Ithaca Energy (UK) Limited

Causeway-Fionn Decommissioning
Environmental Appraisal

Prepared by Ithaca Energy (UK) Limited

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CONTENTS

GLOSSARY AND ABBREVIATIONS

Term	Explanation
BEIS	Department for Business, Energy and Industrial Strategy, formerly the Department of Energy and Climate Change (DECC)
Concrete mattress	A series of concrete blocks usually connected together by polypropylene ropes which resembles a rectangular mattress. These are used for the weighting and/or protection of seabed structures including pipelines
CoP	Cessation of Production: the stage at which, after all economic development opportunities have been pursued, an agreement is sought from the Oil and Gas Authority (OGA) that hydrocarbon production may cease at a particular field. The economic criterion for deciding CoP is typically the point at which the value of the hydrocarbons produced no longer covers the true costs of production.
CSV	Construction support vessel
DECC	Department of Energy and Climate Change, now the Department for Business, Energy and Industrial Strategy (BEIS)
DP	Decommissioning programme
DVS	Dive support vessel
DTI	Department of Trade and Industry (relevant regulatory functions now within BEIS)
EA	Environmental Appraisal
EIA	Environmental Impact Assessment
ENVID	Environmental Issues Identification
GHG	Greenhouse gas
GWP	Global Warming Potential: an emissions metric used to indicate the contribution of a certain greenhouse gas to radiative forcing, accounting for the atmospheric lifetime of a given gas relative to carbon dioxide (the principal greenhouse gas)
HS&E	Health Safety and Environment
HSEQ	Health, Safety, Environment and Quality
JNCC	Joint Nature Conservation Committee
km	kilometre: 1,000m, equivalent to 0.54 nautical miles
LWIV	Light well intervention vessel
MoD	Ministry of Defence
OPEP	Oil Pollution Emergency Plan
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning. Part of BEIS, this regulator is responsible for regulating environmental and decommissioning activity for offshore oil and gas operations in the UK.
OWF	Offshore Wind Farm
ROV	Remotely Operated Vehicle: a small, unmanned submersible used for inspection and the carrying out of some activities such as valve manipulation
SAC	Special Area of Conservation

Term	Explanation
Semi-submersible rig	A mobile floating drilling rig, typically used in deeper water (inaccessible to jack-ups) and harsher environments. Kept on station by either anchored mooring system or dynamic positioning
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Area
Topsides	The collective name for the many drilling, processing, accommodation and other modules which when connected together make up the upper section of the platform which rests on the installation jacket
UKCS	United Kingdom Continental Shelf
WBM	Water Based Mud

EXECUTIVE SUMMARY

Introduction and scope of facilities to be decommissioned

Ithaca Energy (UK) Ltd (Ithaca Energy) is planning to decommission the Causeway and Fionn Fields (Causeway-Fionn) facilities in the northern North Sea. The two subsea developments are located in UK Blocks 211/23 and 211/22, in the East Shetland Basin, and are tied back to the TAQA operated North Cormorant Platform (NCP) located in Block 211/21. Causeway-Fionn is approximately 124km from the UK mainland (Shetland) and 20km from the UK-Norway Median Line.

Under the *Petroleum Act 1998* and amendments to the Act through the Energy Act 2008 (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit Decommissioning Programmes (DPs). Regulator guidance (BEIS 2018) indicates that a DP must be supported by an Environmental Appraisal (EA). The OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations sets out OSPAR Contracting Parties obligations on the decommissioning of offshore installations. This prohibits the leaving of these in place, although under certain circumstances a derogation from OSPAR 98/3 may be applied for to allow installations to remain *in situ*. There is no derogation option available for the Causeway-Fionn facilities, with subsea installations (there are no topside or jacket installations – see below) having to be recovered from the seabed and either reused, recycled or disposed of in landfill. Note that OSPAR Decision 98/3 does not cover pipelines, and therefore options for these to be left *in situ* may be considered.

