SEMS includes procedures for the formal recording and reporting of detected non-conformance, the definition of appropriate corrective action, the allocation of responsibilities and monitoring of close out.
- **Review** – PUK's SEMS includes arrangements for management review. This provides the means to ensure that the EMS remains an effective tool to control the environmental impacts of operations, and to re-configure the EMS in the light of internal or external change affecting the scope of significance of the impacts. Of particular importance is the role management review plays in the definition and implementation of the improvement programme, and the management of change.

4 ENVIRONMENTAL AND SOCIETAL BASELINE

4.1 Introduction

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

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

4.2 Physical Environment

4.2.1 Bathymetry

The southern North Sea (SNS) extends from the Flamborough front in the north to north of the Dover Strait in the south, with a transition from North Sea water to Atlantic water. This region is shallow (generally 0-50 m), with a predominantly sandy seabed (DECC, 2016). Mapped information (McBreen *et al.,* 2011) indicates that the SNS generally comprises of sand and muddy sand with significant areas of coarse sediment, especially closer to shore.

The SNS has many extensive sandbank features present at less than 25 m depth; these include areas which have been designated under the EU Habitats Directive (92/43/EEC) such as Dogger Bank Special Area of Conservation (SAC) and the North Norfolk Sandbanks SAC (DECC, 2016).

The general bathymetry of the area around the Pickerill A platform is generally flat with a few geological features. The depth of the seabed ranges from between a minimum of 19.1 m and a maximum of 22.4 m as shown in Figure 4.1. Generally, the eastern part of the surveyed area is shallower than the western part (MMT, 2013).

Surveys undertaken at Pickerill B in 2018 (BHM, 2018), found the seabed to be generally uniform and consisted of featureless gravelly sand. The seabed in the immediate vicinity of the platform ranges from 18.2 to 22.0 m. To the northeast limit of the survey area (> 400 m) there is a deeper area of megaripples dropping to 41.5 m in depth. Overall there were no observed influence from the platform on the surrounding sediment.

4.2.2 Seabed Sediments

According to the NMPi (2018), the sediment composition near the platforms of the Pickerill installations comprises of undifferentiated gravelly sand deposited during the Holocene period. The surrounding seabed in the UKCS Block 48/11 consists of undifferentiated slightly gravelly sand and sand, also deposited during the Holocene. This was confirmed by the Pickerill B site survey which showed the presence of gravelly sands with proportions of fine sediment chronically low across the survey area due to the strong hydrodynamic regime restricting the finer material from settling on the seabed (BHM, 2018).

The EUNIS habitats (JNCC, 2018) data indicates that the seabed surrounding the Pickerill infrastructure has a EUNIS classification of A5.1, described as: “circalittoral Coarse Sediment”, as shown in Figure 4.2, below. This was confirmed by all 14 ground-truthed stations in the recent Pickerill B pre-decommissioning survey (BHM, 2018). This kind of habitat typically has a low silt content and a lack of a significant seaweed component, this habitat was characterised by a range of mobile crustaceans and teleost fish species. No EC Habitats Directive Annex I habitats or other protected habitats/ species were encountered during the survey. While sporadic individuals of *Sabellaria spinulosa* were evident from macrofaunal analysis of grab samples. No significant *Sabellaria* aggregations were evident on video footage or bathymetry data and as such there is no evidence for the potential presence of qualifying *Sabellaria* reef structures within the survey area (BHM, 2018).

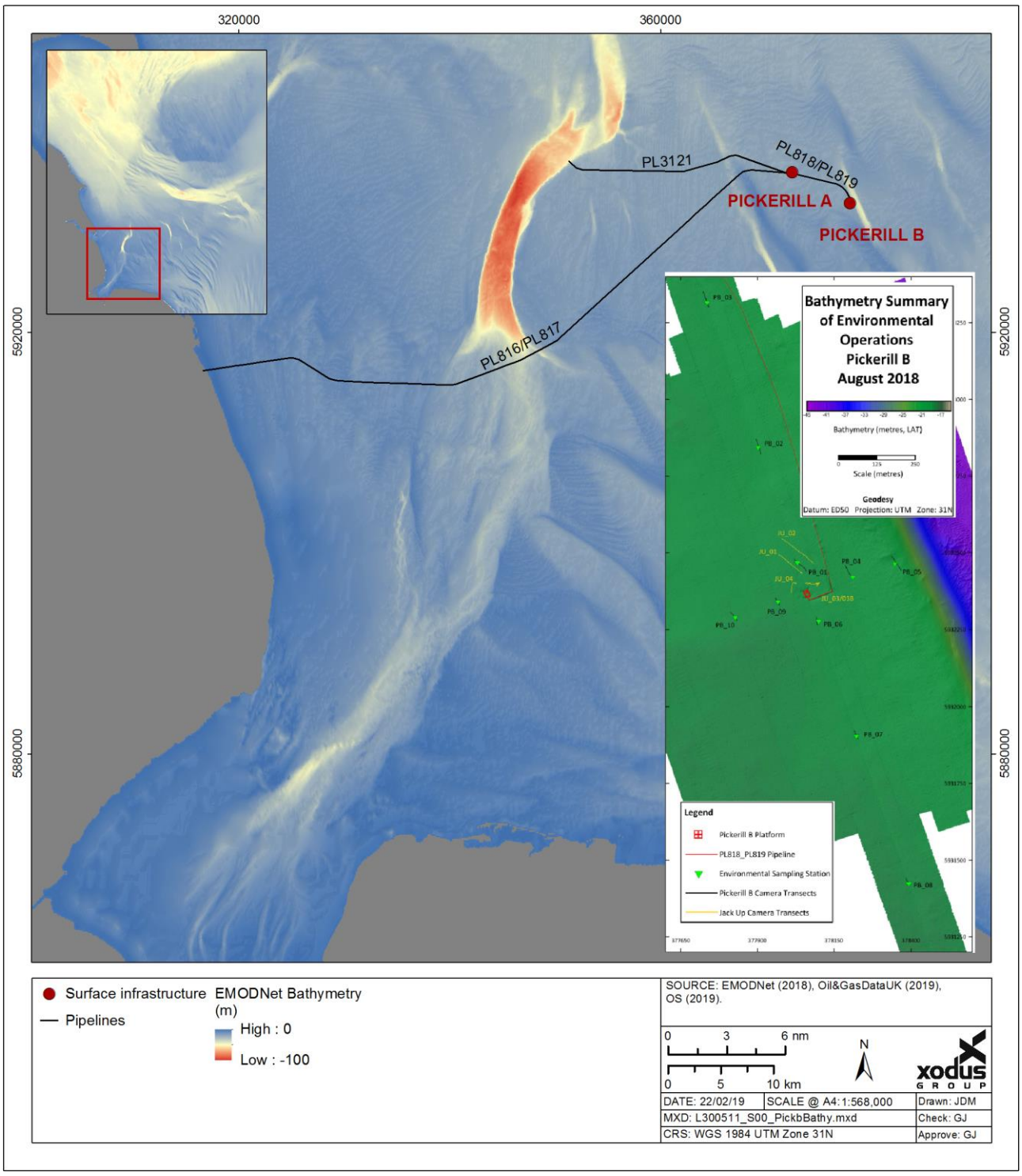

Figure 4.1: Bathymetry at Pickerill A and B installations

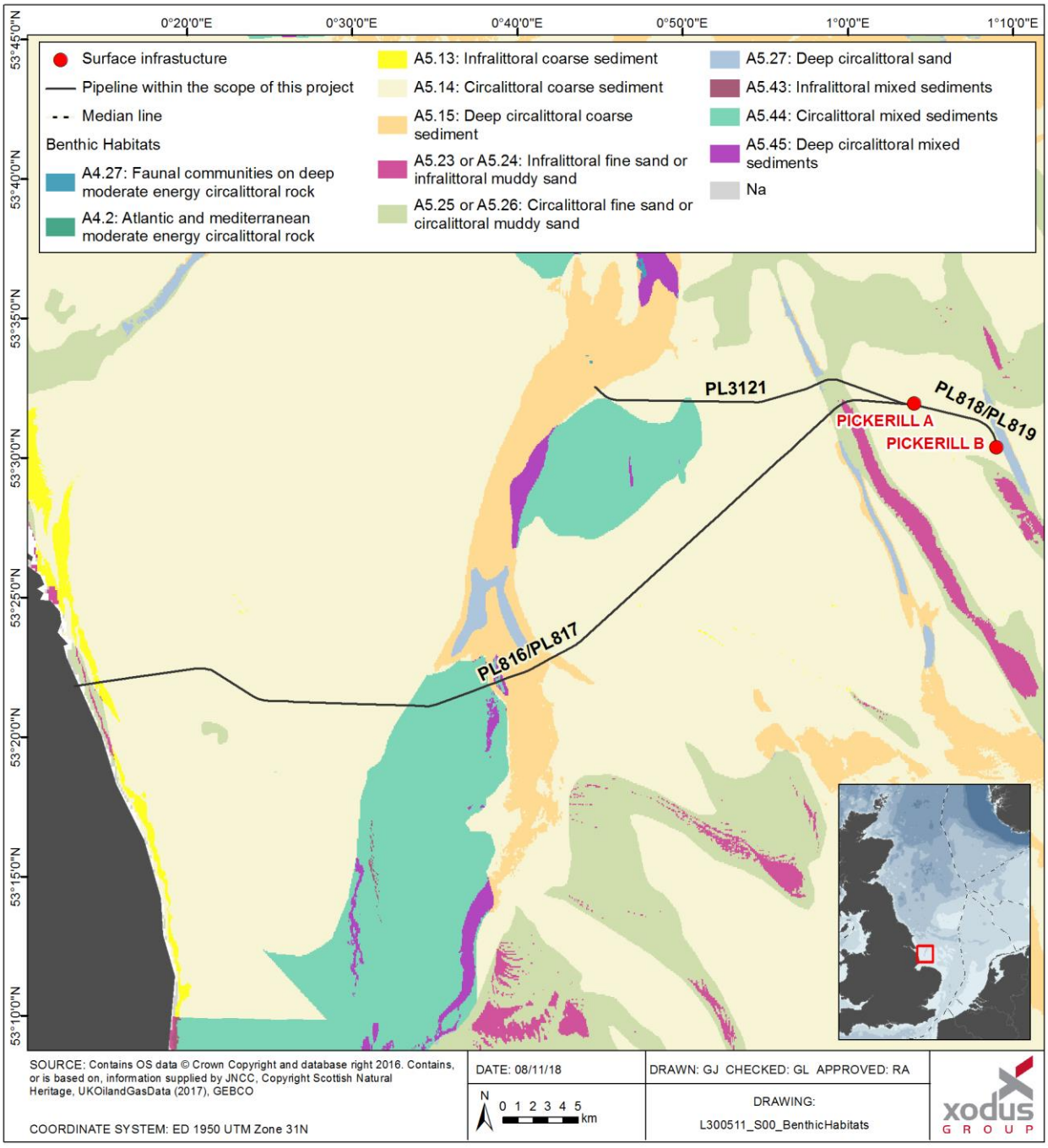

Figure 4.2: Seabed EUNIS broad-scale seabed habitat classification (JNCC, 2018)

4.2.3 Sediment Chemistry

There is no site-specific survey data currently available for the Pickerill A platform but surveys at the Pickerill B platform (BHM, 2018)) showed the survey area to be organically deprived with Total Organic Carbon (TOC results consistently low at all ten stations (mean 0.17%±0.04SD). Results also illustrated generally low levels of Total Hydrocarbon (THC) ranging from 4.65 mg.kg^{-1} to 12.4mg.kg$^{-1,}$

with the highest concentration found 100 m south of the Pickerill B platform, this being the only concentration found to exceed the 95th percentile level for the southern North Sea (UKOOA, 2001). Alkanes contributed on average 5.16% to the THC levels across the survey area indicating a seabed consistent with uncontaminated sediments where background hydrocarbons are continuously replenished. Gas chromatography at samples form Station PB-06 revealed a trace signature consistent with historic contamination at the site by potential drilling fluids with a peak Polycyclic aromatic hydrocarbon (PAH) level of 443 ng.g^{-1}. However all concentrations across the survey area were found to be at the low end of the CEFAS PAH concentrations for sediments surrounding the North Sea oil and gas installations (20ng.g^{-1} to 74,700 ng.g-^{1}) (BHM, 2018).

In addition, data from UK Benthos database (Oil and Gas UK, 2017) has been used to further explore seabed conditions within the vicinity of the Pickerill installations. Specifically, the PIC92 surveys which were performed by Auris in 1992 in which sediments surrounding the Pickerill A and B platforms were sampled at distances from 10 m – 200 m. The total hydrocarbon concentrations (THC) across the survey area ranged from 0.82 to 6551.7 µg/g with an average of 287 µg/g. This is above the UKOOA (2001) mean hydrocarbon concentration for the SNS (5.08 µg/g). These surveys did not provide a range for the fines or particle size distribution.

Heavy metal concentrations in the vicinity of Pickerill B were generally low with the mean concentrations of all metals analysed (where comparable) falling below the UKOOA 95th percentiles for the southern North Sea. Higher concentrations of four metals (chromium, copper, nickel and vanadium) were observed at station PB-09 (100 m west of Pickerill B). However, the lower levels of barium and increased aluminium levels at this station suggests that theses metals may be a result of *in situ* natural processes rather than drilling related contamination. Barium levels were observed at higher concentrations close to Pickerill B in the direction of the prevailing current (stations PB-01 and PB-06), reflecting a potential contamination historically from drilling muds, however no discernible cuttings pile was observed. Despite these observations, the concentrations of barites (ranging from 99 to 557 mg.kg^{-1}) are far below those found within 500 m of active UK platforms which often show concentrations in the thousands of mg.kg^{-1}.

4.2.4 Waves

Wave heights across the SNS region range from 0.26 – 1.50 m over the course of the year, with higher waves ranging between 1.50 – 2.10 m being recorded offshore (NMPi, 2018). McBreen *et al.* (2011) shows wave energy at the seabed to be 'moderate' (0.21 – 1.2 N/m^2) for most of the SNS region, increasing towards the shore and over the Dogger Bank to 'high' (more than 1.2 N/m^2). The wave height within the UKCS Block 48/11 area ranges from 1.21 - 1.50 m and the annual mean wave power is approximately 6.1 - 12.0 kW/m (NMPi, 2018).

4.2.5 Water Circulation and Tides

Currents in the North Sea circulate in an anti-clockwise direction, driven by inflows from the Atlantic via the northern North Sea down the UK east coast and from the English Channel, and outflow northwards along the Norwegian coast. Against this background of tidal flow, the direction of residual water movement in the SNS is generally to the east (DTI, 2001; DECC, 2016). There are significant local variations in patterns of semi-diurnal tidal and residual circulation which occur in

the vicinity of sandbanks. In addition to this, the shallow parts of the SNS and the Channel remain well mixed throughout the year due to tidal action (DTI, 2001; DECC, 2016). The SNS receives significant freshwater input from the rivers along its eastern boundary, which together with input from rivers along the UK coast makes it less saline than other parts of the North Sea (DECC, 2009; DECC, 2016).

The SNS is dynamic, characterised by shallow, well-mixed waters, which undergo large seasonal temperature variations. The region is largely enclosed by land and, as a result, the environment here is subject to nutrient-rich run-off from land (DECC, 2016).

In general, maximum velocities in the SNS are below 1.0 m/s in the nearshore region, except in the vicinity of major headlands (Flamborough Head, Spurn Point and South Foreland) where peak velocities may reach 2.0 m/s. Flows of approximately 0.1 m/s have been recorded in the south-west along the southern edge of Dogger Bank (DECC, 2016). Peak mean residual currents in the offshore SNS area are approximately 0.2 m/s (Wolf *et al.,* 2016). The mean residual currents surrounding the Pickerill A and B field infrastructures are approximately 0.05 ~ 0.1 m/s (Wolf *et al*., 2016).

Winds in the SNS are generally from between south and north-west; however, in spring the frequency of those from the north and east increases. Wind strengths are generally between Beaufort scale 1-6 (1-11 m/s) in the summer months with a greater proportion of strong to gale force winds of force 7-12 (14-32 m/s) in winter (DECC, 2016).

4.2.6 Temperature and Salinity

Winter water temperatures in the SNS are in the range of 4 – 8°C, while summer water surface temperatures are in the range of 16°C – 19°C, with little variation, either down the water column or from near shore to offshore waters (Energinet, 2017). Salinities decrease both towards the south and towards the coastline, reflecting the influence of freshwater inputs from the adjacent landmasses.

4.3 Biological Environment

4.3.1 Benthic Fauna

The biota living near, on or in the seabed is collectively termed benthos. The diversity and biomass of the benthos is dependent on a number of factors including substrata (e.g. sediment, rock), water depth, salinity, the local hydrodynamics and degree of organic enrichment (DECC, 2016). The species composition and diversity of the benthos or macrofauna found within sediments is commonly used as a biological indicator of sediment disturbance or contamination.

Benthic surveys show that the Pickerill B survey area was highly species abundant with a total of 7515 individuals identified. Of the 198 species recorded, 168 species were infaunal and were dominated by annelids accounting for 45.81% of the community. The samples were also considered to be epifaunal rich, with a combined grouping of colonial and solitary epifauna accounting for 33 species of which bryozoan were the most well represented with 16 taxa observed. There appeared to be no distinct impact on community structure or clear geographical distribution from the Pickerill B infrastructure. Benthic fauna was characteristic for this region of the SNS. No EC Habitats Directive

Annex I habitats or other protected habitats/ species were encountered during the survey. While sporadic individuals of *Sabellaria spinulosa* were evident from macrofaunal analysis of grab samples, no *Sabellaria* aggregations were evident on video footage or bathymetry data and as such there is no evidence for the potential presence of qualifying *Sabellaria* reef structures within the survey area (BHM, 2018).

Table 4.1 presents the top 15 ranked species from the survey undertaken at Pickerill B.

Table 4.1: Overall Species Ranking (top 15 species)

Species/ Taxon	Phylum	Numerical abundance (20 replicates)
Balanus crenatus	Crustacea	2336
Abra alba	Mollusca	717
Scoloplos armiger	Annelida	455
Hiatella arctica	Mollusca	893
Urothoe elegans	Crustacea	287
Euclymene oerstedii	Annelida	175
Phyllodoce maculate	Annelida	216
Spio armata	Annelida	132
Mediomastus fragilis	Annelida	101
Cirripedia	Crustacea	154
Ampharete lindstroemi	Annelida	135
Actiniaria	Solitary Epifauna	130
Lanice conchilega	Annelida	98
Sabellaria spinulosa	Annelida	95
Galathowenia oculata	Annelida	59

Viking Link (2017) undertook a benthic survey in the vicinity of the Pickerill installations. The results of the benthic survey indicated that the epibiotic communities reflected the sediment complexity, with the offshore sandier sediments hosting lower faunal diversity represented mainly by fish, echinoderms, crustaceans and molluscs, with sessile epifauna being absent or scarce. The

nearshore coarser sediments comprised a richer and more diverse epibenthic community, which included a variety of sessile epifauna.

The area surrounding both Pickerill platforms A and B have the broad habitat classification the EUNIS biotype circalittoral coarse sediment, as shown in Figure 4.2. According to the Habitat of Conservation Importance (HOCI) and Features of Conservation Importance (FOCI) distribution maps in the Marine Information System (MIS) (MIS, 2018).

4.3.2 Plankton

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

Phytoplankton blooms around the UK are triggered by an increase in sunlight, an increase in the availability of nutrients circulated from deeper waters and warming of the surface waters. Large diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. are usually dominant in the spring bloom. This spring bloom is followed by an increase in the abundance of zooplankton feeding on the phytoplankton bloom (Bresnan *et al*., 2009). Phytoplankton abundance within the SNS fluctuates less than in the central and northern North Sea, and winter levels also remain higher than further north. Monitoring between 1997 and 2007 has shown that whilst phytoplankton numbers increase in May, the spring peak in biomass is lower than that observed in central and northern areas of the North Sea (SAHFOS, 2015).

The zooplankton communities are dominated in terms of biomass and productivity by copepods, particularly Calanus species such as *C. finmarchicus* and *C. helgolandicus*. There is a strong geographical divide between these two species, with *C. finmarchicus* more abundant in colder, more northern waters and *C. helgolandicus* dominating warmer waters in more southerly regions, though their ranges show considerable overlap.

Analysis of data provided by the Continuous Plankton Reader (CPR) surveys in the 10 year period between 1997 and 2007 shows that numbers of *C. finmarchicus* in the SNS remain relatively constant through the year with only a small increase in April (SAHFOS, 2015). This spring increase is likely a reflection of the growth in the zooplankton as a result of the increased food (including phytoplankton).

4.3.3 Fish and Shellfish

Several commercially important fish and shellfish species can be found in the vicinity of the proposed operations. Fish and shellfish populations may be vulnerable to impacts from offshore installations such as hydrocarbon pollution and exposure to aqueous effluents, especially during the egg and juvenile stages of their lifecycles (Bakke *et al*., 2013).

The proposed Pickerill decommission Project is located in International Council for the Exploration of the Sea (ICES) rectangle 36F1, in an area of spawning and nursery grounds for several commercially important species. Information on spawning and nursery periods for these different species, including peak spawning times, are detailed Table 4.2.