In consultation with the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), Ithaca Energy, as licensed operator of the fields, has prepared a combined DP covering the Causeway and Fionn facilities, namely:

- The Causeway production and water injection wells
- The Fionn production well
- Three subsea appraisal wells
- The Causeway-Fionn pipeline system:
    - 2 x steel production pipelines PL2888 and PL2889, both trenched and mechanically backfilled with natural sediment
    - 3 x umbilicals PLU2891, PLU2892 and PLU2893, all three trenched to below seabed level, but not mechanically backfilled, left open to self-cover
    - 1 x water injection pipeline PL2890, trenched to below seabed level, but not mechanically backfilled, left open to self-cover
    - Pipeline associated structures; valve skid/integrated protection structure and purge spool, both gravity based
- Protective material (mattresses, sand bags and rock) – rock is present in various quantities on all lines except the umbilical PLU2892

The technical options to remove the subsea installations, and options to decommission the pipeline system, have been identified through various assessment methods, including Comparative Assessment. The following approaches to decommissioning of the fields are proposed.

A semi-submersible rig will be used for the producer and injector well decommissioning activities, requiring three rig moves. Final options for the three subsea appraisal wells is still to be determined, and a light well intervention vessel (LWIV) may be used for one of these, and single semi-submersible rig move for the remaining two. However, for assessment purposes, to represent worst case, a semi-submersible rig has also been assumed for all of these. The final well decommissioning strategy is in development and will be in accordance with the current version of the Oil and Gas UK guidance on well abandonment and Ithaca Energy's Operational Excellence Policy. The Causeway-Fionn associated subsea infrastructure (wellheads and associated protective structures) will be removed using a construction support vessel (CSV) or similar, under dynamic positioning.

All pipelines and umbilicals remain adequately buried or trenched (>0.6m) for the majority of their lengths, the exceptions being at trench transitions and approaches, here the lines are covered by protective material (i.e. mattresses and/or rock). The recommended decommissioning option from the Comparative Assessment for the pipeline system is to decommission the production pipelines, water injection pipeline and two of the three umbilicals, *in situ*. The shortest (*ca*. 1.5km) umbilical would be removed using reverse reel. The flexible spools, risers and jumpers which tie infrastructure into the various lines, will be removed, along with all exposed protective material, with the exception of rock, and mattresses covered by the rock, which will be decommissioned *in situ*. Where the various lines are cut, e.g. to remove tie-ins and infrastructure, these cut ends will be lowered to below seabed level and mechanically backed filled with natural sediment where required; an alternative option for the production and water injection pipeline cut ends is to cover these with new rock cover.

The production and water injection pipelines and one of the umbilicals cross the Magnus to Ninian export line, with crossings protected by rock and mattresses; this protective material will be decommissioned *in situ.*

Ithaca Energy have actively sought alternative use options for the field infrastructure where feasible; *in situ* reuse or redevelopment have also been explored but are not viable options, leaving recovery with onshore recycling and some disposal to landfill as the remaining options.

Environmental summary

Ithaca Energy conducted a pre-decommissioning survey along the pipeline/umbilical routes, and the well locations. Information from this, along with information from previous surveys and the wider area is included in the summary of the main environmental features of the area and their seasonal variability below.

Tabulated seasonal and other environmental sensitivities

<table>
<tr><th>Aspect</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Location</td><td colspan="12">The Causeway and Fionn facilities are located in the East Shetland Basin area of the northern North Sea, in Blocks 211/23, 211/22 and 211/21, where they tie into the TAQA operated NCP. The facilities are approximately 124km from the Shetland coastline and 20km from the UK/Norway transboundary line.</td></tr>
<tr><td>Water column, climate and hydrography</td><td colspan="12">Winds are variable, although predominately from the south and southwest. In winter, winds of Beaufort force 5 (~9-11m/s) or greater may be experienced at a frequency of approximately 60-65%. Annual mean significant wave height is approximately 2.7m, varying seasonally. Tidal currents in the northern North Sea area are generally weak and are readily influenced by other factors (e.g. winds and density driven circulation). Tidal currents are relatively weak for neap and spring tides (0.3 and 0.6m/s respectively). The water column stratifies thermally in summer and this is broken down in winter with increased wind and convective mixing. Annual mean sea surface temperatures are ~9.6°C, and bottom temperatures ~7.7°C. Surface and bottom salinities are approximately 35ppt and 35.2ppt respectively, with very little seasonal variation.</td></tr>
<tr><td>Seabed, sediments</td><td colspan="12">Relatively flat seabed though shoals slightly to the west; water depths across the area range from a minimum of 148m at the Fionn well location (P2) and maximum of 160m at the tie in at NCP. Depressions are noted on the seabed across the area which are generally minor, isolated features with a low surface expression (most <0.5m), which are sometimes associated with higher reflectivity (i.e. indicating areas of coarser sediment) and boulders; no evidence of shallow gas or gas release that would attribute these to pockmark features. The EUNIS habitat classification records the seabed sediments predominantly deep circalittoral sand across the majority of the area, the decommissioning baseline survey identifies transitional zone of muddy, slightly gravelly sand, with varying densities of cobbles present, either side of the rock placement.</td></tr>
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<tr><th>Aspect</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="3">Plankton</td><td colspan="12">The plankton community in the waters around Causeway-Fionn is similar to that found over a wide area of the northern North Sea. The phytoplankton community is dominated by the dinoflagellate genus Tripos (Tripos fuscus, Tripos furca, Tripos lineatus), with diatoms such as Thalassiosira spp. and Chaetoceros spp. also abundant. Dinoflagellates typically comprise a greater proportion of the phytoplankton community than diatoms from June to October, when waters will be most stratified. The spring bloom in this region is stronger, relative to the autumn bloom, than elsewhere. Zooplankton species richness is higher in the northern North Sea than in the southern North Sea and the community displays greater seasonal variability. The zooplankton community is dominated by calanoid copepods, although other groups such as Paracalanus and Pseudocalanus are also abundant. There is also a high biomass of Calanus larval stages present in the region.</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Key: Period of increased plankton abundance shown in darker blue</td></tr>
<tr><td>Benthos</td><td colspan="12">Sensitivity similar throughout the year. The wider area has been described as a region of transition in the epibenthic community with species typical of water >100m deep such as Astropecten irregularis (echinoderm), Hyalinoecia tubicola (polychaete), Echinus spp. (echinoderm), Anapagurus laevis and Pagurus pubescens (crustaceans), and the anemone Hormathia digitata, as well as species more characteristic of shallower water, including crabs Hyas coarctatus and Pagurus bernhardus, the whelks Neptunea antiqua and Colus gracilis, starfish Asterias rubens and the hydroid Hydractinia echinata.
The pre-decommissioning survey found that fauna was sparse across all biotopes, but primarily included sea pens (P. phosphorea and Virgularia sp.), urchins (Echinidae), starfish (Asteroidea), hermit crabs (Paguridae) and cushion stars (Goniasteridae, including Hippasteria phrygiana) and polychaete worms (Hyalinoeciinae and Sabellidae) with faunal tracks, mounds and burrows identified. Taxa also included squat lobsters (Galatheoidea), redfish (Sebastidae), anemones (Actiniaria, including Bolocera tuediae), gadoid fish (Gadiformes) and faunal turf (Hydrozoa/Bryozoa), which were primarily associated with the rock placement for infrastructure protection. Sea pens and faunal burrows were present across all stations and most transects within the survey area. There was no survey evidence of the presence of Arctica islandica and no other sensitive habitat or species were observed.</td></tr>
<tr><td rowspan="3">Fish</td><td colspan="12">The area overlaps reported spawning grounds of Norway pout, saithe, haddock, cod and whiting (see below for timing) and also supports known nursery grounds for blue whiting, spurdog, European hake, haddock, Norway pout, herring, ling, mackerel and whiting.</td></tr>
<tr><td>3</td><td>5</td><td>5</td><td>5</td><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="12">Key: 1 = 1 species spawning, 2 = 2 species spawning etc</td></tr>
<tr><td>Birds</td><td colspan="12">The area may be considered to be of low importance for seabirds in the context of the North Sea as a whole – this is related to the distance from breeding colonies (Causeway-Fionn is >124km from shore) and the availability of prey species (e.g. inshore areas around Shetland are of much greater importance, with only a few species breeding at colonies in Shetland with mean maximum foraging ranges exceeding 100km, e.g. northern gannet, northern fulmar, black-legged kittiwake). Species present vary seasonally and being far offshore, the birds present in the area are likely to be (predominantly) those transiting through the area during migration, post breeding dispersion from colonies.
The Seabird Oil Sensitivity Index (SOSI) has been developed based on previous indices and with method refining. Where there is no data coverage the JNCC guidance is used to reduce the extent of coverage gaps (these are shown in red). Where these could not be reduced, these are shown with N and highlighted Yellow. For the Blocks of interest, seabird sensitivity is low, for those months with data, with the exception of Dec for Block 211/23 where sensitivity is high and Sept and Dec for Block 211/22 which is moderate.</td></tr>
<tr><td>Block 211/21</td><td>5</td><td>5</td><td>5</td><td>5</td><td>N</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td></tr>
<tr><td>Block 211/22</td><td>5</td><td>5</td><td>5</td><td>5</td><td>N</td><td>5</td><td>5</td><td>5</td><td>4</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Block 211/23</td><td>5</td><td>5</td><td>5</td><td>5</td><td>N</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>3</td><td>3</td></tr>
<tr><td></td><td colspan="2">1=extremely high</td><td colspan="2">2=Very high</td><td colspan="2">3 =High</td><td colspan="2">4=Moderate</td><td colspan="2">5=Low</td><td colspan="2">N=no coverage</td></tr>
</table>