Table 4.2: Fisheries sensitivities within the 36F1 ICES rectangle (Coull et al., 1998 and Ellis et al., 2012)

Species	J	F	M	A	M	J	J	A	S	O	N	D
Anglerfish			N	N	N	N	N	N				
Cod			N	N	N	N						
Herring										N	N	N
Horse Mackerel [1]					N	N	N	N	N	N		
Lemon Sole						N	N	N	N	N	N	
Mackerel							N	N	N	N		
Nephrops	N	N	N	N	N	N	N	N	N	N	N	N
Plaice												
Sandeels	N	N	N	N								
Sole												
Sprat							N	N	N	N		
Spurdog [2]	N	N	N	N	N	N	N	N	N	N	N	N
Whiting				N	N	N	N	N				

Key

Peak Spawning | Spawning | N | Nursery | No activity recorded

[1] Horse mackerel appear to be widespread and with no spatially discrete nursery grounds (*Ellis et al., 2012*).
[2] Viviparous species (gravid females can be found all year) (*Ellis et al., 2012*).

Spawning areas for most species are not rigidly fixed and fish may spawn either earlier or later from year to year. In addition, the mapped spawning areas represent the widest known distribution given current knowledge and should not be seen as rigid unchanging descriptions of presence or absence (Coull *et al,* 1998). Whilst most species spawn into the water column of moving water masses over extensive areas, benthic spawners (e.g. sandeel) have very specific habitat requirements, and as a consequence their spawning grounds are relatively limited and potentially vulnerable to seabed disturbance and change.

There are five species of sandeels known to occur in the North Sea, with the majority (90%) of the commercial catch made up of the lesser sandeel *Ammodytes marinus*. Sandeels are shoaling fish which lie buried in the sand during the night, and hunt for prey in mid-water during daylight hours (DECC, 2016). They are restricted to sandy sediments (Holland *et al*., 2005; DECC, 2016). They feed mainly on planktonic prey such as copepods and crustacean larvae, but they can also consume polychaete worms, amphipods, and small fish including other sandeels. When active, sandeels swim continually in order to remain clear of the bottom (DTI, 2001). Sandeels usually spawn between November and February and lay eggs in clumps on sandy substrates (DECC, 2016). The larvae are pelagic up to approximately two to five months after hatching and are believed to over-winter buried in the sand (DECC, 2016). Sandeel are important not only to commercial fisheries but also are of ecological significance as they are a vital food source for marine birds and predatory fish

(DECC, 2016). According to Mazik, *et al*. (2015), sandeels are likely to avoid areas with greater than 10% of silt/clay or very fine sand.

Herring are demersal spawners, depositing their sticky eggs on coarse sand, gravel, small stones and rock. Shoals of herring gather on the spawning grounds and spawn more or less simultaneously. Each female releases her eggs in a single batch and the resulting egg carpet may be several layers thick and cover a considerable area (DECC, 2016). The drift rate of the larvae is variable, and it is probable that in some years many of them do not reach the nursery areas (Scottish Government, 2017a).

Important spawning grounds for plaice were identified in the SNS eastern English Channel, Trevose Head and eastern and western Irish Sea (CEFAS, 2001). Plaice are pelagic during spawning and demersal during the larval stage. Sediment characteristics are thought to be of importance; larval plaice use sandy beaches and coastal estuaries as nurseries (DECC, 2016). The preference for sandy sediments remains during the entire lifespan, although older age groups may be found on coarser sand (ICES, 2006) and in older individuals are usually found in deeper water than younger individuals (DECC, 2016).

The sediment regime in the vicinity of the Pickerill installations consists of sublittoral coarse sediment which provides fish species with a flat sandy habitat made up of unstable cobbles, pebbles, gravels and coarse sands. Due to the composition of the seabed and sediment type present it is likely that the sandeels and herring will be spawning in the area.

In UKCS Block 48/11 between January and March, there is a period for concern for seismic surveys listed by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS). Similarly, between August to October, there is a period of concern for drilling issued by the CEFAS due to concerns about possible environmental effects on spawning fish species.

4.3.4 Seabirds

Much of the North Sea and its surrounding coastline is an internationally important breeding and feeding habitat for seabirds. The western flank of the Dogger Bank supports high densities of seabirds, with notable colonies on the east coast located at Flamborough Head and Bempton Cliffs, including black-legged kittiwake *Rissa tridactyla*, gannet *Morus* spp., guillemot *Uria*, razorbill *Alca torda* and northern fulmar *Fulmarus glacialis* (DECC, 2016). Seabirds are not normally affected by routine offshore oil and gas operations. In the unlikely event of an oil release, however, birds are vulnerable to oiling from surface pollution, which could cause direct toxicity through ingestion, and hypothermia as a result of the birds' inability to waterproof their feathers. Birds are most vulnerable in the moulting season when they become flightless and spend a large amount of time on the water surface.

After the breeding season ends in June, large numbers of moulting auks (common guillemot and razorbill) disperse from their coastal colonies and into the offshore waters from July onwards. At this time these high numbers of birds are particularly vulnerable to oil pollution. In addition to little auks, great black-backed gull and northern fulmar are present in sizable numbers during the post breeding season (DECC, 2016).

The Joint Nature Conservation Committee (JNCC) has released the latest analysed trends in abundance, productivity, demographic parameters and diet of breeding seabirds, from the Seabird Monitoring Programme (JNCC, 2016c). This data provides at-a-glance UK population trends as a percentage of change in breeding numbers from complete censuses. From the years 1998-2015, the following population trends for species known to use the field area have been recorded: northern fulmars (-31%), black legged kittiwakes (-44%), and common guillemots (+5%). Breeding seabird numbers of some species have shown a long-term decline, most probably as a result of a shortage of key prey species such as sandeels associated with changes in oceanographic conditions (Baxter *et al*., 2011: DECC, 2016).

According to the density maps provided in Kober *et al*., (2010), the following species have been recorded within the area of the Pickerill platforms A and B during the proposed period of operations:

- Northern fulmar, breeding (March – July) and wintering (August - February) at low densities.
- Sooty shear water, during the summer (July - November) at low densities.
- Manx Shear water, breeding (May – September) and in an additional season (October – November) at low densities.
- European storm petrel, breeding (June – October) at low densities.
- Leach storm-petrel, breeding (June – October) at low densities.
- Northern gannet, breeding (May – September) and wintering (October - April) at low densities.
- Great cormorant, breeding (April – August) and wintering (September – March) at low densities.
- European shag, breeding (March – September) and wintering (October – February) at low densities.
- Pomarine skua, between March – November at medium densities.
- Artic Skua, breeding (May – August) in medium densities and in an additional season (September – November) at medium to high densities.
- Long-tailed skua, additional season (May – June and September – November) at low densities.
- Great Skua, breeding (May – August) and winter (September – April) at low densities.
- Black-legged kittiwake, breeding (May – September) and wintering (October - April) at low densities.
- Black-headed gull, breeding (April – August) and wintering (September – March) at low densities.
- Little gull, breeding (May – July), wintering (December - April), and in an additional season (August – November) at low densities.
- Great black-backed gull, breeding (April – August) and winter (September – March) at low densities.
- Mediterranean gull, all year at low densities.
- Common gull, breeding (May – August) and wintering (September – April) at low densities.
- Lesser black-backed gull, breeding (May – August) and wintering (September - April) at low densities.

- Herring gull, breeding (April – August) and wintering (September – March) at low densities.
- Iceland gull, winter (November – April) at low densities.
- Glaceous gull, winter (October – March) at low densities.
- Sandwhich tern, breeding (May – August) at high densities and wintering (September – October) at low densities.
- Common tern, breeding (May – September) at low to medium densities.
- Artic tern, breeding (May – August) at low densities.
- Common guillemot, breeding (May - June) at low to medium densities, wintering (October - April) at medium to high densities and in an additional season (August – September) at low densities.
- Razor bill, breeding (May – June) and in an additional season (August – September) at low densities and wintering (October - April) at medium – high intensities.
- Little Auk, wintering (November – March) at low densities.
- Atlantic puffin, breeding (April – July) and wintering (August - March) at low densities.

In general, species can be found breeding at low densities from March to November, predominantly during the summer months (June, July and August).

The Seabird Oil Sensitivity Index (SOSI) (Webb *et al*., 2016) identifies sea areas where seabirds are likely to be most sensitive to oil pollution. It is an updated version of the Oil Vulnerability Index (JNCC, 1999) as it uses survey data collected between 1995 and 2015 and includes an improved method to calculate a single measure of seabird sensitivity to oil pollution. The survey area covers the UKCS. Seabird data was collected using boat-based, visual aerial and digital video aerial survey techniques. This data was combined with individual species sensitivity index values and summed at each location to create a single measure of seabird sensitivity to oil pollution (Webb *et al.,* 2016). Clock/month combinations that were not provided with data have been populated with the SOSI using the indirect assessment method provided by Webb *et al.* (2016)

Seabird sensitivity in the region of UKCS Block 48/11 and in the vicinity of the Pickerill installations are considered overall medium (score of 3) between August and March. The seabird sensitivity can be considered low from May till July (score of 5). No data was available for the April, and therefore an indirect assessment of SOSI data has been made. See Table 4.3 for an overview of the scores for each month, and Figure 4.3 and Figure 4.4.

Table 4.3: Seabird oil sensitivity in Block 48/11 and surrounding vicinity (Webb et al., 2016)

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
47/10	2	2	2	2	5	5	4	3	4	2	2	1
48/6	2	2	2	2	5	5	3	3	2	2	2	1
48/7	3	2	2	2	5	3	3	3	2	2	2	1
48/12	2	2	2	2	**5**	**5**	**5**	3	3	2	1	2
48/11	3	3	2	2	5	5	5	3	5	4	2	2
47/15	3	3	2	5	5	5	5	3	5	3	1	2
47/20	3	4	2	5	5	5	5	4	4	3	1	2
48/16	3	4	3	3	5	5	5	4	5	4	2	3
48/17	3	3	3	3	5	5	5	3	4	2	1	3
Key	Extremely High		Very High		High		Medium		Low		No Data	

Note: In light of coverage gaps, an indirect assessment of SOSI has been made. This data is highlighted in red and underlined.

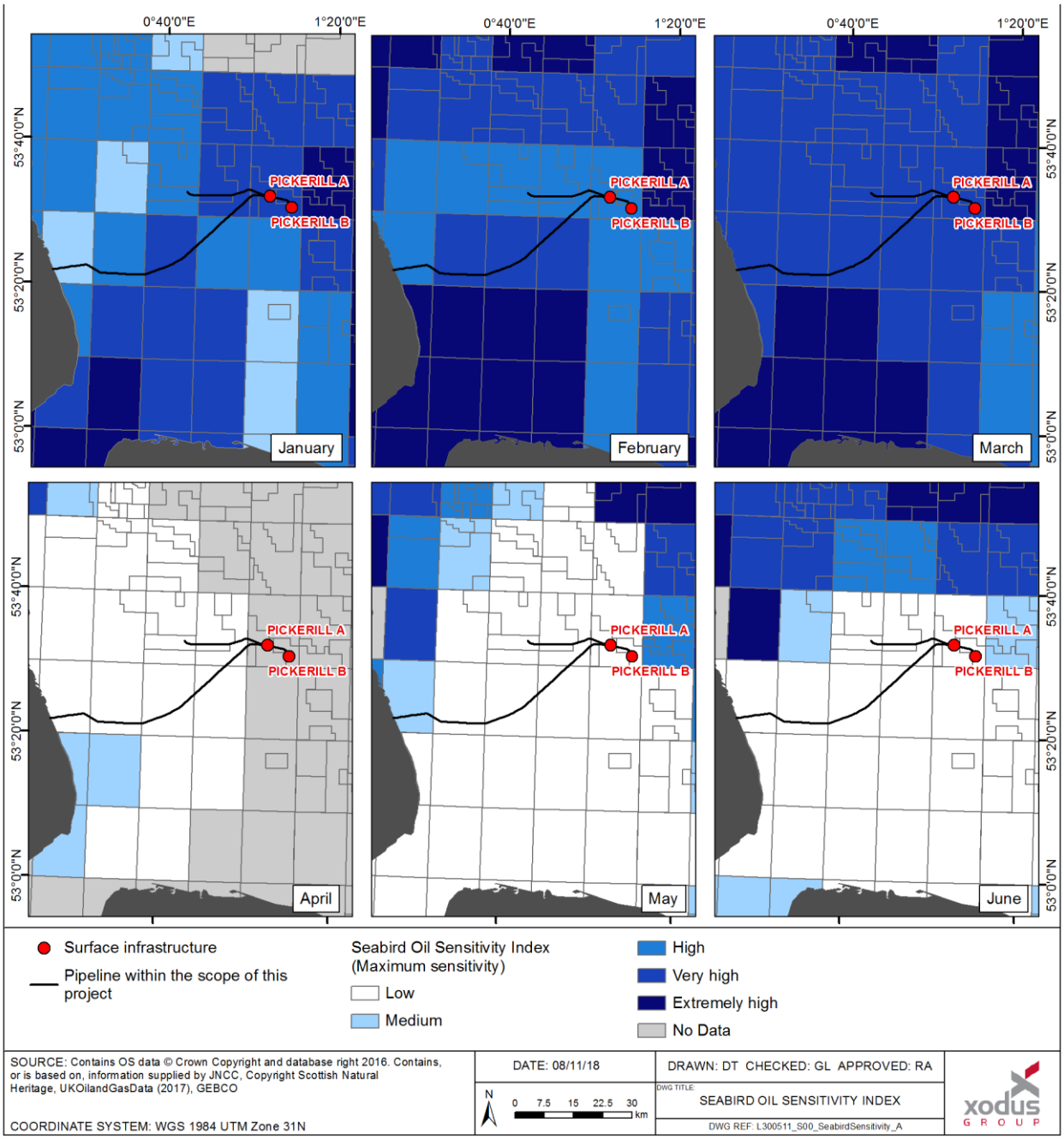

Figure 4.3: Seabird sensitivity (SOSI) within the vicinity of Pickerill A and B infrastructure from January to June

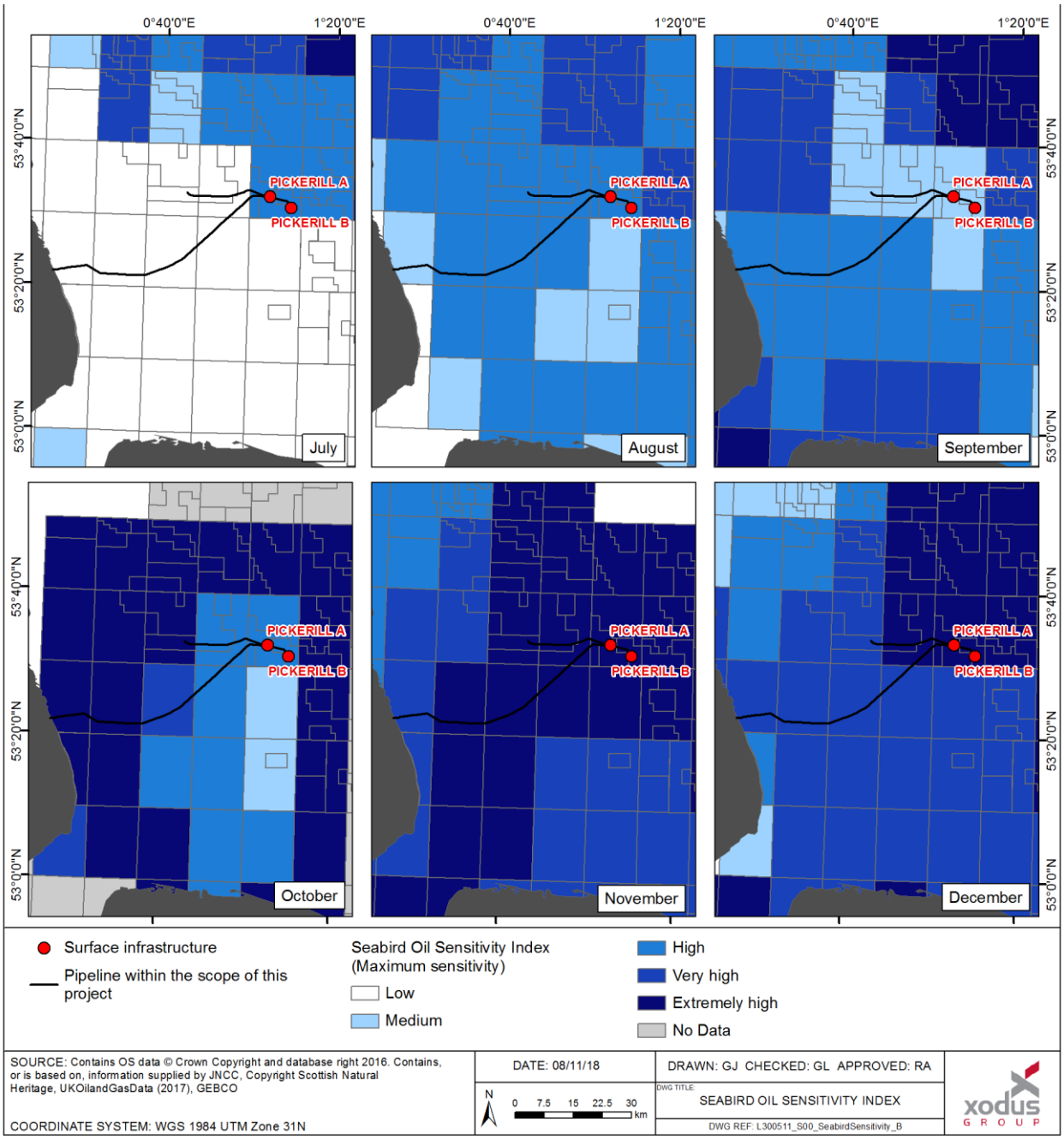

Figure 4.4: Seabird sensitivity (SOSI) within the vicinity of Pickerill A and B infrastructure from July to December

The two inter-field pipelines (PL818 and PL819) and two export pipelines (PL816 and PL817) lie within the UKCS Block 48/11. The decommissioning projects of the Pickerill platforms A and B are located approximately 58 km from the nearest UK coast and are remote from sensitive seabird breeding areas on the coast.

There is a total of four inshore SPAs located within 100 km from the Pickerill A and B installations:

- Humber Estuary SPA;
- The Wash SPA;
- Greater Wash SPA; and
- North Norfolk Coast SPA.

The above noted SPA's are detailed further in section 4.3.6.

4.3.5 Marine Mammals

4.3.5.1 Cetaceans

Compared to the central and northern North Sea, the SNS generally has a relatively low density of marine mammals, with the exception of harbour porpoise *Phocoena*. While over ten species of cetacean have been recorded in the SNS, only harbour porpoise and white-beaked dolphin *Lagenorhynchus albirostris* can be considered as regularly occurring throughout most of the year, whilst minke whales *Balaenoptera acutorostrata* form seasonal visitors. Bottlenose dolphin *Tursiops truncatus* and Atlantic white-sided dolphin *Lagenorhynchus acutus* are considered uncommon visitors (DECC, 2016). All cetacean species are listed under Annex IV of the Habitats Directive for protection in UK waters.

Harbour Porpoise, white-beaked dolphin, and white sided-dolphin have all been recorded near UCKS Block 48/11 wherein the Pickerill field lies (Reid *et al.*, 2003). Table 4.4 below depicts seasonal sightings of these species in the vicinity of the project.

Table 4.4: Monthly cetaceans sightings, adapted from Reid et al. (2003)

Species	J	F	M	A	M	J	J	A	S	O	N	D
Harbour porpoise												
White-beaked dolphin												
White-sided dolphin												

Key - Number of individuals sighted per hour of search effort

	High (10-100)		Moderate (1-10)		Low (0.01-1)		Very Low (0.01-0.01)		No Sightings

Harbour porpoise are observed throughout the year in the SNS and were sighted near the Pickerill Field during February, and from June to October in low to moderate numbers (Reid *et al*., 2003). White-beaked dolphins were observed with less frequency, with low numbers recoded during January and October, whilst white-sided dolphins were only observed in August in very low numbers (Reid *et al*., 2003).

The Small Cetaceans in European Atlantic waters and the North Sea (SCANS-III) project constitutes a large-scale ship and aerial survey to study the distribution and abundance of cetaceans in European Atlantic waters (Hammond *et al*., 2017). Information on the occurrence of cetaceans in the vicinity of the Pickerill installations from the SCANS-III data is provided in Table 4.5 below.

Table 4.5: Density and abundance of cetacean species recorded in the vicinity of the Pickerill Field (Block O) during the SCANS-III surveys (Hammond et al., 2017)

Species	Density (individuals/km^2)	Abundance
Harbour porpoise	0.888	53,485
White-beaked dolphin	0.002	143
Atlantic white-sided dolphin[1]	0.010	644
Minke whale	0.010	603

4.3.5.2 Seals

Two species of seals live and breed in the UK, namely the grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina* (Jones *et al*., 2015; DECC, 2016). Both grey and harbour seals are listed under Annex II of the EU Habitats Directive. Approximately 38% of the world's grey seals breed in the UK and approximately 30% of harbour seals are found in the UK. However, the harbour seal population has declined by approximately 40% since 2002 (Special Committee on Seals, 2017).

Important numbers of grey and harbour seals are present off the east coast of England, particularly around The Wash where harbour seals forage over a wide area (DECC, 2016).

Grey and harbour seals will feed both in inshore and offshore waters depending on the distribution of their prey, which changes both seasonally and yearly. Both species tend to be concentrated close to shore, particularly during the pupping and moulting season. Seal tracking studies from the Moray Firth have indicated that the foraging movements of harbour seals are generally restricted to within a 40–50 km range of their haul-out sites (Special Committee on Seals, 2017). 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).

Since the Pickerill installations are located approximately 59 km offshore, grey and harbour seals may be encountered from time to time, but it is not likely that they use the area with any regularity or in great numbers. This is confirmed by the grey and harbour seal density maps published by the Sea Mammal Research Unit (SMRU), which are provided in the NMPi (2018) and shown in Figure 4.5. The maps report the presence of grey seals between 1 and 50 per 25 km^2 within the vicinity of the Pickerill A platform, and less than 1 per 25 km^2 within the vicinity of the Pickerill B platform. Harbour seals within the proposed Pickerill field are noted as being between 1 and 50 per 25 km^2 (Jones *et al*., 2015).

[1] No individuals recorded in Block O of the survey area, wherein the Pickerill Field sits. Density and abundance data has been taken from Block R, to the north of the project area (Hammond *et al*., 2017).

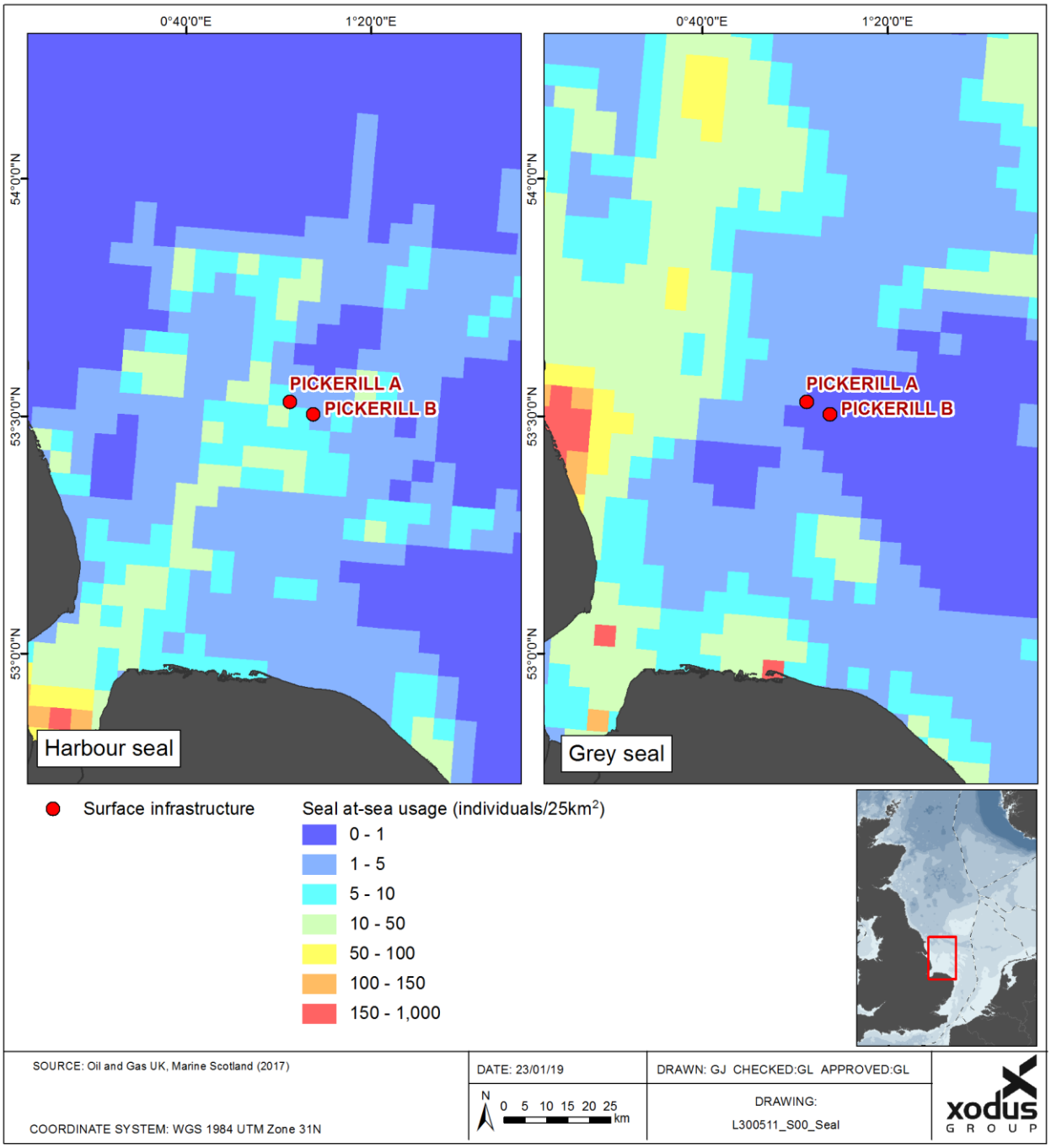

Figure 4.5: Seals at-sea usage (average numbers/ 5km^2) density maps within the vicinity of the Pickerill installations

Please note that no marine mammals were observed during the pre-decommissioning survey around the Pickerill B installation.

4.3.6 Protected Species

Harbour porpoise, Grey and harbour seals are listed in Annex II of the habitats directive and may be observed near the Pickerill project as described in section (4.3.5).

White-beaked dolphin and white -sided dolphins are three Annex IV marine mammal species which could be present near the Pickerill decommissioned installations. Due to the mobile nature of the species, they are likely to move away and not be adversely affected by the proposed Pickerill decommissioning activities described in Section 3.

All species of cetacean recorded within the proposed operations area are listed as European Protected Species (EPS). Other marine species listed as EPS's include turtles and sturgeon, which are not likely to be present within this area of the North Sea.

While sporadic individuals of *Sabellaria spinulosa* were evident from macrofaunal analysis of grab samples, no significant *Sabellaria* aggregations were evident on video footage or bathymetry data and as such there is no evidence for the potential presence of qualifying *Sabellaria* reef structures, as listed in Annex I of the habitats directive, within the survey area (BHM, 2018).

4.3.7 Conservation Areas

Designated sites within 75 km of the Pickerill A and B installations are detailed within Figure 4.6 and Table 4.6.

Table 4.6: SACs, SPAs and MCZs located < 100 km from the Pickerill platforms

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
SAC	Humber Estuary SAC	The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. It is a muddy, macro-tidal estuary, fed by the Rivers Ouse, Trent and Hull, Ancholme and Graveney. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast (JNCC, 2018).	58
	The Wash and North Norfolk Coast SAC	Marine areas, Sea inlets (51%) Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including salt work basins) (46%) Salt marshes, Salt pastures, Salt steppes (3%) (JNCC, 2018).	53

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
	Inner Dowsing, Race Bank and North Ridge SAC	Marine areas, Sea inlets (100%) (JNCC, 2018). The sandbanks typically have fields of sand waves associated with them. The Annex I biogenic reef habitats formed by *S. spinulosa* (cold water coral) are also present in this SAC.	23
	Haisborough, Hammond and Winterton SAC	Marine areas, Sea inlets (100%) (JNCC, 2018).	63
SAC	North Norfolk Sandbanks and Saturn Reef SAC	Marine areas, Sea inlets (100%) (JNCC, 2018). The sandbanks typically have fields of sand waves associated with them. The Annex I biogenic reef habitats formed by *S. spinulosa* are also present in the SAC.	32
	North Norfolk Coast SAC	This site comprises of a mixture of habitats including tidal rivers, sand beaches, sea cliffs and bogs. As such, there are a number of designated features for this site; Coastal lagoons, perennial vegetation of stony banks, Mediterranean and thermos-Atlantic halophilous scrubs, embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria*, fixed coastal dunes with herbaceous vegetation, humid dune slacks, otter and petalwort. (JNCC, 2018).	61
	Salfleetby-Theddlethorpe Dunes and Gibraltar Point SAC	This site comprises of salt marshes, salt steppes, coastal sand dunes, sand beaches, machair, bogs, marshes, water fringed vegetation and fens. This site is designated for the following features; shifting along the shoreline with *Ammophila arenaira* “white dunes”, fixed coastal dunes with herbaceous vegetation “grey dunes”, dunes with	58

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
		Hippopha rhamnoides, humid dune slacks and embryonic shifting dunes.	
	Norfolk Valley Fens SAC	This site is characterised by a number of habitats includes; inland water bodies, bogs, marshes, dry grassland, humid grassland and broad-leaved deciduous woodland. The site is designated for a number of features including; alkaline fens, northern Atlantic wet heaths with *Erica tetralix*, European dry heaths, narrow-mouthed whorl snail and desmoulin's whorl snail.	68
SAC	Southern North Sea SAC	This site is located to the east of England, with the majority of the site laying offshore. It comprises of a mixture of habitats including sandbanks and gravel beds. The site is designated for harbour porpoise.	12
	Overstrand Cliffs SAC	This site comprises of shingle, sea cliffs and inlets and is designated for vegetated sea cliffs of the Atlantic and Baltic Coasts (JNCC, 2018).	70
SPA	Humber Estuary SPA	The Humber Estuary is a large macro-tidal coastal plain estuary with high suspended sediment loads, which feed a dynamic and rapidly changing system of accreting and eroding intertidal and subtidal mudflats, sandflats, saltmarsh and reedbeds. The range of habitats on the Estuary (detailed in the feature descriptions) support a variety of wintering, passage and breeding birds, including internationally important populations of a number of species. Birds are widely distributed throughout the site, the distribution of individual species reflecting habitat distribution and species ecology (Natural England, 2018).	57

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
	The Wash SPA	The Wash is located on the east coast of England and is the largest estuarine system in the UK. It is fed by the rivers Witham, Welland, Nene and Great Ouse that drain much of the east Midlands of England. The Wash comprises very extensive saltmarshes, major intertidal banks of sand and mud, shallow waters and deep channels (JNCC, 2018).	71
SPA	North Norfolk Coast SPA	The North Norfolk Coast SPA encompasses much of the northern coastline of Norfolk in eastern England. It is a low-lying barrier coast that extends for 40 km from Holme to Weybourne and includes a great variety of coastal habitats. The main habitats – found along the whole coastline – include extensive intertidal sand- and mud-flats, saltmarshes, shingle and sand dunes, together with areas of freshwater grazing marsh and reedbed, which has developed in front of rising land. The site contains some of the best examples of saltmarsh in Europe (JNCC, 2018).	61
	Gibraltar Point SPA	This site is located on the Lincolnshire coast in eastern England. It lies north of The Wash and consists of an actively accreting sand-dune system, saltmarsh and extensive intertidal flats. The site is designated for Little Tern *Sterna albifrons*, Bar-tailed Godwit *Limosa lapponica*, Grey Plover *Pluvialis squatarola* and Knot *Calidris canutus* (JNCC, 2018).	67
MCZ	Holderness Inshore MCZ	This site is located north of the Humber estuary mouth and includes Spurn Head geological features. The site is designated for eight features; intertidal sand and muddy sand, moderate energy circalittoral rock, high energy circalittoral rock, subtidal coarse sediment, subtidal mixed	55

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
		sediments, subtidal sand, subtidal mud, and spurn head (subtidal) (Defra, 2016).	
MCZ	Holderness Offshore rMCZ	The Holderness Offshore recommended MCZ is an inshore/offshore site located approximately 11 km offshore from the Holderness coast in the Southern North Sea. The proposed site is predominantly composed of sediment habitats ranging from subtidal sand to subtidal coarse sediments and contains part of a glacial tunnel valley. The site is also the spawning and nursery ground for a number of fish species including lemon sole, plaice and European sprat.	17.5
	Cromer Shoal Chalk Beds rMCZ	Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) is an inshore site 200 metres off the North Norfolk Coast. It begins just west of Weybourne and ends at Happisborough, extending around 10 km out to sea and covering an area of 321 km2. The site protects seaweed-dominated infralittoral rock. These rocks in shallow water are an important habitat, providing a home for a variety of small creatures which shelter and feed amongst seaweeds. Within a wider area that is predominantly sandy, the chalk beds provide stable surfaces for seaweeds and static animals to settle on and grow. The beds are nursery areas for juvenile species as well as being important in the food chain for animals such as the fish, tompot blenny and the small-spotted catshark. The chalk beds are home to lobsters and crabs which settle within the crevices and holes (Defra 2016).	53

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
MCZ	Markham's Triangle rMCZ	This site is composed of a mix of subtidal coarse sediment, subtidal sand, subtidal mud and subtidal mixed sediments. This site is proposed to be designated for the following features; subtidal coarse sediment, subtidal sand, subtidal mud, subtidal mixed sediments.	60
MCZ	Silver Pit rMCZ	Located approximately 26 km from the Lincolnshire coast, this site incorporates the Inner Silver Pit glacial tunnel valley. Sloping from 11 - 98 metres the deep canyon walls here descend into a 50 km long glacial tunnel. The seafloor consists of mixed sediments and ross worm reef which in addition to blue mussel beds supports an abundance of marine wildlife, including brittlestars, sea squirts, hydroids, buried polychaete worms and bivalve molluscs. The deepest areas are carpeted in common and serpent's table brittlestars. Lemon and dover sole, sprat, whiting, cod, plaice and herring all spawn here and attract feeding white-beaked dolphins, minke whales and harbour porpoises.	16.5

Site Designation	Site Name	Description / General Site Characteristics	Distance to (closest) Pickerill installation (km)
MCZ	The Wash Approach rMCZ	Located 25 km off the Lincolnshire coast, at the entrance of the Wash, this diverse seabed consists of sandbanks (including the Race Bank, North Ridge and Dungeon Shoal Banks), interspersed with cobbles, ribbons of coarse sand, gravel and ross worm reef. Carpets of bryozoans, sea squirts, hydroids, sponges and anemones cloak the sand and gravel, whilst squat lobsters and crabs scuttle to and fro. Harbour porpoises, grey and harbour seals feed here all year round alongside abundant numbers of seabirds. The diverse waters also support many species of fish, including sandeels, Dover and lemon sole, whiting, thornback rays, sea scorpions, dragonet and weaver fish.	17

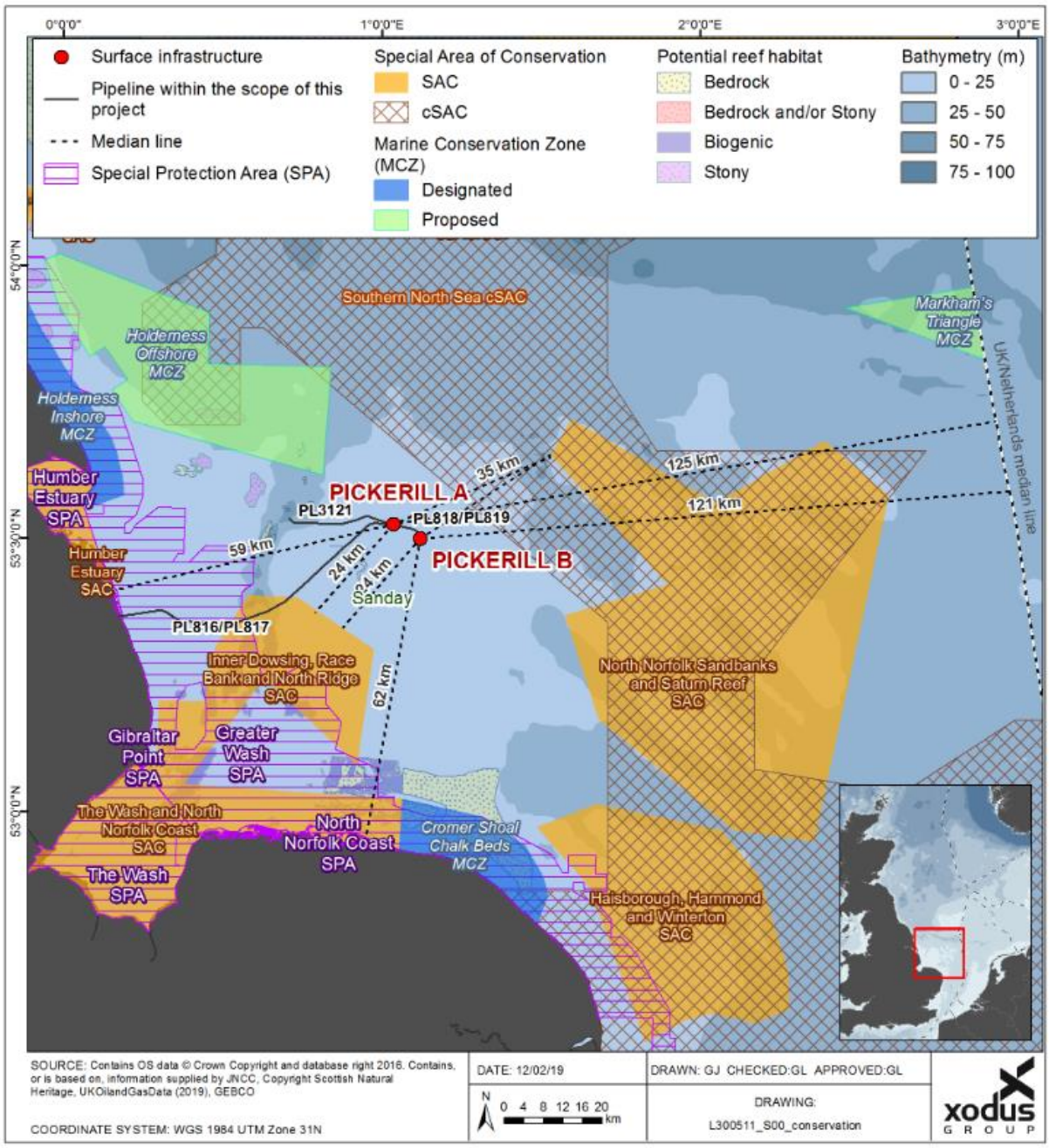

Figure 4.6: Relevant protected sites related to the Pickerill installations

The two export pipelines, PL816 and PL817, make landfall in the Lines Belt Marine Conservation Zone (MCZ), along the Lincolnshire coast. The decommissioning activities associated with these pipelines will be detailed within a separate Environmental Appraisal.

4.3.8 National Marine Plans / East Inshore and East Offshore Marine Plans

The Pickerill A and B field infrastructures are located within in the East offshore marine plan.

The East Offshore Marine Plan (DEFRA, 2014) was one of the first marine plans produced for English seas and came into force in April 2014. The aim of marine plans is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the marine plan areas. The proposed operations have been assessed against the marine plan objectives and sectoral and cross-sectoral policies, specifically EC01, BIO1, FISH1, FISH2, CC1 and CC2.

Assessment of compliance against relevant policies has been achieved through the impact assessments in Section 6. The proposed operations do not contradict any of the marine plan objectives and policies. Perenco will ensure they comply with all the policies; with particular attention being made to the following policies:

4.3.8.1 Policy ECO1

Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation. Perenco will ensure that any potential impacts associated with the proposed decommissioning of the Pickerill installations will be kept to a minimum.

4.3.8.2 Policy ECO2

The risk of release of hazardous substances as a secondary effect due to any increased collision risk should be taken account of in proposals that require an authorisation. Perenco will ensure that any potential collision risks associated with the proposed decommissioning of the Pickerill installations' vessels are kept to a minimum.

4.3.8.3 Policy BIO1

Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial). Perenco will ensure that any potential impacts associated with the proposed decommissioning of the Pickerill installations will be kept to a minimum.

4.3.8.4 Policy FISH1

Within areas of fishing activity, proposals should demonstrate in order of preference:

1. That they will not prevent fishing activities on, or access to, fishing grounds;
2. How, if there are adverse impacts on the ability to undertake fishing activities or access to fishing grounds, they will minimise them;
3. How, if the adverse impacts cannot be minimised, they will be mitigated; and
4. The case for proceeding with their proposal if it is not possible to minimise or mitigate the adverse impacts.

Perenco will ensure potential impacts to spawning and nursery areas during the proposed decommissioning of the Pickerill installations are kept to a minimum.

4.3.8.5 Policy FISH2

Proposals should demonstrate, in order of preference:

1. That they will not have an adverse impact upon spawning and nursery areas and any associated habitat;
2. How, if there are adverse impacts upon the spawning and nursery areas and any associated habitat, they will minimise them;
3. How, if the adverse impacts cannot be minimised they will be mitigated; and
4. The case for proceeding with their proposals if it is not possible to minimise or mitigate the adverse impacts.

Perenco will ensure potential impacts to spawning and nursery areas during the proposed decommissioning of the Pickerill installations are kept to a minimum.

4.3.8.6 Policy CC1

Proposals should take account of:

- how they may be impacted upon by, and respond to, climate change over their lifetime and
- how they may impact upon any climate change adaptation measures elsewhere during their lifetime.

Where detrimental impacts on climate change adaptation measures are identified, evidence should be provided as to how the proposal will reduce such impacts.

Perenco will ensure potential impacts associated with atmospheric emissions from the proposed decommissioning of the Pickerill installations are kept to a minimum.

4.3.8.7 Policy CC2

Proposals for development should minimise emissions of greenhouse gases as far as is appropriate. Mitigation measures will also be encouraged where emissions remain following minimising steps. Consideration should also be given to emissions from other activities or users affected by the proposal.

Perenco will ensure potential impacts associated with atmospheric emissions from the proposed decommissioning of the Pickerill installations are kept to a minimum.

4.4 Societal

4.4.1 Commercial Fisheries

The Pickerill installations are located within International Council for the Exploration of the Sea (ICES) Rectangle 36F1. The associated pipelines are located within ICES rectangle 35F0.

Landings associated with both ICES Rectangles 35F0 and 36F1 are dominated by shellfish species. Shellfish are predominantly targeted in this region by static fishing gear, such as pots and traps. Species targeted include: crabs, whelks, *Nephrops* and lobsters. Some demersal beam trawling targeting demersal finfish and flatfish takes place in the area; however, this is a minor contributor

to the total value of the commercial fisheries which utilise the region. Shellfish accounted for > 90% of the value and live weight landed between 2014 and 2017. Table 4.7 shows the live weight and value of demersal, pelagic and shellfish landings from ICES Rectangle 36F1 for the last five fishing years (Scottish Government, 2018).

Table 4.7: Live weight and value of fish and shellfish from ICES rectangle 36F1 in 2017 (Scottish Government, 2018)[2]

Species Type	2017		2016		2015		2014		2013	
	Live Weight (tonnes)	Value (£)	Live Weight (tonnes)	Value (£)	Live Weight (tonnes)	Value (£)	Live Weight (tonnes)	Value (£)	Live Weight (tonnes)	Value (£)
Demersal	1	505	6	13,192	10	24,511	44	76,336	36	53,855
Pelagic	-	-	-	-	-	-	-	-	<1	7
Shellfish	1,218	2,023,677	1,050	1,405,270	1,266	1,584,931	1,010	1,276,886	320	497,771
Total	1,218	2,024,182	1,057	1,418,462	1,275	1,609,442	1,054	1,353,222	356	551,633

Fisheries landings in the Pickerill Field are low compared to other regions of the UK. Whilst landings are dominated by high value shellfish species, effort in ICES Rectangle 36F1 remains high, whilst live weight tonnage remains low. In the most recent fishing year (2017), fisheries landings in the vicinity of the Pickerill Field contributed 0.2% of the total live weight tonnage landed in the UK and the 0.3% of the total landings value therein (Scottish Government, 2018).

Table 4.8 compares the average annual effort and landings from ICES Rectangle 36F1 to the average landings across the UK. The total fishing effort for 2012 – 2016 within ICES Rectangle 36F1 and the surrounding region is depicted in Figure 4.7 below.

[2] All values are rounded to the nearest whole number and disclosive data has been omitted.

Table 4.8: Summary statistics of total annual fishing effort by UK vessels > 10 m within ICES Rectangle 36F1 in comparison to UK averages for the last five fishing years (Scottish Government, 2018)[1]

Year	Within ICES Rectangle 36F1			Throughout the UK		
	Total Fishing Effort (days)	Average Value of Landings (£)	Average Quantity (tonnes)	Average Fishing Effort (days)	Average Value of Landings (£)	Average Quantity (tonnes)
2013	167	£551,633	356	93	£2,788,378	2,442
2014	456	£1,353,222	1,054	97	£3,262,317	2,962
2015	554	£1,609,442	1,275	92	£2,976,321	2,836
2016	410	£1,418,462	1,057	95	£3,610,706	2,795
2017	475	£2,024,182	1,218	92	£3,587,656	2,819
Annual Average	**412**	**£1,391,388**	**992**	**93.8**	**£3,245,075**	**2,770.8**

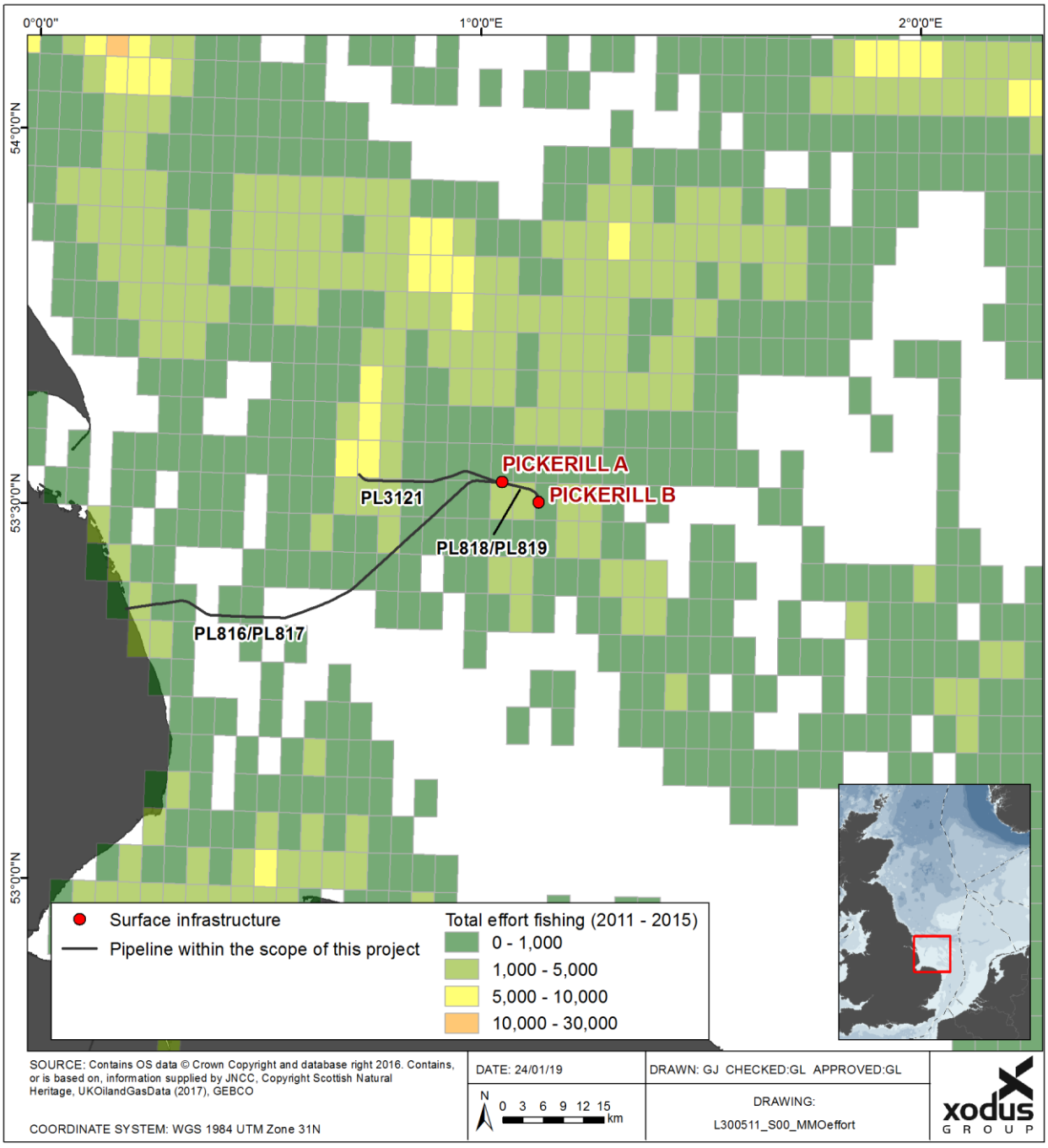

Figure 4.7: Total fishing effort (days) between 2012 - 2016 (MMO, 2017)

Fishing effort was roughly consistent between years in ICES Rectangle 36F1, except in 2013, when it was about a third lower than in other years (Table 4.8 and Table 4.9). Seasonal effort in ICES Rectangle 36F1 peaked during the summer (June – October), and was very low (i.e. data became disclosive) in the winter months. (Scottish Government, 2018). Overall, the fishing effort in ICES rectangle 36F1 was low compared to region surrounding the Pickerill Field (Figure 4.7), but high compared to the rest of the UK (Table 4.8).

Table 4.9: Number of days fished per month (all gears) in ICES rectangle 36F1 in 2013-2017 (Scottish Government, 2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	21	D	D	12	17	31	D	D	D	11	13	D
2014	D	15	36	40	D	53	53	42	51	46	51	27
2015	D	D	D	34	51	37	53	67	82	86	42	43
2016	14	25	D	D	D	28	42	86	67	18	35	D
2017 (p)	16	D	15	23	23	25	89	93	70	44	33	33

Note: Monthly fishing effort by UK vessels landing into Scotland: Blank = no data, D = Disclosive data (indicating very low effort), green = 0 – 100 days fished, yellow = 101 – 200, orange =201-300, red = ≥301]

4.4.2 Oil and Gas Activities

There are a number of installations located within the vicinity of the Pickerill decommission project as outlined in Table 4.10 and Figure 4.8.

Table 4.10: Oil and gas activities near the Pickerill Field

Infrastructure	Operator	Status	Pickerill A	Pickerill B
Amethyst A1D	Perenco	Active	24 WNW	30 WNW
Amethyst A2D	Perenco	Active	21 WNW	27 WNW
Amethyst B1	Perenco	Active	13 WNW	19 WNW
Amethyst CD	Perenco	Active	33 WNW	39 WNW
Anglia	Ithaca	Active	43 ESE	37 ESE
Barque PB	Shell	Active	31 ENE	26 ENE
Barque PL	Shell	Active	37 ENE	32 ENE
Clipper PC	Shell	Active	45 ESE	39 ESE
Clipper PT	Shell	Active	45 ESE	39 ESE

Infrastructure	Operator	Status	Pickerill A	Pickerill B
Clipper PW	Shell	Active	45 ESE	39 ESE
Clipper PH	Shell	Active	45 ESE	39 ESE
Excalibur	Perenco	Active	20 ESE	14 ESE
Galahad	Perenco	Active	19 ENE	13 ENE
Guinevere	Perenco	Production Ceased. Platform certified hydrocarbon free	20 SSE	14 SSE
Hoton	Perenco	Active	30 NNE	31 NNE
Hyde	Perenco	Active	29 NNW	33 NNW
Lancelot	Perenco	Active	25 ESE	19 ESE
Malory	Perenco	Active	11 ESE	6 ENE
Waveney	Perenco	Active	27 SSE	21 SSE
West Sole A (8 leg)	Perenco	Active	18 NNE	20 NNW
West Sole A (6 leg)	Perenco	Active	18 NNE	20 NNW
West Sole B	Perenco	Active	19 NNE	22 NNW
West Sole SP	Perenco	Active	18 NNE	20 NNW

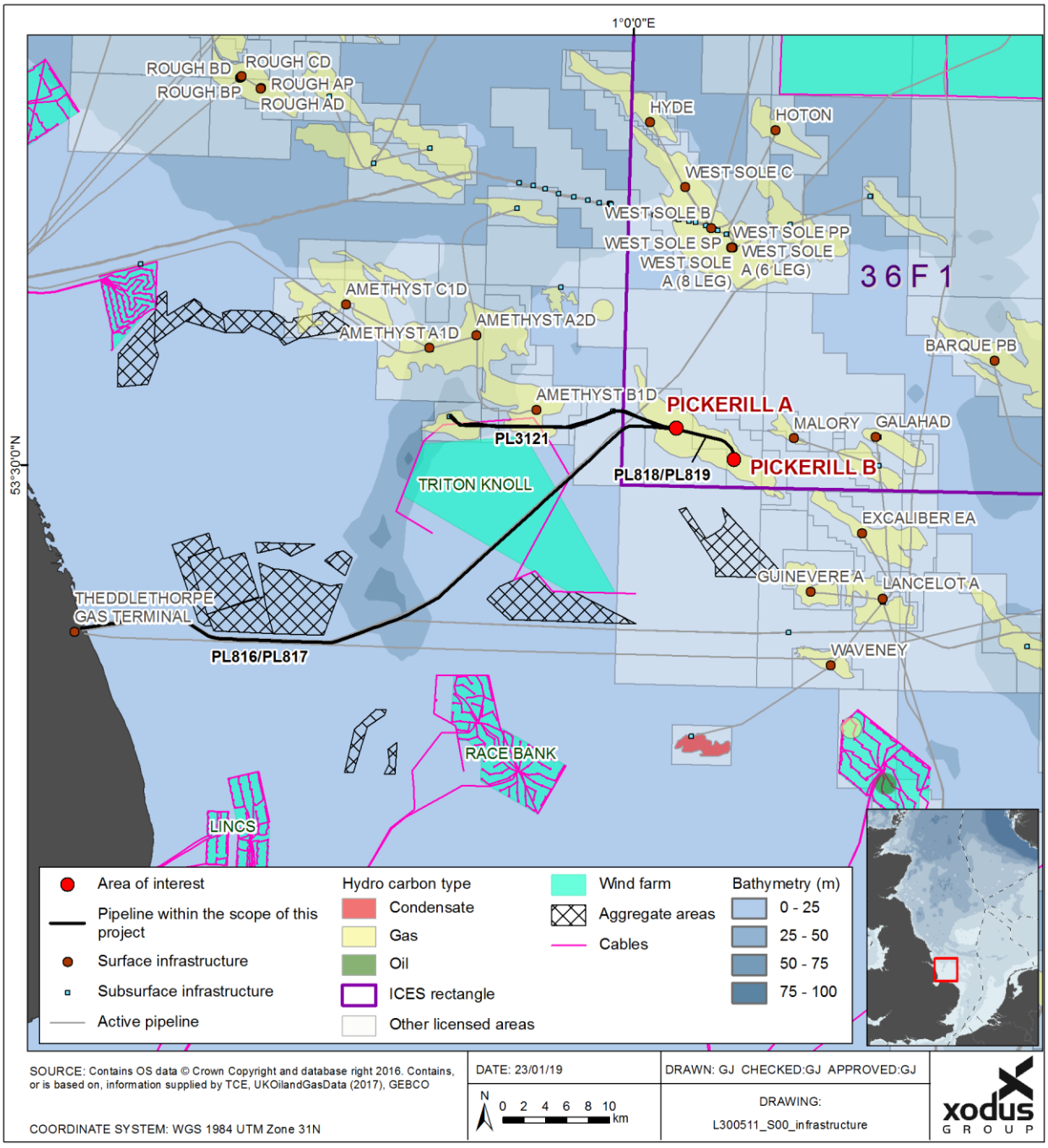

Figure 4.8: Other sea users in the vicinity of the Pickerill infrastructure

4.4.3 Aggregate Extractions, Offshore Renewables and Carbon Capture and Storage

There are a number of other users who utilise the seabed in the vicinity of the Pickerill installations. There are 11 aggregate production areas located within 85 km of the Pickerill installations. There are 14 windfarm sites within 65 km of the Pickerill field infrastructure, ten of these are leased sites with the other four in the planning consent stage, Table 4.11 and Figure 4.8.

Table 4.11: Aggregate sites within the vicinity of the Pickerill installations

Site	Operator	Distance and Direction to Pickerill infrastructure (km)
Sheringham Shoal Wind Farm	SCIRA Offshore Energy Limited (Lease)	39 SSW
Lincs Wind Farm	Lincs Wind Farm Limited (Lease)	50 WSW
Dudgeon Wind Farm	Dudgeon Offshore Wind Limited (Lease)	26 SSE
Humber Gateway Wind Farm	E.ON Climate & Renewables UK Humber Wind Limited (Lease)	50 WNW
Westermost Rough Wind Farm	Westermost Rough Limited (Lease)	63 WNW
Lynn Wind Farm	Lynn Wind Farm Limited (Lease)	59 SSW
Inner Dowsing	Inner Dowsing Wind Farm Limited (Lease)	56 WSW
Hornsea Project 1 (East)	Hornsea 1 Limited (Lease)	66 ENE
Hornsea Project 1 (West)	Hornsea 1 Limited (Lease)	47 NNE
Hornsea Project 1 (Centre)	Hornsea 1 Limited (Lease)	54 ENE
Hornsea Project Two	Breesea Limited (Agreement/option to lease)	40 NNE
Hornsea Project Three	Orsted Hornsea Project Three (UK) Limited (Agreement/option to lease)	85 ENE
Hornsea Project Four	Orsted Hornsea Project Four Limited (Agreement/option to lease)	32 NNE
Triton Knoll Wind Farm	Triton Knoll Offshore Windfarm (Lease)	12 WSW
Outer Dowsing Aggregate site	Westminster Gravels Limited	4.5 SSW
Humber 4 Aggregate Site	CEMEX UK Marine Limited	31 WNW

Site	Operator	Distance and Direction to Pickerill infrastructure (km)
Inner Dowsing Aggregate Site	Van Oord Limited Tarmac Marine Limited	38 WNW
Humber Estuary Aggregate Site	Hanson Aggregates Marine Limited	40 WSW
Off Saltfleet Aggregate Site	Tarmac Marine Limited	42 WSW
Humber 3 Aggregate Site	CEMEX UK Marine Limited DME Building Materials Limited	43 WNW
Humber 2 Aggregate Site	CEMEX UK Marine Limited	45 WNW
Humber Overfalls Aggregate Site	Tarmac Marine Limited	49 WSW
Humber 1 Aggregate Site	CEMEX UK Marine Limited	54 WNW
Humber 4 and 7 Aggregate Site	DME Building Materials Limited	62 ENE
Humber 5 Aggregate Site	DME Building Materials Limited	75 ENE

The recently consented Triton Knoll Windfarm is located 12.7 km west from the Pickerill infrastructure as shown in Figure 4.8. This project is jointly owned by Innogy, J-Power and Kansai Electric Power. Construction on the site began in September 2018.

4.4.4 Commercial Shipping

Regionally, the SNS contains numerous international ports and the area sees a moderate number of oil tankers, cargo vessels and ferries passing through (DECC, 2016). The latest shipping density list produced by the Oil and Gas Authority (2016) indicates that the level of shipping density can be considered high in the UKCS Block 48/11. The shipping density can also be considered high for the surrounding UKCS Blocks 47/10, 48/6, 48/7 and 48/12. The shipping density was moderate for the surrounding UKCS Block 48/17. It is considered very high in the UKCS Blocks 48/16, 47/20 and 47/15.

Shipping activity in the Project area ranges from very low to high as shown in Figure 4.9.

Automatic Identification System (AIS) satellite vessel data for 2017 -2018 (Anatec, 2018), focusing primarily on a six-month period comprising August – October 2017 and January – March 2018 indicates that there are a wide range of vessel types operating within 10NM, comprising:

- Cargo (57%);
- Tanker (30%);
- Offshore (9%);
- Dredger (1%);
- Tug (1%);
- Passenger (<1%:);
- Windfarm (1%); and
- Other (1%)

The average daily vessel numbers per month were in the region of 30-35 vessels. This did not vary greatly over the study period and the busiest day recorded 49 vessels (Anatec, 2018).

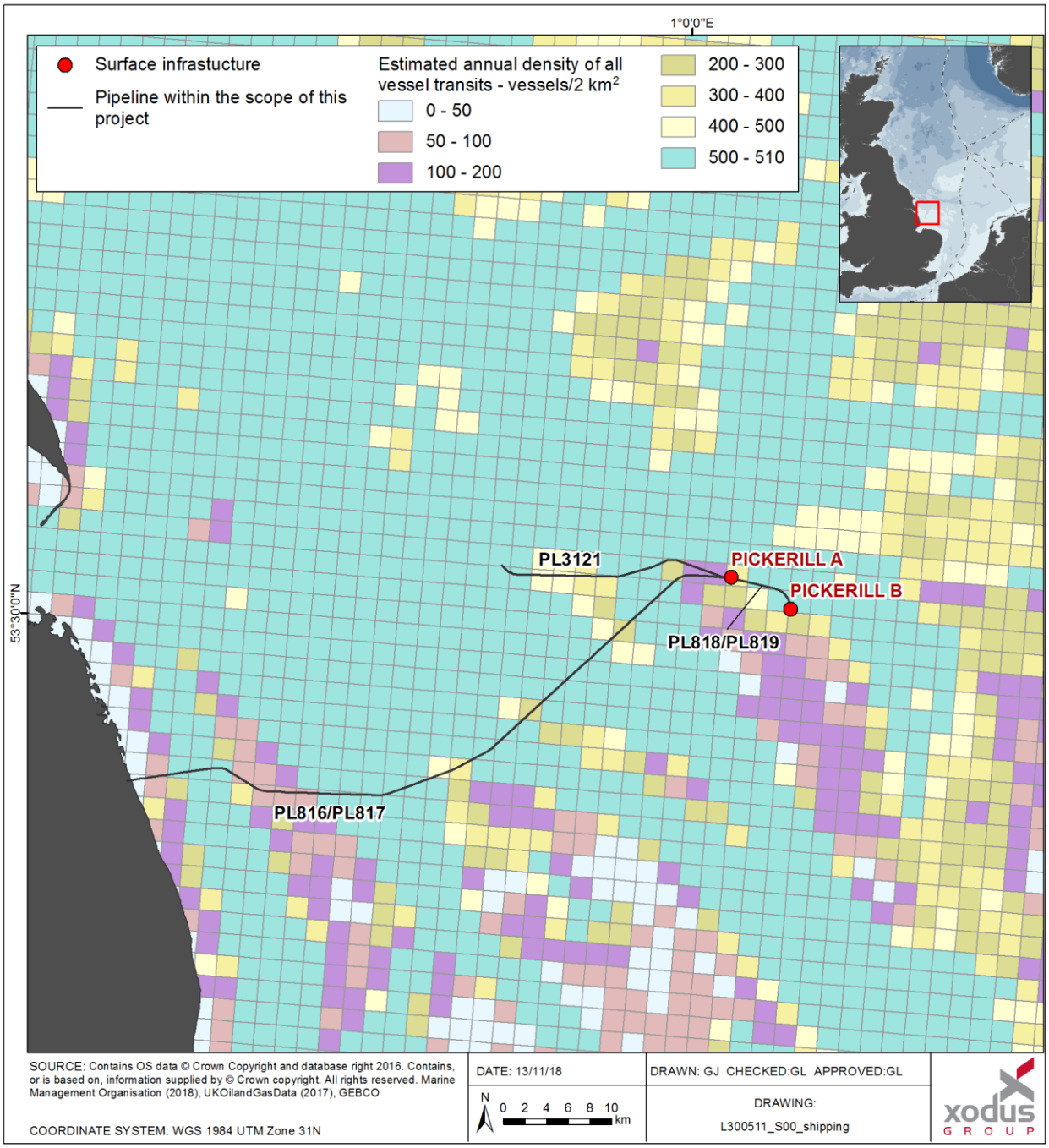

Figure 4.9: Estimated annual density of all shipping vessel transits

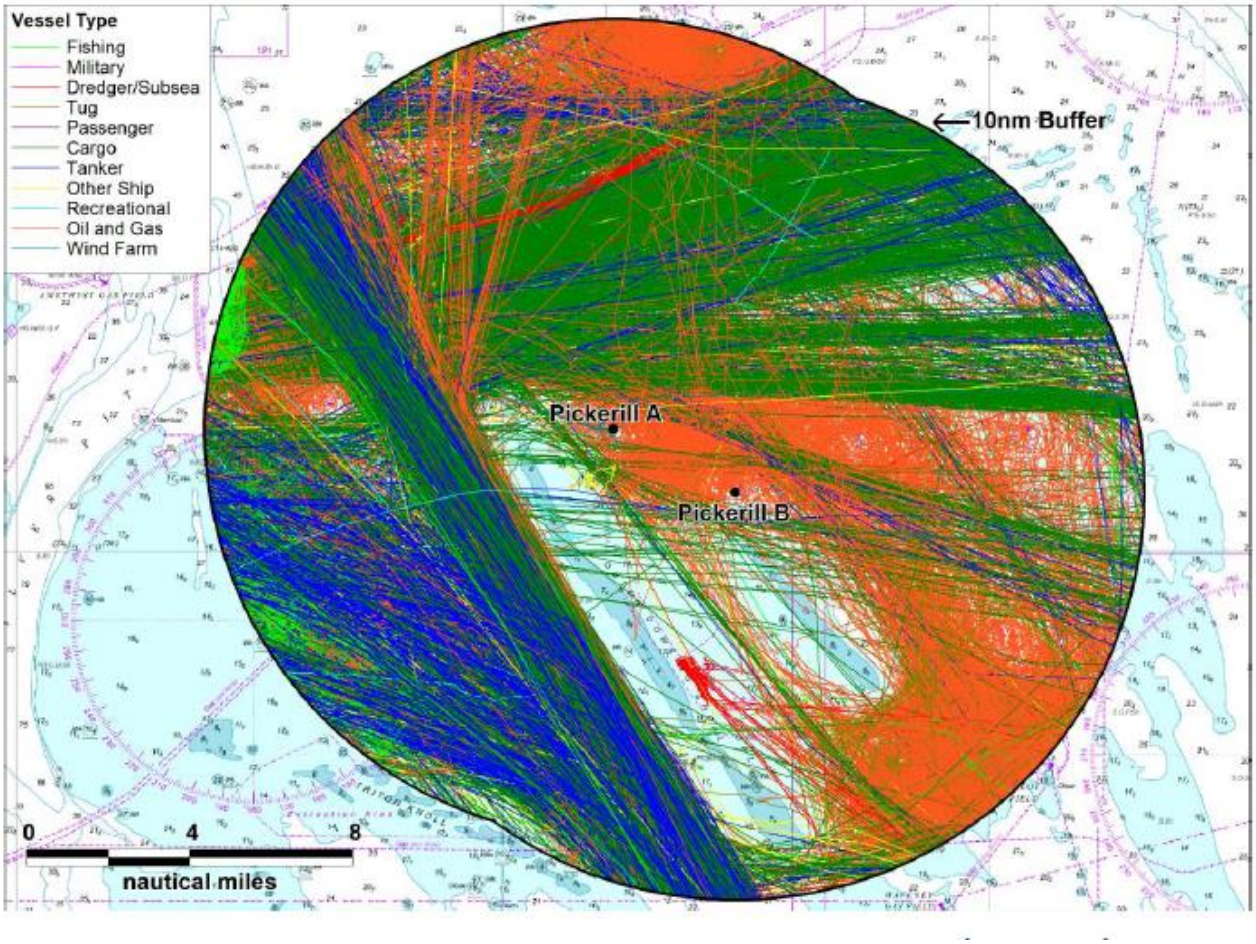

Figure 4.10: Filtered AIS track records within 10 NM of the Pickerill installations (over a 6-month period)

Recreational vessel activity is generally low, with a three Royal Yachting Association recreational offshore routes within approximately 50 km of the Pickerill infrastructure.

4.4.5 Telecommunications and Cabling

There are three cabled areas that are within the vicinity of the Pickerill installations, as detailed in Table 4.12. These areas are also shown in Figure 4.11.

Table 4.12: Cables in the vicinity of the Pickerill Platform A and B

Cables	Operator	Pickerill A	Pickerill B
Dudgeon extension	Statoil	31 km SE	26.5 km SE
Race Bank Array	Dong	29.5 km SW	30.5 km SW
Triton Knoll	Innogy	11.5 km WSW	15 km W

4.4.6 Military Activity

The Pickerill infrastructure is located in Block 48/11 and as such, it is not located within an MOD Danger and Exercise Area (DEA).

4.4.7 Wrecks

There are no designated historical wrecks recorded in the immediate vicinity of the Pickerill decommissioning project. However, there are two shipwrecks located to the south of the Pickerill installations:

- Umpire submarine (approximately 35 km south); and
- Vortigern Destroyer (approximately 40 km south).

5 ENVIRONMENTAL ISSUES IDENTIFICATION SUMMARY AND IMPACT ASSESSMENT METHODOLOGY

As required by the Petroleum Act, 1998 and OSPAR Decision 98/3, this section identifies and ranks the environmental and societal impacts and risks that could arise from planned and accidental activities associated with the proposed decommissioning activities.

The activities associated with the decommissioning (removal phase) of the Pickerill installations have the potential to give rise to environmental impacts in several different ways, including physical disturbance of the seabed and discharge to sea. These effects could arise as consequences of the following aspects of the DP, which have also been outlined in Section 3:

- Full removal of the topsides and jacket;
- Leaving the dispersed drill cuttings *in situ* (if present); and
- Accidental full diesel inventory loss from the HL vessel.

An assessment of the significance of the risks to any environmental and societal compartment as a result of the operations was undertaken. The assessment looked at both planned operations and accidental events. Where appropriate, site specific, transboundary and cumulative impacts were also included in discussions during the risk assessment process.

5.1 Risk Assessment Methodology

The purpose of the risk assessment is to:

- Identify potential impacts to the environment that may arise from the proposed decommissioning activity;
- Evaluate the potential significance of those potential impacts in terms of the threat that they pose to specific environmental receptors;
- Assign measures to manage the risks in line with industry best practice; and
- Address concerns or issues raised by stakeholders during the consultation for this EA.

The risk assessments were undertaken using PUKs Environmental Risk Assessment Methodology (PUK, 2017). Details are provided in Appendix A and the process is outlined below:

1) Each decommissioning activity was broken into its component, operations and end-points
2) Receptors at risk (elements of society or the environment) were identified from the potential operational impacts and end-point impacts.
3) The significance of the potential environmental impacts and risks was assessed according to pre-defined criteria. These criteria recognise the likely effectiveness of planned mitigation measures to minimise or eliminate potential impacts/ risks.
4) Assessments were undertaken to determine what level of impacts/ risks the component activity/ operation could pose to the different groups of environmental or societal receptors. The following Scoring Criteria and Risk Matrix were applied to complete the associated worksheets:
   - PUK's Consequence Matrix (Figure 9.4 and Figure 9.5).
   - PUK's Likelihood Matrix (Figure 9.3).

5) The overall significance of risk for a particular activity was determined by the PUK's Risk Matrix (Figure 9.2).

5.2 Risk Assessment Findings

Environmental and societal impacts from the planned and accidental events during the lifetime of the decommissioning project are presented in Table 5.1.

Taking the effects of planned mitigation into account, the risk assessment indicates that the general decommissioning activities carry one activity identified as high risk, and the other decommissioning activities relating to jacket and topside removal have several medium risks associated with them. These risks are assessed further in Section 6 and relate to the following aspects:

- Seabed impact (Section 6.1);
- Accidental Events (Section 6.2); and
- Other Users (Section 6.3).

For the impacts or risks that were considered, Table 5.1 provides a summary of the impacts and risks considered and provides some justification for inclusion in further assessment within the EA.

Table 5.1: Summary of impact assessment

Impact	Further assessment	Rationale
Emissions to air	No	Generally, emissions during decommissioning activities (largely comprising fuel combustion gases) will occur in the context of offshore storage, transfer to shore and treatment and/ or disposal of materials and emissions from burning of fuel during vessel operations. As such, emissions from operations and vessels associated with operation of the Pickerill installations will cease. Reviewing historical European Union (EU) Emissions Trading Scheme data and comparison with the likely emissions from the proposed work scope suggests that emissions relating to decommissioning will be small relative to those during production. A review of previous decommissioning ES's shows that atmospheric emissions in highly dispersive offshore environments are exclusively concluded to have no significant impact and are usually extremely small in the context of UKCS global emissions. Most submissions also note that emissions from short-term decommissioning activities are small compared to those previously arising from the asset over its operational life. The majority of emissions for the Pickerill installations removal relate to the vessel time. As the decommissioning activities proposed are of such short duration this aspect is not anticipated to result in significant impact. The estimated CO_2 emissions to be generated by the selected decommissioning options is 23,703.1 te, this equates less than 0.02% of the total UKCS vessel emissions (excluding fishing vessels) in 2014 (BEIS, 2017). Considering the above, atmospheric emissions do not warrant further assessment.

Impact	Further assessment	Rationale
Seabed impacts - Disturbance to the seabed and associated impacts on the fauna and habitat present in the vicinity of the installations	Yes	Currently it is envisaged there will be a direct seabed interaction associated with the decommissioning of the installations resulting from spud can placement, the use of vessel anchors and rig stabilisation material (if required) and removal of anything within the footprint of the installations (e.g. jackets, conductors, etc.) On this basis, further assessment is required.
Physical presence of vessels in relation to other sea users	Yes	The presence of a small number of vessels for installation decommissioning activities will be relatively short-term in the context of the life of the Pickerill installations. However, vessel activity may result in the exclusion of commercial fisheries and other users of the sea, a loss of fishing grounds and economic impact on commercial fisheries and present a short-term shipping hazard. Activity will occur using similar vessels to those currently deployed for oil and gas installation, operation and decommissioning activities. The small number of vessels required will also generally be in use within the existing 500 m safety zone and will not occupy 'new' areas. Other sea users will be notified in advance of activities occurring meaning those stakeholders will have time to make any necessary alternative arrangements for the very limited period of operations. The decommissioning of the Pickerill installations is estimated to require a maximum of three vessels (1 x HL vessel and 2 x support vessels) to be present at the DP site at any one time. A review of previously submitted decommissioning ES's and EA's show that some projects indicate a greater potential issue with short-term vessel presence, but those largely relate to project-specific sensitive locations and local levels of vessel traffic. Considering the above, the temporary presence of vessels requires further assessment.
Physical presence of infrastructure decommissioned *in situ* in relation to other sea users	No	As the topsides and jackets will be fully removed, there will be no mechanism for associated long-term impact through physical presence. Removal of the installations, and the removal of the 500 m safety zones once clear seabed state has been achieved, will result in a seabed area of circa 0.79 km^2 (per installation) made available for other sea users.
Discharges to sea (short-term and long-term)	No	The installations and pipeline system will have been through the HCF process prior to the commencement of decommissioning (removal phase) activities described herein. There will be no planned discharged to the marine environment relating to the DP. Seabed disturbance may lead to the suspension of sediments. However, the hydrodynamic conditions will result in suspended sediment, in particular the fine particles (fines), being transported away from the source of the disturbance. The natural settling of the suspended sediments is such that the coarser fraction (sands and gravels) will quickly fall out of suspension with the less dense material being the last to settle. This natural process will ensure that all the suspended sediment is not deposited in one location. It should be noted that there were little or no fine sediments present in the vicinity of the Pickerill B platform and evidence suggests that this would be the same for the Pickerill A platform area given the

Impact	Further assessment	Rationale
		proximity to the B platform and the consistence in the seabed multi-beam imagery (BHM, 2018). Given the temporary duration of seabed disturbance in association with the limited spatial extent of drill cutting materials (pre-decommissioning environmental survey work conducted at Pickerill B indicated no discernible cuttings pile), it is expected that any residual effects will be negligible and any seabed disturbance is highly unlikely to result in significant dispersal of contaminated materials. On this basis, further assessment is not required.
Underwater noise	No	Underwater noise will be generated from vessel dynamic positioning, engines and cutting activities. Cutting required to remove the jacket piles and vessel presence will be limited in duration. The project is not located within an area protected for marine mammals. With industry-standard mitigation measures and in-line with JNCC guidance for minimising the risk of injury to marine mammals from geophysical surveys, EAs for offshore oil and gas decommissioning projects typically show no injury, or significant disturbance associated with these projects (Shell, 2017; CNRI, 2013; CNRI, 2017; and Marathon, 2017). To support the well decommissioning phase of another PUK Installation Decommissioning Programme (covered by a separate EA), PUK recently commissioned a study to assess the impact of the noise generated from explosives used during down-hole well decommissioning activities on marine mammals. This study showed that the impact of this noise would be insignificant (PUK, 2018c). Any noise generated from the Pickerill A and B installations removal phase activities will be significantly less than the levels assessed during this study, and therefore on this basis, underwater noise assessment does not need assessed further.
Resource use	No	Generally, resource use from the proposed activities will require limited raw materials and be largely restricted to fuel use. Such use of resources is not typically an issue of concern in offshore oil and gas. The estimated total energy usage for the project is 435,649 GJ. Material returned to shore is not within the scope of the Decommissioning EA. Considering the above, resource use does not warrant further assessment.
Onshore activities	No	The OPRED Guidance states that onshore activities are not in scope of Decommissioning EA's, and this topic does not require further assessment. It should be noted that through PUK's Waste Management Strategy only licensed contractors will be considered who can demonstrate they are capable of handling and processing the material to be brought ashore. This will form part of the commercial tendering process.
Waste	No	It is waste management, not generation, that is the issue across DPs, with capacity to handle waste within the UK often cited as a stakeholder concern. Waste returned to shore is not within the scope of Decommissioning EA's, however it should be noted that the limited waste to be brought to shore, which will be routine in nature, will be managed in line with PUK's Safety and Environmental Management System (SEMS) as

Impact	Further assessment	Rationale
		part of the project Active Waste Management Plan (AWMP), using approved waste contractors (Section 4.7). On this basis, no further assessment of waste is necessary.
Employment	No	The Pickerill installations are both Normally Unattended Installations (NUIs), resulting in limited requirement to manage employment changes as a result of decommissioning. Considering the NUI status of the Pickerill installations, further assessment is not warranted for this aspect.
Accidental events - Collision of vessels offshore resulting in a release of hydrocarbons in the form of diesel fuel	Yes	The installations and pipeline system will have been through the HCF process prior to the commencement of decommissioning activities described herein. Release of a live hydrocarbon and chemical inventory is therefore not a relevant impact mechanism. The HL vessel to be used for removing the installations is likely to have the largest fuel inventory of the few vessels involved in the decommissioning activities. However, the inventory is likely to be less than the worst-case condensate spill from loss of pipeline containment modelled and assessed in the Pickerill field oil pollution emergency plan (OPEP). In addition, the vessel's fuel inventory is likely to be split between multiple separate fuel tanks, significantly reducing the likelihood of an instantaneous release of a full inventory. Overall, therefore, the potential impact from fuel inventory release will be, at worst, equivalent to that already assessed and mitigated for the operational phase of Pickerill. The current OPEP for the Pickerill installations considers a condensate release of approx. 450 m^3. For the purpose of this EA, it is considered that the worst case spill of the full HL vessel diesel inventory is equivalent to the 450m^3 of condensate. The results of the spill modelling within the existing OPEP indicate a limited likelihood (maximum of 11%) of beaching following an accidental release in winter. The shortest arrival time is 23hrs with an estimated volume of 48.9 m^3 of hydrocarbons. Sea surface oiling of 0.3 µm has the possibility to impact protected sites within the vicinity of the infrastructure. There exists the possibility that during ~~transport~~ dismantlement/removal of the materials, elements may dislodge and drop from the HL vessel. Dropped object procedures are industry-standard and there is only a very remote probability of any interaction with any live infrastructure. Although the risk of oil spill is remote, an OPEP is in place for the Pickerill Decommissioning activities. Any spills from vessels in transit and outside the 500 m zones is covered by a separate Shipboard Oil Pollution Emergency Plan (SOPEP). The decommissioning of the Pickerill installations is estimated to require a maximum of three vessels (1 x HL vessel and 2 x support vessels) to be present at the DP site at any one time. The current facilities OPEP will be reviewed and updated to assess the worst case accidental event in accordance with the Offshore Safety Directive Regulator (OSDR) requirements.

6 ENVIRONMENTAL AND SOCIETAL ASSESSMENT

6.1 Seabed Impacts

6.1.1 Approach

The Pickerill decommissioning activities (removal phase) will require work below, at or near the seabed, which may result in either short-term or long-term disturbance to the seabed sediments and marine organisms. The extent of any disturbance, combined with the seabed type and hydrodynamic conditions during the activities, will determine the burial and smothering from suspended sediments and any direct impact to species or habitats, as described in Table 6.1.

Table 6.1: Summary of potential sources of seabed disturbance and resultant environmental impacts

Decommissioning activity	Environmental impact			
	Suspended sediments	**Release of contaminants**	**Burial and smothering**	**Change in habitat**
Full removal of topsides	Short-term		Long-term*	Long-term*
Full removal of jackets	Short-term		Long-term*	Long-term*
Physical presence of drill cuttings pile *in situ*		N/A**		

*Only deemed a long-term impact if rock-protection is used for stabilisation of HL vessel. This is not anticipated but is considered here as a worst-case scenario.

**The recent environmental survey carried out for Pickerill B identified no evidence of a cuttings pile. The Pickerill A equivalent survey is still to be executed however a significant cuttings pile is not expected to be found.

6.1.2 Sources of Potential Impacts

The following activities represent worst-case scenarios and will potentially impact the seabed at the Pickerill facilities:

- Anchoring and positioning of a jack-up HL vessel on the seabed and the removal of the topsides and jacket (short and potential long-term impacts based on one vessel deployment per installation – topsides removal and jacket removal); and
- Possible excavation activities to enable access for a Remotely Operated Vehicle (ROV) and/ or cutting tool (short-term impact).

At this time, the HL vessel which will be used for the topsides and jacket removal works is not known. In order to make a conservative estimate of the potential seabed disturbance, a six-legged jack-up HL vessel has been assumed as worst case.

6.1.2.1 Jacket Removal

The weight (in air) of the Pickerill jacket is <10,000 tonnes and therefore it falls within the OSPAR 98/3 category of steel structures for which derogation cannot be sought. Therefore, the only decommissioning option available for the installations is full removal, as presented in Section 3.

The four piles on the jacket will be cut internally using high pressure water abrasion and removed to, approximately, 3 m below the seabed. As per the conductor removal, the cutting of the Pickerill A and B jacket legs may use garnet as a cutting medium. Should this method be used, this will result in garnet settling on the seabed. PUK estimate the garnet use to be circa 40 te based on 5 te per leg cut. The garnet deposit (circa 10 te) will be located within the excavation footprint of the jackets therefore it has not been considered as a separate impact event.

If the internal cutting operations encounter problems, excavation of an area around each jacket pile may be required. During excavation, sediment would be excavated by a work class ROV and would be deposited down-current of the jacket piles to undergo natural dispersal with minimal/ short-term impact on surrounding seabed area. Excavation of the footings has therefore been considered as a worst-case scenario. This seabed disturbance will be further assessed and permitted via the PETS process in the form of a marine license. Excavation of the jacket members and associated risers would impact a maximum seabed area of approximately 0.0012 km^2 (Table 6.2). Due to the proximity of the excavation it is possible there may be some overlap in the sediment deposition and this footprint is therefore an overestimate. Given the relatively coarse sediment characteristic of the seabed in this area (Section 4) dispersion of the sediment is expected to be rapid. The cut jacket will be removed from the seabed in a single lift and transported to shore by HL vessel for dismantlement, disposal and recycling.

Table 6.2: Structures and materials with potential to impact on the seabed – jacket removal pile excavation

Structures	Dimensions	Total seabed impact (km^2)
Pickerill jacket	(154 m^2 x 4 piles) x 2	0.0012
Jacket removal total		0.0012

6.1.2.2 Jack-Up Removal Vessel

The vessel contract for the removal of the topsides and jacket has yet to be awarded; it is planned that a jack-up HL vessel will be contracted. To represent a worst-case scenario, calculations have been based on:

- A large HL vessel supported on seabed by six spud cans and four positioning anchors;
- The topsides and jacket removal works for each installation being executed in independent vessel deployments (i.e. four deployments in total – two per installation) and
- Approximately 6,000 te (1,000 te per leg) of contingency stabilisation rock material.

Positioning the vessel spud cans on the seabed will impact a total seabed area of, approximately, 0.00053 km^2 (Table 6.3). The deployment of the positioning anchors will result in an area of disturbance of 0.0081 km^2.

Contingency Rock Stabilisation Material

It is possible that stabilising rock berms may be required to provide extra support for the vessel jack-up legs when working at the installation. The following assessment has been undertaken to allow for any contingency requirements for rock to be discussed prior to the submission of any subsequent deposit applications if this material should be required. The rock would be placed at six locations on the seabed as rock berms to support the six jack-up legs. The amount of rock required (and therefore footprint) is dependent on local bathymetry and sediment structure at the installation location. A direction for deposits application will be submitted to the OPRED to seek approval for the commencement of the rock-placement operations at the installation. The volume of rock and berm design will be detailed within the application.

PUK estimate the worst-case mass of rock required for the jack-up would be 6,000 te per vessel deployment. PUK estimate that 0.032 km^2 of the seabed would be impacted from the installation of the rock berms at the installations (Table 6.3).

Table 6.3: Structures and materials with potential to impact on the seabed – HL ~~Lift~~ vessel installation

Structures	Dimensions	Total seabed impact (km^2)
HL vessel spud cans	(6 x 22 m^2) x 4	0.00053
HL vessel (positioning anchors)	Anchors – (9 m^2x 4 anchors) x 4	0.00014
	Anchor chains – ((250 m with lateral movement of 2 m) x 4 chains) x 4	0.008
Contingency stabilisation material (rock berms)	(1.5 m x 6,000 tonnes) x 4	0.032
HL vessel installation total		**0.041**

6.1.2.3 Drill Cuttings Material Decommissioned *in situ*

Pre-decommissioning environmental survey work conducted at Pickerill B indicated no discernible cuttings pile, there was some minor evidence of historic presence of drilling related contamination, but this was below any level of concern and generally below UKOOA 95th percentiles. However, since no site-specific survey data is currently available for Pickerill A, the presence of residual cuttings deposits cannot be ruled out. However, any seabed disturbance is highly unlikely to result in significant dispersal of contaminated materials (BHM, 2018).

6.1.3 Short and Long-Term Impacts

The seabed impacts resulting from the decommissioning activities associated with the Pickerill installations can be classified as short or long-term. Short-term impacts can be defined as those which have transient impacts lasting a few days to a few years. Long-term impacts are those which will continue to have an impact for decades to centuries following decommissioning.

6.1.3.1 Short-Term Impacts

Excavation and anchoring activities will be temporary and will have a short-term impact on the local benthic environment in the Pickerill decommissioning area. The likely short-term impacts arising from these activities can be summarised as:

- Sediment disturbance within the water column; and
- Fauna disturbance.

6.1.3.2 Long-Term Impacts

- Habitat change;
- Seabed morphological change; and
- Fauna disturbance.

6.1.4 Short-Term Impacts on Sensitive Receptors

The following sections provide an overview of the current understanding of the potential impact to the seabed environment at Pickerill, enabling an assessment to be made of the spatial and temporal extent of the short-term impacts.

6.1.4.1 Sediment Disturbance

Sediments in the vicinity of the Pickerill facilities are described in Section 4. The proposed excavation, cutting and anchoring operations will physically disturb the sediment in the local area. The disturbance to the sediments will be short-term, localised and confined to a maximum estimated area of impact of approximately 0.042 km^2 (Table 6.4).

Table 6.4: Decommissioning activities with short-term potential to impact on the seabed and benthic fauna

Activity	Total seabed impact (km^2)	Table reference
Jacket removal	0.0012	Table 6.2
Jack-up HL vessel installation	0.0087	Table 6.3
Contingency rock for HL vessel	0. 032	Table 6.3
Total short-term impact	**0.042**	-

Sediments that are redistributed and mobilised as a result of the proposed decommissioning activities will be transported by the seabed currents before settling out over adjacent seabed areas. The hydrodynamic conditions (Section 4.2) will result in suspended sediment, in particular the fine particles (fines), being transported away from the source of the disturbance. The natural settling of the suspended sediments is such that the coarser fraction (sands and gravels) will quickly fall out of suspension with the less dense material being the last to settle. This natural process will ensure that all the suspended sediment is not deposited in one location. It should be noted that there were little or no fine sediments present in the vicinity of the Pickerill B platform and evidence suggests that this would be the same for the Pickerill A platform area given the proximity to the B platform and the consistence in the seabed multi-beam imagery (BHM, 2018).

Based on the seabed mobility in the area, the deposition resulting from the proposed decommissioning activities is likely to be comparable to the background sediment redistribution processes. Site-specific survey indicates the absence of any significant cuttings deposits in the area of Pickerill B and this would be expected to be the same at Pickerill A given the proximity to the Pickerill B platform and the energetic hydrodynamic conditions present in the mobile seabed environment of the southern North Sea. However, since no site-specific survey data is currently available for Pickerill A, the presence of residual cuttings deposits cannot be ruled out. However, the jacket removal and any excavation activities around the area of contamination are expected to have a minimal impact on the further dispersion of drill cuttings.

There is potential for seabed activities associated with the positioning of the HL vessels to result in the localised disturbance of minor contaminated sediments. Any suspended sediments are expected to fall out of suspension as previously described. Given the temporary duration of these activities in association with the limited spatial extent of drill cutting materials, it is expected that any residual effects will be negligible.

Published calculations of wave and tidal current-induced bed shear stress clearly show that large waves have the capability to mobilise seabed sediments, increasing sediment suspension particularly for those sizes of fine sands and smaller (ABPmer, 2012). Further, the sediment at and around the Pickerill field includes coarse sand, gravel, pebbles, shingle and cobbles which are often unstable due to tidal currents and/or wave action.

6.1.4.2 Fauna Disturbance

The Pickerill installations are located within spawning grounds for herring, cod, plaice, lemon sole, sole, sandeel, sprat, whiting and *Nephrops* of which herring, plaice, sandeel and *Nephrops* are demersal spawners (Section 4.3.3).

The proposed operations will physically disturb the benthic fauna living on or in the sediment in the local area. The disturbance to benthic fauna will be short-term, localised and confined to a maximum estimated area of impact of approximately 0.042 km^2 (Table 6.4).

The proposed activities will cause some direct impact to fauna living on and in the sediments. Mortality is more likely in non-mobile benthic organisms whereas mobile benthic organisms may be able to move away from the area of disturbance and return once operations have ceased. Upon completion of the subsea decommissioning activities, it is expected that the re-deposited sediment

will be quickly recolonised by benthic fauna typical of the area. This will occur as a result of natural settlement by larvae and plankton and through the migration of animals from adjacent undisturbed benthic communities (Dernie *et al*., 2003). In a series of large scale field experiments, Dernie *et al*. (2003) investigated the response to physical disturbance (sediment removal down to 10 cm) of marine benthic communities within a variety of sediment types (clean sand, silty sand, muddy sand and mud). Of the four sediment types investigated, the communities from clean sands had the most rapid recovery rate following disturbance.

Studies of seabed dredging sites indicate that faunal recovery times are generally proportional to the spatial scale of the impact (where the impact is between 0.1 m^2 and 0.1 km^2 (Foden *et al*., 2009). Biological recovery is therefore expected to be quicker in less extensive, dynamic sandy habitats (Hill *et al*., 2011). In low-energy areas of the North Sea subject to extensive dredging, local fauna took approximately three years to recover to the original level of species abundance and diversity. Studies of the impacts from anchoring indicate that the faunal recovery from the processes of anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1 to 5 years) (DECC, 2011). Based on the dynamic characteristics of the seabed in the Pickerill area, recovery would be expected to be at the lower end of this scale.

A small number of demersal and pelagic fish and their spawning grounds might also be temporarily disturbed by the removal of the structures. The potential release of minor levels of contaminants from the sediments is unlikely to affect the early life stages of any significant numbers of fish species spawning in the area during the time of operations. In addition, fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the activities. Therefore, the proposed activities are unlikely to have an impact on species populations or their long-term survival.

6.1.5 Long-Term Impacts on Sensitive Receptors

The following sections describe the potential impacts resulting from the placement of rock for stabilisation purposes at the Pickerill field.

6.1.5.1 Habitats Change

Habitat change will result from the introduction of hard substrate (rock-placement) into a predominantly soft substrate environment within the Pickerill area. Annex I habitats occurring within Pickerill include “habitat sandbanks” (JNCC, 2017).

As organisms associated with hard substrates will naturally be present in the wider area (cobbled reef habitat), the rock stabilisation would provide a relatively small additional rocky habitat for epibenthic organisms, without a significant alteration to the natural habitats present in the wider area. The seabed features that will result from rock-placement may also provide habitats for crevice-dwelling fish (e.g., ling, conger eel and wolf fish) and crustaceans (e.g., squat lobsters and crabs) in addition to attracting fish species to the site (Lissner *et al*., 1991).

6.1.5.2 Seabed Morphological Change

Morphological change in the seabed in the Pickerill area (further to the natural seabed dynamics evident in these areas) may result from the presence of rock placed on the seabed.

The worst-case footprint resulting from leaving associated supporting material *in situ* is estimated to be 0.032 km^2 (Table 6.5). In addition to this, there will be a small reduction in the long-term footprint through the removal of the jacket and its current footprint.

The long-term presence of the rock stabilisation material used for the jack-up HL vessel, could potentially influence sediment dynamics in the Pickerill area.

Table 6.5: Decommissioning activities with long-term potential to impact on the seabed habitat

Activity	Total seabed impact (km^2)	Table reference
Stabilisation material for the HL vessel	0.032	Table 6.3
Total	0.032	-

6.1.6 Cumulative and Transboundary Impact

Following completion of the proposed decommissioning activities, the total maximum seabed impact is expected to be 0.042 km^2. This includes the decommissioning of both Pickerill A and B.

Within 20 km of the Pickerill installations there are approximately nine oil and gas related infrastructures, all with varying dimensions and footprints. Based on the lack of information available regarding the physical extent of the footprint, the estimated lifespan and the planned method of decommissioning of these installations, it is difficult to quantify the level of potential cumulative impact from the existing infrastructure in the Pickerill vicinity.

The cumulative effect of these deposits and others that may be necessary during decommissioning activities at other facilities is not expected to significantly impact any conservation features. The proposed decommissioning activities are located, 125 km (Pickerill A) and 121 km (Pickerill B) west of the UK/ Netherlands median line. Decommissioning activities are not anticipated to create any transboundary impacts.

6.1.7 Proposed Mitigation Measures

Mitigation measures to minimise seabed impacts within the Pickerill decommissioning area during the removal phase are detailed within Table 6.6.

Table 6.6: Proposed mitigation measures

Potential sources of impact	Proposed mitigation and control measures
Subsea equipment: cutting, excavation and lifting	Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. Internal cutting techniques will be used.

Potential sources of impact	Proposed mitigation and control measures
Anchoring activities	All anchors will be completely removed from the seabed at the end of the decommissioning operations. An overtrawl survey (or equivalent) will be undertaken following decommissioning activities and establish whether any additional mitigation is needed.
Protection material: Rock (not anticipated as part of normal operations)	A rock-placement vessel or CSV with ROV will be used for any rock placement. The rock mass will be carefully placed over the designated areas of the seabed by ROV and/or controlled fall pipe equipped with cameras, profilers, pipe tracker and other sensors as required. This will control the profile of the rock covering and accurate placement of rock on the seabed to ensure rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance. Vessel orientation will be reviewed and selected to minimise the requirements for rock whilst allowing for the safe locating of the accommodation work vessel and access, i.e. crane reach to undertake essential scopes of work.

6.1.8 Conclusion

The cutting and lifting of the Pickerill jackets will create a temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.0012 km^2. This disturbance will be relatively small and occur due to the seabed excavation (where required), the ROV manoeuvring, and the use of cutting equipment. These activities will be controlled to minimise excavation activity and to ensure the accurate placement of cutting and lifting, thereby minimising the risk of sediment disturbance.

The contract for the topsides and jacket removal is yet to be awarded and it is possible that a jack-up HL vessel could be utilised. As a worst case (four vessel deployments with rock stabilisation and anchoring), the placement of such a vessel would impact a seabed area of 0.042 km^2. Recovery of the seabed and associated fauna following the removal of a jack-up ~~lift~~ HL vessel is expected to be rapid (<5 years). All anchors would be removed from the seabed following decommissioning operations and recovery of the seabed and associated fauna is expected to be rapid (<5 years).

The potential laying of stabilisation material for the removal vessel will impact the sediment through long-term, localised modification of the seabed over an estimated area of 0.032 km^2 and short-term physical disturbance caused by suspension of material into the water column. This impact will be mitigated by controlled placement of the rock material to minimise seabed footprint. In addition, there are patches of cobbles in the surrounding area so the small additions of a hard substrate would not be significantly different than the natural substrates present.

The rate of colonisation of new material such as rock in the installation area is difficult to predict, but as organisms associated with hard substrates will be naturally present in the area, the mattresses and areas of rock-placement provide a relatively small additional habitat for epibenthic rock-dwelling organisms.

Overall, the removal phase of the Pickerill facilities decommissioning is expected to impact a maximum area of seabed of 0.042 km^2.

6.2 Accidental Events

This section evaluates the potential impacts of accidental events and the proposed mitigation measures which PUK will implement to reduce an event's probability of occurrence and ensure that the environmental impact is reduced as far as is reasonably practicable.

The accident that presents the most likely worst-case environmental impact is the total loss of diesel fuel inventory from the HV vessel as the result of an accidental event such as a collision.

The potential risk from this event is examined in the following sections.

6.2.1 Hydrocarbon Releases

This sub-section examines the potential impacts of an accidental hydrocarbon release during the removal phase of decommissioning of the Pickerill installation.

6.2.1.1 Sources of Potential Impacts

All offshore activities carry the potential risk of a hydrocarbon loss to the marine environment. During the period from 1975 to 2005, a total of 16,930 tonnes of oil was discharged from 5,225 individual spill events in the UKCS (UKOOA, 2006). Analysis of spill data for this period shows that 46% of spill records related to crude oil, 18% to diesel and the remaining 36% to condensates, hydraulic oils, oily waters and other materials (UKOOA, 2006). During 2012 on the UKCS, a total of 248 oil spills were reported to OPRED, of which 8% were greater than 455 litres (ACOPS, 2013).

The potential sources of hydrocarbon spillages from the removal phase of the Pickerill installations have been identified through the risk assessment process and the knowledge and experience developed from PUK oil and gas operations in the North Sea. Based on this knowledge, the following scenarios have been identified for the proposed activities:

- Vessel sinking due to collision, releasing diesel to the sea;
- Diesel spill or diesel tank loss from a vessel; and
- Accidental bunkering fuel (diesel or aviation) spillage during refuelling.

There is only a small probability of a vessel collision occurring. Further, the subsea infrastructure and topsides are HCF and as such an accidental release of condensate is not considered here. Additionally, the Pickerill A and B wells will have been plugged and abandoned to stage 3. The possibility of marine diesel spillages and the associated impacts on sensitive receptors have been investigated below. The Pickerill condensate and diesel are both classified as an ITOPF Group 1 oil and thus have similar properties if released into the environment.

6.2.1.2 Oil behaviour at sea

When hydrocarbons are released to the marine environment, it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation (Table 6.7).

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important early on in a spill whilst oxidation, sedimentation and biodegradation become more important in later stages. The behaviour of hydrocarbons released at depth will depend on the

immediate physical characteristics of the release, subsequent plume dispersion processes and metocean conditions (DTI, 2001; ITOPF, 2012).

Table 6.7: Overview of the main weathering fates of oil at sea (DTI, 2001; ITOPF, 2012)

Weathering Process	Description
Evaporation	Lighter components of oil evaporate to the atmosphere. An oil with a high percentage of light and volatile compounds will evaporate more than one with a larger amount of heavier compounds.
Dispersion	Waves and turbulence at the sea surface can cause the slick to break up into droplets of varying sizes, which will start dispersing through the water column.
Emulsification	Emulsification occurs as a result of physical mixing promoted by wave action. The emulsion formed is usually very viscous and more persistent than the original oil and formation of emulsions causes the slick volume to increase between three and four times. This will slow and delay the other processes which cause the oil to dissipate.
Dissolution	Water soluble compounds in an oil may dissolve into the surrounding water.
Oxidation	Oils react chemically with oxygen either breaking down into soluble products or forming persistent tars. This process is promoted by sunlight.
Sedimentation	Sinking is usually caused by the adhesion of sediment particles or organic matter to the oil. In contrast to offshore, shallow waters are often laden with suspended solids providing favourable conditions for sedimentation.
Biodegradation	Sea water contains a range of micro-organisms that can partially or completely breakdown the oil to water soluble compounds (and eventually to carbon dioxide and water).

6.2.1.2.1 Hydrocarbon properties

The fate and effect of a spill is dependent on the chemical and physical properties of the hydrocarbons. The Pickerill facilities are HCF, and therefore the only potential source of hydrocarbons is diesel inventory from the vessels present at the DP site. The current OPEP

modelling has been based on the potential condensate that would be released should a blowout/pipeline split occur. This is expected to be a worse case in terms of potential marine impacts, a condensate release of the same volume as a diesel release would be slightly greater. However, if the volume of diesel on-board any of the contracted vessels is outside that of the modelled condensate, PUK will undertake additional modelling to account for this and update the OPEP accordingly.

Diesel is a very light oil which disperses quickly upon interaction with the marine environment. It is likely to exhibit rapid dispersion and undergo natural weathering processes quickly. Vessels will use ultra-low Sulphur fuel in line with MARPOL requirements.

The current OPEP for the Pickerill installations considers a condensate release of approx. 450 m^3. For the purpose of this EA, it is considered that the worst case spill of the full HL vessel diesel inventory is equivalent to the 450m^3 of condensate. The results of the spill modelling within the existing OPEP indicate a limited likelihood (maximum of 11%) of beaching following an accidental release in winter.

6.2.1.2.2 Impact Assessment and Oil Spill Modelling

An accidental hydrocarbon release can result in a complex and dynamic pattern of pollution distribution and impact in the marine environment. As there are a variety of natural and anthropogenic factors that could influence an accidental spill, each spill is unique. Long-term effects reported range from nothing detected (e.g., after the Ekofisk blow-out in 1977) to chemical contamination but no acute biological effects detectable (e.g., after the wreck of the Braer in 1993) (DTI, 2001). The extent of an environmental impact of a spill depends on several factors including:

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

Oil spill modelling for the Pickerill facilities is included within the OPEP (PUK, 2018a). The results are presented in the following section. This OPEP and spill assessment applies to the pre-HCF state of the platforms. Post HCF operations, the OPEP will be updated and the assessment made in relation to the HL vessel diesel inventory if that is greater than the currently modelled condensate volume.

6.2.1.2.3 Overview of the oil spill modelling undertaken

The worst-case oil spill at Pickerill is represented by an instantaneous loss of 450 m^3 of Pickerill condensate from pipeline PL816, at the Pickerill A platform. This was modelled using OILMAP Version 6.10.3.22.

The modelling results indicate the following:

- Beaching has a limited likelihood (maximum 11%) and is more likely to occur following an accidental release in winter than in other seasons. The shortest arrival time is 23 h (<1 day);
- The greatest volume beached is in winter - 48.9 m^3;
- No significant probability for oil moving across any median line found; and
- Sea surface contamination by oiling of 0.3 µm has the possibility to impact several protected sites (Figure 6.1)

6.2.1.3 Impacts on Sensitive Receptors

The potential for both short-term (temporary) and long-term impacts are assessed for the major taxonomic groups relevant to the southern North Sea marine environment in order to determine the potential scale of interaction within the vicinity of an accidental oil spill.

6.2.1.4 Impact on protected sites

The worst-case oil spill modelling demonstrated that there is a 25% probability for the condensate (with a minimum thickness of 0.3 µm) to impact the Holderness Offshore rMCZ and the Southern North Sea cSAC in less than 10 hours. The location of designated sites which are contaminated to a minimum threshold of 0.3 µm are illustrated in Figure 6.1.

Considering the properties of the Pickerill condensate no adverse or significant impact to protected sites are expected. In addition, no Major Environmental Impact (MEI) is expected as a result of a pipeline realise at Pickerill.

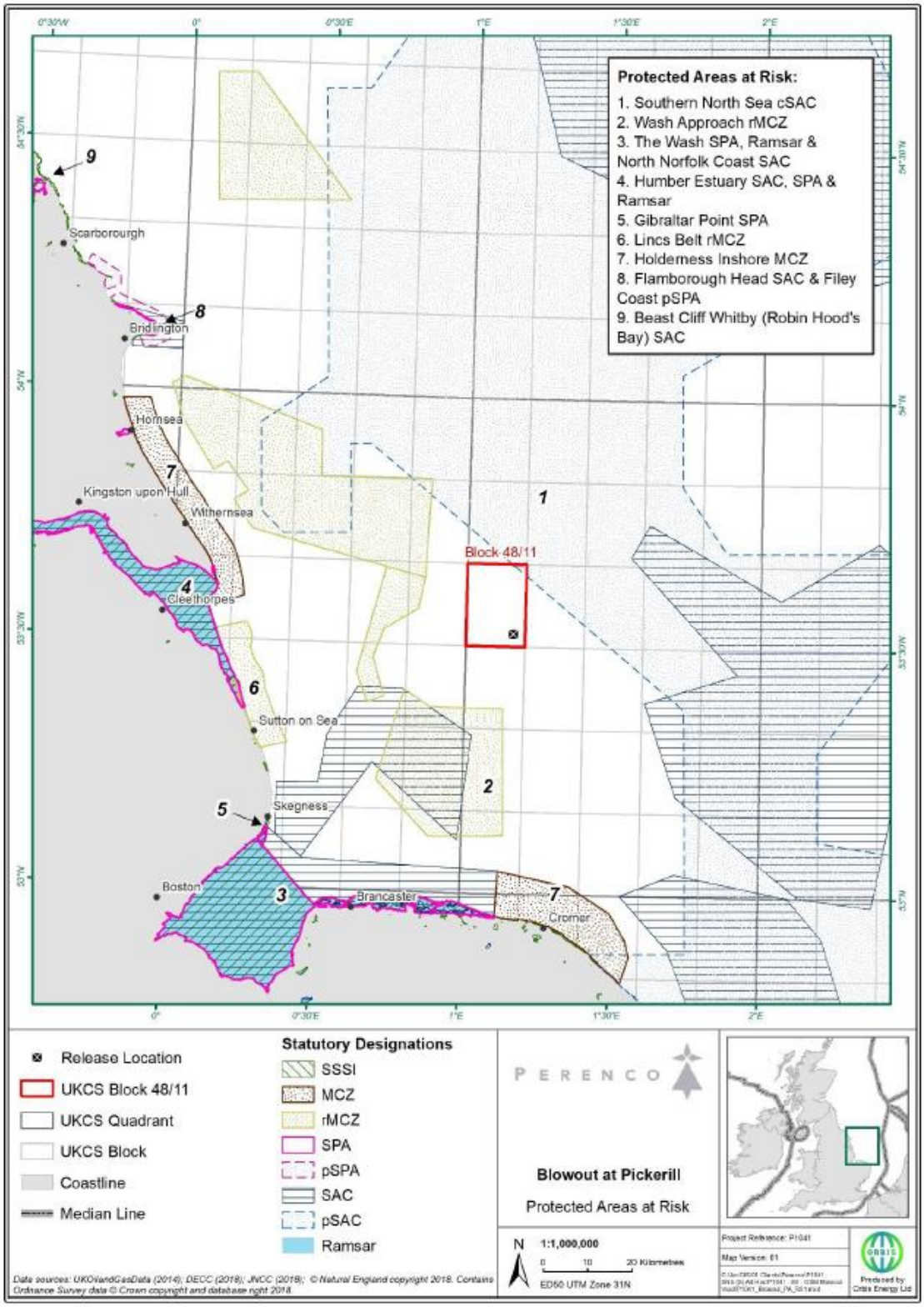

Figure 6.1: Location of designated sites with the potential to be contaminated by > 0.3 µm of condensate from a pipeline release at the Pickerill installations (PUK, 2018)

6.2.1.4.1 Biological receptors

Although there is only a small likelihood of a hydrocarbon spill from the Pickerill facilities, there is a potential risk to organisms in the immediate marine environment if a spill were to occur. The following section highlights the biological receptors that may be impacted from a potential oil spill incident. The potential effects of oil spills to marine life during the Pickerill installation's decommissioning activities are summarised in Table 6.8.

As the majority of potential spills are likely to be on the surface, both planktonic and benthic communities are less likely to be influenced by an accidental spill. Other communities including fish, birds and marine mammals may incur greater impacts. For a description of the environmental sensitivities in Pickerill facilities areas, please refer to Section 4.

Table 6.8: Summary of potential impacts to main biological receptors from a generic hydrocarbon release at the Pickerill installations location

Biological receptor	Effects and communities at risk
Plankton	Localised effects due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation. ITOPF (2012) reported that plankton is abundant and replenished by the constant movement of water body. There is little evidence that oil spills have caused a significant population decline in the open sea.
Benthos	The surface releases of diesel and condensate will likely not impact benthic communities and therefore the risk is considered minimal.
Fish, spawning and nursery grounds	The Pickerill infrastructure is located within ICES rectangle 36F1, which is spawning grounds for nine species. Those species which have benthic eggs have a dependency on specific substrata for spawning. For example, sandeels and herring lay their eggs on sandy sediments and therefore may spawn on sandy sediments within the interest blocks. The Pickerill infrastructure also lies within the nursery grounds for 8 species (Section 4.3.3). As most adult free-swimming fish will move away from oil contaminated water, fish kills in open water following an oil spill are rare (ITOPF, 2012). However, if fish may be affected by oil spills, hydrocarbons may result in tainting of the fish, and hence in a reduction of commercial value. Eggs and larvae may be affected, but such effects are generally not considered to be ecologically important because eggs and larvae are distributed over large sea areas. In addition, laboratory tests have not shown evidence that oil induced mortalities of fish and shellfish eggs and larvae in the open sea would result in significant effects on future adult populations (ITOPF, 1998).
Shellfish	Whilst data shows that shellfish species (*Nephrops*) are present in the vicinity of the Pickerill infrastructure (Section 4.3.3), the surface releases of diesel and condensate will likely not impact seabed communities and therefore the risk is considered minimal.

Biological receptor	Effects and communities at risk
Seabirds	The seabird sensitivity to oil pollution in UKCS Block 48/11, where the Pickerill infrastructure is located, and in surrounding blocks varies from low to high throughout the year (Oil & Gas UK, 2016). The most sensitive times of year for birds in the Pickerill area are November, December and March. Sensitivity was medium during January, February and August while being low May to July (Table 4.3). Physical fouling of feathers, damage to eyes and toxic effects of ingesting hydrocarbons can result in direct and indirect fatalities. Effects would depend on species present, their abundance, reliance on particular prey species and the time of year. Diving birds such as auks and gannets are particularly susceptible. Species most affected may be guillemots, razorbills and puffins that spend large periods of time on the water, particularly during the moulting season when they become flightless (DTI, 2001).
Marine mammals	The main cetacean species occurring in the Pickerill Field and surrounding Blocks are harbour porpoise, white-beaked dolphin, and Atlantic white-sided dolphin (Section 4.3.5.1). Grey seals and harbour seals are considered as frequent visitors to the Pickerill area (Section 4.3.5.2). Potential effects may include inhalation of toxic vapours, eye/ skin irritation and bioaccumulation. Ingestion of oil can damage the digestive system or affect liver and kidney function. Loss of insulation through fouling of the fur of young seals and otters increases the risk of hypothermia. Oil contamination can impact food resources directly through prey loss or indirectly through bioaccumulation. However, it is expected that marine mammals would avoid the area if a spill were to occur.
Protected habitats and species	The Pickerill area is located within 75 km of 13 designated and proposed conservation sites (Section 4.3.6, Table 4.6).

6.2.1.4.2 Shoreline impact

Oil spill modelling for a condensate pipeline release at the Pickerill installation area has predicted a low probability (maximum 11%) of shoreline contamination along the UK coast only. There is no beaching predicted for the Netherlands, Denmark, Belgium or French coastlines. The maximum beached volume is 48.9 m^3.

6.2.1.4.3 Societal receptors

A number of other users of the sea may be influenced by a potential accidental release during the Pickerill infrastructure decommissioning activities and are described in Table 6.9.

Table 6.9: Summary of main societal receptors

Societal receptor	Risks and status at the Pickerill installations
Fisheries	One of the primary economic activities in the EU, fishing supports other shore-based activities including fish processing and boat construction. Impacts to offshore fishing can be either restricted to the period that oil remains on the surface or could be closed for a specified period of time following an oil spill, as access to fishing grounds would be limited. There is the potential for fish that come into contact with oil to become tainted precluding commercial sale. There is no UKCS evidence of any long-term effects of oil spills on offshore fisheries. The value and quantity of fish landed in ICES rectangle 36F1 is higher than the UK average while the fishing effort is low in comparison to other North Sea areas (Scottish Government, 2018) (Section 4.4.1).
Tourism	Coastal tourism can be adversely affected by oil pollution events owing to reduced amenity value. Impact can be further influenced by public perception and media coverage. The offshore location of the Pickerill installations (greater than 59 km from the nearest coast), combined with the limited beaching (probability and volume) suggests that there is unlikely to be any impact on tourism.
Shipping	The latest shipping density list produced by the Oil and Gas Authority (2016) indicates that the level of shipping density can be considered high in the UKCS Block 48/11 (Section 4.4.4, Figure 4.9). Although all may potentially be impacted by an oil spill, the impacts likely last only while oil is on the sea surface, as this may restrict access.
Oil and gas/ wind farms	The Pickerill installations are located in the southern North Sea gas basin, which is densely populated by various installations (Figure 4.8). The closest platforms to Pickerill are the Malory located 6 km North East, the Galahad located 13.5 km North east and the Guinevere located 14.5 km south east from Pickerill (Table 4.10). There are 11 aggregate sites located in the vicinity of the Pickerill installations and 14 wind farm sites (Section 4.4.3, Table 4.11). Although these receptors may potentially be impacted by an oil spill, the impacts would likely last only whilst there is oil on the sea surface as this may, for example, restrict access to installations/ on boarding of the aggregate material. As such, it is considered unlikely that there will be any long-term impacts on this industry.

6.2.1.5 Cumulative and Transboundary Impacts

The sub-sections below summarised the residual, cumulative and transboundary impacted expected in case of accidental oil spill event.

6.2.1.5.1 Residual impacts

During removal operations, the loss of hydrocarbons contained within tanks and storage sumps may result in a small release, which would cause a localised and temporary deterioration in water quality. PUK will ensure that pumps and tanks in the topsides are emptied and cleaned prior to removal. Any vessel receiving or handling the topsides will operate under the OPEP until it exits the 500 m zone, after which the vessels SOPEP will take primacy.

The residual risk of an environmental impact from accidental spills during the decommissioning of the Pickerill installations will be reduced to levels that are 'As Low As Reasonably Practicable (ALARP)'. This will be achieved by the preventive measures incorporated during design, operational control procedures and training. Even with these in place, there will still be a residual, albeit very low, risk of marine environmental and/or societal impact.

6.2.1.5.2 Cumulative impacts

Cumulative effects arising from the decommissioning activities at the Pickerill installations have the potential to act additively with those from other oil and gas activities, including both existing activities and new activities, or to act additively with those of other human activities (e.g., fishing and marine transport of crude oil and refined products) (DTI, 2004).

Any hydrocarbon discharge as a result of the decommissioning activity would be expected to evaporate rapidly in the immediate environment without the potential to combine with other discharges from concurrent incidents. It is difficult to precisely predict whether the impacts from an oil spill to the marine ecology of the affected area would be cumulative. This would depend on previous disturbances or releases at specific locations. Cumulative effects of overlapping "footprints" for detectable contamination or biological effects are considered to be unlikely. No significant synergistic effects are anticipated (DTI, 2004).

6.2.1.5.3 Transboundary impacts

The modelling did not show any measurable amount of oil moving over any median line. The Marine and Coastguard Agency (MCA), Counter Pollution and Response Branch also have agreements with equivalent organisations in other North Sea coastal states (Belgium, France, Germany, Ireland, the Netherlands, Norway, Sweden and Denmark), under the Bonn Agreement 1983. In the case of a spill reaching the English Channel, the Anglo-French Joint Maritime Contingency Plan (Mancheplan) covering counter pollution and rescue operations, will be activated.

6.2.1.6 Mitigation Measures

Mitigation and management primarily focus on preventing or minimising the probability of an accidental spill and secondly, reducing the consequences of the event through optimum and efficient containment and release response. During decommissioning, minor non-routine and emergency events such as minor leaks, drips and spills from machinery and hoses on the installation, from vessels, could cause a localised and temporary impact. The accidental release of small quantities of oil would be minimised as far as possible through appropriate management procedures and mitigation measures. The effects of such releases will be immediately rectified on site and managed through vigilance, operational, inspection and emergency procedures, and

specific safeguards such as on-site clean-up equipment and containment measures. For these reasons, such minor events have been excluded from this assessment as they will be managed under normal operational procedures and controls.

PUK's planned response to all spills is detailed in the relevant OPEP (PUK, 2018a). Table 6.10 lists the planned measures to prevent or reduce the likelihood of a spill occurring during decommissioning of the Pickerill installations. Based on the estimated volumes of diesel, the PUK response capability for both counter pollution and containment is capable of providing an appropriate level of spill response. The mitigation measures and contingency plans in place would consider all foreseeable spill risks and would ensure that the spill risk is reduced to ALARP.

6.2.1.7 Conclusions

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

- A worst-case scenario (equating to 450m^3 of diesel) of a release at the Pickerill installations would result in spilt contaminants potentially reaching/travelling through designated sites, the probability of such an occurrence remains low and the duration of the hydrocarbon within the marine environment is short;
- The diesel is likely to remain afloat on the water surface and has a high evaporation rate upon release to sea. Should the removal vessels diesel inventory be greater than the modelled condensate volume then additional modelling and assessment will be made following vessel award and prior to further decommissioning works offshore;
- The probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area; and
- The approved OPEP response will provide the direction and strategies required to effectively manage the spill in the case of an accidental event.

Table 6.10: Oil spill preventive measures for likely scenarios during decommissioning

Potential source of impact	Proposed mitigation and control measures
All oil spills	The inventories will be minimised prior to removal. The OPEP's have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The OPEP's detail responsibilities for initial response and longer-term management and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the spill size: Tier 1 - standby vessel equipped with dispersants and spraying equipment; Tier 2 - air surveillance and dispersant spraying through Oil Spill Response Ltd. (OSRL); and Tier 3 - clean-up equipment and specialist staff available through OSRL. In addition, PUK have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability Fund (OPOL).

Potential source of impact	Proposed mitigation and control measures
Vessel collision	Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	In the event of an accidental spill to sea, vessels will implement their SOPEP.

6.3 Other Users of the Sea

This section describes the potential impacts to other users of the sea which may result from the activities associated with the proposed removal phase of the Pickerill Field decommissioning programme. The assessment herein focuses on the societal aspects of the environment and aims to address potential impacts on individuals and how they utilise the environment.

6.3.1 Approach

As discussed in Section 5, the activities which have the potential to impact other sea users are limited to the physical presence of vessels and their associated activities. Impacts from these activities include:

- Introduction of temporary shipping hazards.

The following activities are not anticipated to impact upon other users and have, therefore, been screened out from further assessment:

- Physical presence of infrastructure decommissioned *in situ*; and
- Employment.

6.3.2 Sources of Potential Impact

Vessel activity associated with the decommissioning of the Pickerill topsides and jackets, will be limited on both temporal and spatial scales. The vessel activity associated with the decommissioning activities will occur within the current 500 m safety exclusion zone.

6.3.3 Impacts on Sensitive Receptors

There is potential for vessel use to present a short-term hazard to commercial shipping, or a short-term exclusion from commercial fishing grounds. However, these potential impacts will be limited by the number and size of vessels to be employed for the decommissioning activities. The section below details the potential impacts of project-related vessel activity on commercial fisheries and shipping users.

6.3.3.1 Temporary shipping hazards

The presence of a small number of vessels during the decommissioning activities will be relatively short-term (in the range of two to four months). Vessel activity associated with the decommissioning of the Pickerill topsides and jackets, will be limited on both temporal and spatial

scales. The vessel activity associated with the decommissioning activities will occur within the current 500 m safety exclusion zone.

Activity will occur using similar vessels to those currently deployed for oil and gas installation, operation and decommissioning activities. The small number of vessels required will also be in use within the existing 500 m safety zone and will not occupy 'new' areas. Other sea users will be notified in advance of activities occurring meaning those stakeholders will have time to make any necessary alternative arrangements for the very limited period of operations. Once decommissioning activities have been completed and verification of a clear seabed has been given it is envisioned that the 500 m safety exclusion zone around each installation will be removed. This will result in the availability of an additional 0.4 km^2 of potential fishing ground previously excluded from the fleet.

The decommissioning of the Pickerill installations is estimated to require up to eight vessels depending on the selected method of removal, however these would not all be on location at the same time (max of three at any one time).

6.3.4 Cumulative and Transboundary Impact

Although the area of the SNS has high vessel activity the low number of vessels required (maximum of three vessels at any one time) and the short duration (two to four months) and the fact that decommissioning activities will primarily be within the 500 m safety exclusion zone, there are not perceived to be any significant cumulative impacts associated with these activities.

There are in the region of 457 safety zones in operation in the UKCS (UKOilandGasData, 2019). The decommissioning of the Pickerill A and B platforms would see the removal of two of these zones resulting in the release of approximately 0.4 km^2 of potential fishing ground. This would reduce the area of the southern North Sea that is currently unavailable to other users of the sea and reduce the cumulative impact of the oil and gas physical presence in the region. There are no significant cumulative impacts associated with the proposed decommissioning activities.

As the Pickerill decommissioning area is beyond the UK's 12 NM limit, EU and non-EU vessels are also permitted to fish in the area, subject to management agreements including, for example, quota allocation and days at sea. Although the area is primarily fished by UK registered vessels (61% of fishing vessels) there are a number of other nationalities who utilise the area. Including French (35%), Dutch (3%) and Danish and Flemish (1% combined). These foreign vessels are primarily stern trawlers and dredgers; however, this activity is still relatively low in comparison to other regions of the North Sea (Anatec, 2018).

6.3.5 Proposed Mitigation Measures

The proposed mitigation measures to reduce the likelihood of impact to other users of the sea in the vicinity of the Pickerill installations or the decommissioning activities are presented in Table 6.11.

Table 6.11: Proposed mitigation measures

Potential sources of impact	Proposed mitigation and control measures
Temporary shipping hazard	All offshore decommissioning activities will be notified to stakeholders prior to vessels undertaking these activities. Notifications will be sent out via kingfisher navigation bulletins and direct notification with the fishing industry. In addition, the 500 m safety exclusion zone will remain in operation during the decommissioning activities limiting exposure of other sea users to the presence of these decommissioning vessels. All decommissioning vessels will operate a manned bridge policy and have active AIS positioning in operation so other vessels can identify the decommissioning vessels via radar.

6.3.6 Conclusions

Considering the above, the temporary presence of vessels poses a low risk to commercial fishing and other users. As such, the impact on other users of the sea is considered not significant.

7 CONCLUSIONS

7.1 Summary

During the removal phase of the Pickerill A and B installations decommissioning, the topsides of both facilities will be completely removed and as the substructures fall below the OSPAR 98/3 Decision thresholds for consideration for derogation, the jackets will be recovered to shore leaving a clear seabed.

As required by the Petroleum Act, 1998 and OSPAR Decision 98/3, PUK have undertaken an environmental and societal risk assessment, to identify and rank the potential hazards due to the Pickerill installations decommissioning activities. The risk assessment concluded that, post-mitigation, there is one 'high' risk decommissioning activity and several 'medium' risks. These risks are:

- Seabed impacts;
- Accidental Events; and
- Risk to other users of the sea.

Following further assessment and implementation of additional control and mitigation measures the level of impact from these aspects was reduced to 'low' and therefore not significant. These control and mitigation measures are an essential component of the decommissioning project Environmental Management Plan (see below).

7.2 Environmental Management

In order to ensure that the environmental and societal impact of the decommissioning activities remains as low as reasonably practicable, PUK will adhere to their in-house management procedures, including but not limited to contractor management, vessel inspections and audits and the legal obligation to report any accidental discharges and emissions which may occur. As the impact assessment in this report details, the decommissioning to the Pickerill A and B installations are unlikely to have a significant impact on the environment of other users (both offshore and onshore) if the control and mitigation measures are applied effectively. A summary of the PUK's environmental commitments are presented in Table 7.1 and all proposed mitigation measures is shown in Table 7.2.

Table 7.1: Environmental Commitments

Issue	Commitment
Atmospheric emissions	• Vessels will be audited as part of selection and pre-mobilisation. • Work programmes will be planned to optimise vessel time in the field. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plan and maintenance systems.

Issue	Commitment
	• Vessels will use ultra-low Sulphur fuel in line with MARPOL requirements. • All mitigation measures will be incorporated into contractual documents of subcontractors.
Underwater noise	• Machinery and equipment will be in good working order and well-maintained. • The number of vessels utilising dynamic positioning will be minimised. • PUK will minimise risk to marine mammals from underwater noise throughout operations in-line with industry guidance.
Seabed impact	• Cutting and lifting operations of subsea equipment will be controlled and any impact on seabed sediment will be minimised. • Internal cutting will be used preferentially where access is available to avoid interaction with the sediment adjacent to the Pickerill installations. • The requirements for excavation will be assessed on a case-by-case basis, with the aim of minimising the area of excavation. • All anchors (where they are used) will be completely removed from the seabed following decommissioning operations. • Vessel orientation will be reviewed and selected to minimise the requirements for rock placement whilst allowing for the safe locating of the accommodation work vessel and access, i.e. crane reach to undertake essential scopes of work. Site specific assessment will be completed to assess suitable locations. • Post-removal surveys of the seabed will be carried out to identify significant anomalies and dropped objects.
Onshore impact	• Licensed contractors will be used at licensed sites for all waste related management.
Shipping	• PUK have undertaken a site-specific shipping assessment prior to the Pickerill decommissioning operations (Anatec, 2018) • Prior to commencement of operations, the appropriate notifications will be made, and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used in accordance with the consent to locate conditions to ensure other users of the sea are made aware of the presence of vessels. • The number of vessels standing by at Pickerill will be kept to a minimum.

Issue	Commitment
	• A mandatory 500 m safety zone will remain around the Pickerill infrastructures during the decommissioning activities.
Fisheries	• On-going consultation with fisheries representatives. • Post-decommissioning seabed clearance. • Overtrawl survey (or equivalent) to be completed after removal of infrastructure. • Materials left *in situ* will be mapped, the UK Hydrographic Office (UKHO) and Kingfisher informed and legacy management / survey requirements to the agreed with OPRED.
Discharges to sea	• Cutting and lifting operations will be controlled and managed to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment which may lead to the release of contaminated sediment via sediment resuspension. • Any vessel related discharges will be managed in line with MARPOL requirements.
Accidental spills and dropped objects	• The Oil Pollution Emergency Plan (OPEP) has been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. This OPEP will be updated in line with operational stages as required throughout the preparation and decommissioning lifecycle. • PUK have specialist oil spill response services provided by OSRL and are members of the OPOL. • Local shipping traffic will be informed of proposed decommissioning activities and a standby/support vessel will monitor shipping traffic at all times. • Any spill originating from the HL vessel during the removal operations will be controlled under the installations OPEP. Any accidental spill to sea out-with the 500 m safety zone will be managed by individual vessel Shipboard Oil Pollution Emergency Plans (SOPEP). • PUK will conduct all operations in a controlled manor with trained personnel using suitable equipment. All vessels will have suitable spill containment kits and an efficient spill response process is in place. • PUK routinely swap out perishable equipment such as hoses, and a management programme is implemented in order to ensure their integrity.

Issue	Commitment
	• Prior to the transfer of materials, visual checks and pre-bunkering checklists are undertaken by trained personnel in communication with the standby vessel. • Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities. • Items recovered will be secured in a bunded area to ensure that any spills containing residual hydrocarbon traces are captured, preventing loss to sea. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects.
Waste	• An AWMP will be developed and put into place before the decommissioning activities commence. This plan will ensure that individual waste streams are appropriately managed, staff / crew are aware of waste management requirements and waste storage, transfer and final disposal / recovery is compliant with relevant legislation. • Opportunities where materials destined for landfill can be reduced, or otherwise recycled or reused, will be actively sought out.
Environmental responsibilities	• Key environmental responsibilities, duties, communication, reporting and interface management arrangements of PUK and any main contractors involved in the decommissioning activities will be agreed, documented and communicated at the appropriate stages of the project.
Delivery of commitments	• The commitments made within this EA will be incorporated into operational work programmes, plans and procedures. • Programmes will be tracked to ensure that commitments and mitigation measures are implemented throughout the project.

Table 7.2: Proposed mitigation and control measures

Control and mitigation measures
General and Existing
• Lessons learnt from previous decommissioning scopes will be reviewed and implemented as appropriate; • Vessels will be managed in accordance with PUK's existing marine procedures; • The vessels' work programme will be optimised to minimise vessel use; • The OPEP is one of the controls included in a comprehensive management and operational control plan developed to minimise the likelihood of large hydrocarbon releases and to mitigate their impacts should they occur; • All vessels undertaking decommissioning activities will have an approved Shipboard Oil Pollution Emergency Plan (SOPEP) for use outside of the installations' 500 m zones; • Existing processes will be used for contractor management to assure and manage environmental and social impacts and risks; • PUK's management of change process will be followed should changes of scope be required; • All mitigation measures will be incorporated into contractual documents of subcontractors; and • Vessel activities will be of relatively short duration.
Seabed Disturbance
• All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised; • Where possible, the decommissioning activities will be undertaken outside the spawning periods of the potentially affected species; • A debris survey (or equivalent) will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from oil and gas activities will be recovered from the seabed where required after consultation with OPRED; and • The area that requires an overtrawl assessment will be optimised through discussion with the relevant fishing organisations and regulators.
Large-scale Releases to the Sea
• Any release will be managed under the existing OPEP. The OPEP will be updated with additional inventory as required should modelling show increased risk; • All vessel activities will be planned, managed and implemented in such a way that vessel durations in the field are minimised; • PUK's existing marine procedures will be followed to minimise risk of hydrocarbon releases; and

Control and mitigation measures
• Risk of a complete inventory loss from a vessel is very low given that the majority of vessels have compartmentalised or distributed fuel tanks, making complete containment loss highly unlikely.
Risk to other users
• Any potential snagging hazards identified will be discussed with regulators and remediated where required; • All offshore decommissioning activities will be notified to stakeholders prior to vessels undertaking these activities. Notifications will be sent out via kingfisher navigation bulletins and direct notification with the fishing industry; • A 500 m safety exclusion zone will remain in operation during the decommissioning activities limiting exposure of other sea users to the presence of these decommissioning vessels; and • All decommissioning vessels will operate a manned bridge policy and have active AIS positioning in operation so other vessels can identify the decommissioning vessels via radar.

7.3 Final Remarks

The majority of the environmental and societal effects of the removal phase of the Pickerill A and B installations decommissioning activities will be short term and of insignificant impact. As outlined in the above table, PUK has undertaken a range of control and mitigation measures to ensure that the impact is minimised as far as reasonably practicable. PUK's Safety and Environmental Management System will ensure that all the measures described herein to minimise and mitigate against environmental impact will be delivered and these will be documented in the close out report.

Overall, it is concluded that the proposed Pickerill A and B installations decommissioning project will not result in any significant negative environmental or societal impact.

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9 APPENDIX A – ENVIRONMENTAL IMPACT METHODOLOGY

The process for identifying and assessing environmental risk, and managing that risk is summarised in Figure 9.1.

Full details are provided in the PUK Environmental Risk Assessment Methodology document (PUK, 2017).

The methodology employs a likelihood and consequence risk matrix as indicated in Figure 9.2. Aspects assessed to lie within the green and yellow areas are either acceptable or tolerable if as low as reasonably practicable (ALARP). Red scouring aspects would be intolerable and would require further mitigation before they could be undertaken.

Definitions for the likelihood categorisation is provided in Figure 9.3 and the definitions for each category of consequence is provided in figures Figure 9.4 to Figure 9.5.

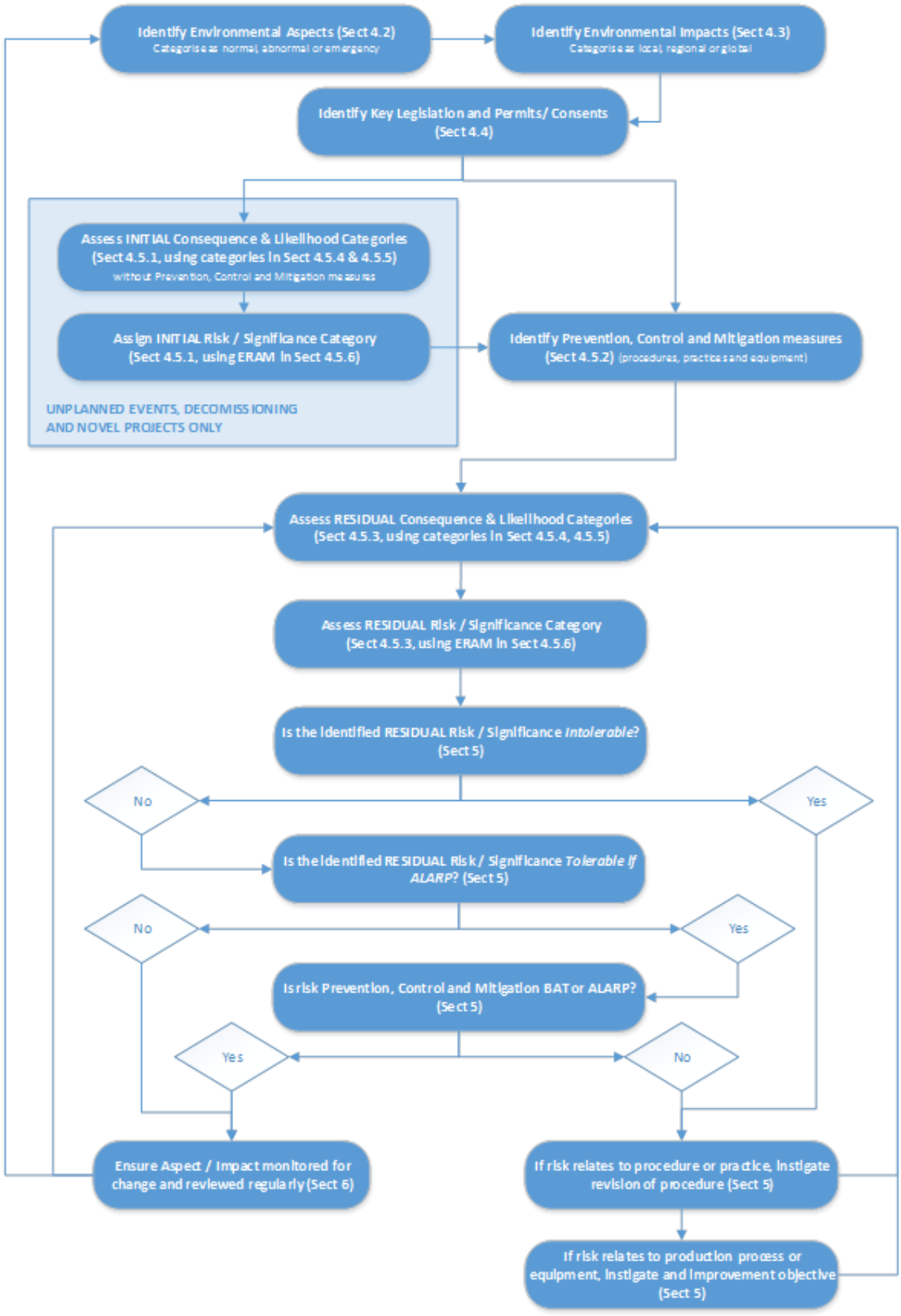

Figure 9.1: Environmental risk assessment process

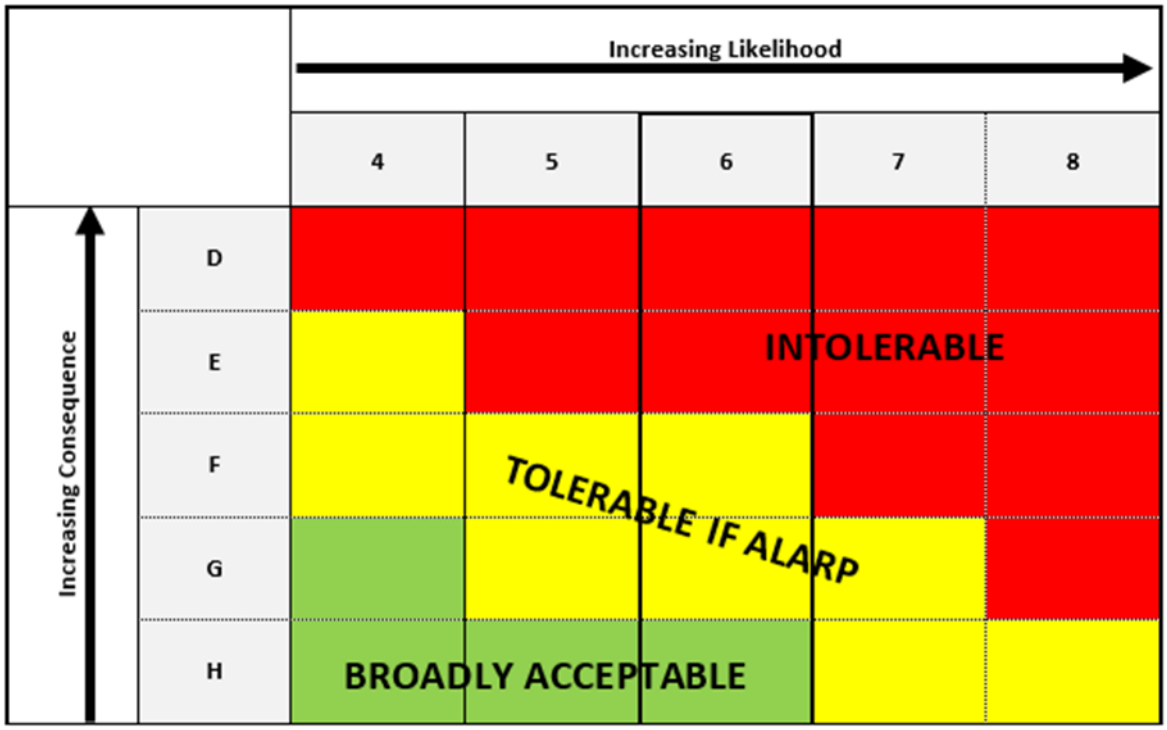

Figure 9.2: Environmental risk assessment matrix

Category		Definition	
		Incidents	Planned Activities
More frequent	8	Common occurrence at the facility (at least annually)	Not applicable
	7	Likely to occur five or more times in facility lifetime	Not applicable
	6	Likely to occur once or twice in facility lifetime	All planned activities
	5	Likely to occur at least once within the lifetime of ten similar facilities	Not applicable
Less Frequent	4	Similar event has occurred within UKCS	Not applicable

Figure 9.3: Definition of likelihood for environmental aspect assessment

Environmental Receptor	Consequence - OFFSHORE				
	Lower				Higher
	H	G	F	E	D
Marine water quality	Routine oil in produced water discharges <2 te/yr. Oil and chemical discharges within permit limits for last 12 months. Routine discharge of chemicals with OCNS Gold/Silver Ranking or D/E Grouping, within permit limits.	Routine oil in produced water discharges >2 te/yr. Isolated breach of oil in produced water / drainage concentration limits (100 mg/l instantaneous; 30 mg/l monthly average) within last 12 months. Malfunction or breakdown of discharge abatement equipment, even if still within discharge limits. Routine discharge of chemicals with OCNS White or higher ranking, or A/B/C grouping, or SUB warning, to sea within permit limits.	Regular breaches of oil in produced water / drainage concentration limits (100 mg/l instantaneous; 30 mg/l monthly average) within last 12 months. Isolated breach of chemical permit limits within last 12 months.	Regular breaches of chemical permit limits within last 12 months.	
	For **high sensitivity receptors** (near shore waters and beaches; Marine Protected Areas (MPA), including SACs, SPAs, MCZs, SSSIs, & RAMSAR sites), increase consequence by one category.				
Marine sediments	No contamination above background &/or national / international quality standards &/or known biological effect concentrations on scale < **2 km**.	Short term contamination above background &/or national / international quality standards &/or known biological effect concentrations on scale < **2 km**.	Medium term contamination above background &/or national / international quality standards &/or known biological effect concentrations on scale < **2 km**.	Long to medium term contamination above background / national / international quality standards &/or known biological effect concentrations on scale > **2 km**.	Long term/ permanent contamination above background &/or national / international quality standards &/or known biological effect concentrations on scale > **2 km.**
	For **high sensitivity receptors** (near shore waters and beaches; Marine Protected Areas (MPA), including SACs, SPAs, MCZs, SSSIs, & RAMSAR sites), increase consequence by one category.				
Plankton, benthic communities, fish / shellfish, marine mammals, seabirds / coastal birds / migratory birds, protected or sensitive habitats	No identifiable disruption of population. No identifiable impact on critical habitat or activity.	Localised and /or short term impacts to portion of population. Minor and temporary impact on critical habitat or activities. No threat to overall population viability. Recovery < 1 years.	Medium term impacts to a portion of the population. Minor impacts on critical habitat or activities. No threat to overall population viability. Recovery 1-5 years.	Widespread or long-term disruption to a significant portion of the population. Moderate impacts on critical habitats or activities. Recovery 5-10 years.	Extensive and/or long-term / permanent impact on population(s). Significant impact on critical habitats or activities. Recovery >10 years or permanent.
	For **high sensitivity receptors** (near shore waters and beaches; Marine Protected Areas (MPA), including SACs, SPAs, MCZs, SSSIs, & RAMSAR sites), increase consequence by one category.				
Climate change	CO_2 emissions <20,000 t/yr Gas venting <200 t/yr F-Gas Inventory of <50 t CO_2e	CO_2 emissions 20,000 - 100,000 t/yr Gas venting 200 - 1,000 t/yr F-Gas Inventory of 50-499 t CO_2e Unplanned F-gas loss of <250 t CO_2e	CO_2 emissions >100,000 t/yr Gas venting >1,000 t/yr F-Gas Inventory of >500 t CO_2e Unplanned F-gas loss of >250 t CO_2e		
Air quality	NOx emissions < 10 t/yr Atmospheric emissions within PPC permit emission limits for last 12 months.	NOx emissions 10-50t/yr Malfunction or breakdown of emissions abatement equipment, even if still within PPC permit emission limits. Isolated and/or minor breach of PPC permit emission limits within last 12 months.	NOx emissions >50 t/yr Regular and/or moderate breaches of PPC permit emission limits within last 12 months.	Sustained and/or major breaches of PPC permit emission limits within last 12 months.	Continuous and/or severe breach of PPC permit emissions limits within last 12 months.

Figure 9.4: Definitions of consequence for environmental aspect assessment

Environmental Receptor	Consequence - OFFSHORE				
	Lower				Higher
	H	G	F	E	D
Landfill / waste treatment & disposal	Disposal of general waste to approved landfill.	Disposal of hazardous or radioactive wastes e.g. sludge, low activity scale to approved landfill Disposal of general waste to unpermitted site.	Disposal of hazardous or radioactive waste to unpermitted site.	n/a	n/a
Socio-economic (fisheries / oil and gas / shipping & ports / tourism & leisure)	No identifiable impact to stakeholder economic practices.	Localised impact small number of stakeholders that are affected for < 6 months.	Localised impact to a small community of stakeholders. Impact does not affect economic practices. 6 - 12 months.	Impact to regional population and national stakeholders for a period >12 months.	Long term impact to communities including displacement of communities or loss of economic stability of large number of stakeholders. Long term impacts to national stakeholder groups.
Regulatory	Permitted discharges, within permit limits. No notification to Regulatory Authorities required. No regulatory concern.	Isolated and/or minor unplanned release and /or breach of consent limits. Notification to Regulatory Authorities required. Regulatory compliance issue (e.g. verbal warning), which does NOT lead to higher severity level consequence.	Regular and/or moderate unplanned release and/or breach of consent limits. Notification to Regulatory Authorities required. Regulatory compliance issue (e.g. letter / inspection items), which does NOT lead to enforcement or other higher severity level consequences.	Sustained and/or major unplanned release and/or breach of consent limits. Notification to Regulatory Authorities required. Regulatory enforcement / improvement notice. Serial non-compliances which may lead to enforcement action, where return to compliance is unlikely within a year.	Continuous and/or severe unplanned release and/or breach of consent limits. Notification to Regulatory Authorities required. Major regulatory enforcement action (i.e. prohibition / suspension notice).
Size of spill	No unpermitted release of hydrocarbons or chemicals.	**Hydrocarbons released:** • High sensitivity receptor: <0.1 tonne • Low sensitivity receptor: <1 tonne **Chemicals released:** • High toxicity chemical, high sensitivity receptor: <0.1t • High toxicity, low sensitivity: <0.2t • Low toxicity, high sensitivity: <0.5t • Low toxicity, low sensitivity: <1t	**Hydrocarbons released:** • High: 0.1-1 tonne • Low: 1-10 tonne **Chemicals released:** • High toxicity, high sensitivity: 0.1-1t • High toxicity, low sensitivity: 0.2-2t • Low toxicity, high sensitivity: 0.5-5t • Low toxicity, low sensitivity: 1-10t	**Hydrocarbons released:** • High: 1-10 tonne • Low: 10-100 tonne **Chemicals released:** • High toxicity, high sensitivity: 1-10t • High toxicity, low sensitivity: 2-20t • Low toxicity, high sensitivity: 5-50t • Low toxicity, low sensitivity: 10-100t	**Hydrocarbon released:** • High: >10 tonne • Low: >100 tonne **Chemicals released:** • High toxicity, high sensitivity: >10t • High toxicity, low sensitivity: >20t • Low toxicity, high sensitivity: >50t • Low toxicity, low sensitivity: >100t
		Low sensitivity receptors: Open sea surface. **High sensitivity receptors:** Near shore waters and beaches; Marine Protected Areas (MPA), including SACs, SPAs, MCZs, SSSIs, & RAMSAR sites. **Low toxicity chemicals:** OCNS Gold/Silver Ranking or D/E Grouping or equivalent. **High toxicity chemicals:** OCNS White or higher ranking, or A/B/C grouping, or SUB warning or equivalent.			
Financial	Less than £50,000	£50,000-£500,000	£500,000-£10M	£10M-£50M	£50M-£100M
Reputation	Isolated complaint from neighbour. No adverse media coverage.	Regular short term complaints on similar issues from neighbours. Short term adverse local media coverage.	Ongoing unresolved complaint on similar issue from neighbours. Prolonged adverse local media coverage.	Short term adverse national media coverage Damage to relationships with stakeholders of benefit to the asset.	Interventions from Governments in which Perenco has aspirations to operate. Partner / stakeholder outrage in major market. Prolonged adverse national media coverage. Adverse international media coverage

Figure 9.5: Definitions of consequence for environmental aspect assessment

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10 APPENDIX B – ENERGY AND EMISSIONS

Table 10.1: Summary of Project energy and emissions

Aspect	Energy Use (GJ)	CO_2 Emissions (tonnes)
Vessels	366,453	17371.6
Dismantling	5,213	166.8

Table 10.2: Atmospheric emissions by vessel type

Aspect	**CO_2**	**CO**	**NO_x**	**N_2O**	**SO_2**	**CH_4**	**VOC**	**CO_2e**
HLV[1]	9,763.60	48.36	181.72	0.68	36.96	0.55	7.39	9,979.38
Tugs[2] x 2	121.73	0.60	2.27	0.01	0.46	0.01	0.09	124.42
standby vessel[3]	4,564.80	22.61	84.96	0.32	17.28	0.26	3.46	4,665.69
supply vessel[4]	380.40	1.88	7.08	0.03	1.44	0.02	0.29	388.81
Total (tonnes)	**14,830.53**	**73.45**	**276.03**	**1.04**	**56.14**	**0.84**	**11.23**	**15,158.30**

Notes

[1] Fuel use rate based on IoP, 2000 (HLV – with propulsion)

[2] Fuel use rate based on IoP, 2000 (Anchor handling vessel – working);

[3] Fuel use rate based on IoP, 2000 (Standby vessel – working)

[4] Fuel use rate based on IoP, 2000 (Supply vessel – working)