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<tr><th>Aspect</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="3">Marine mammals</td><td colspan="12">Harbour porpoise are frequently sighted throughout the central North Sea area and are likely to be the most abundant species in this area too; while present throughout the year, peak numbers are generally recorded from June to October. White-beaked dolphins, are encountered regularly in coastal and offshore waters of the central and northern North Sea, although sightings are less common at latitudes above that of Shetland; while they can be sighted throughout the year, most frequent sightings are from July to October. Minke whales are also present, appearing to move south into the North Sea at the beginning of May and remaining until October. Several other species have been sighted in offshore waters of the northern North Sea, such as killer whale, bottlenose dolphin and beaked whales, but infrequently and/or in small numbers only. The area is distant from seal breeding colonies and haul-out sites; models based on tagging data suggest very low densities of both grey and harbour seal in the area.</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Key: Darker colours reflect months when marine mammals are most frequently observed</td></tr>
<tr><td>Conservation sites</td><td colspan="12">The Shetland and wider region’s coast has a variety of important habitats and species protected under international, national and local designations; however, these are at least 124km from the Causeway-Fionn area. The closest offshore Special Area of Conservation (SAC) is the Pobie Bank Reef, approximately 77km to the southwest, the closest Nature Conservation Marine Protected Area (NCMPA) is the North-east Faroe-Shetland Channel, approximately 104km to the northwest; these sites are designated for either habitat (reef, offshore deep-sea muds, offshore subtidal sand and gravels) and low or limited mobility species (deep-sea sponge aggregations). The pre-decommissioning survey identified sea pens Pennatula phosphorea and Virgularia sp, mounds and burrows and that the presence of the OSPAR listed threatened and/or declining habitat “sea pens and burrowing megafauna communities” was considered likely to occur within the survey area. However, based on sediment type and surface features, the consideration is that the habitat is not present.</td></tr>
<tr><td>Other Users</td><td colspan="12">Blocks 211/23, 211/22 and 211/21 are all located in ICES rectangle 51F1 and fishing effort in the area is focused on demersal species; 2019 saw an increase in landings of pelagic species compared to that seen in 2018 and 2017, both of which had low or mainly disclosive catches. The area is within a wider mature oil and gas province, with considerable infrastructure in adjacent Blocks and the wider area. Shipping density is low, with these predominantly associated with vessels servicing the oil and gas industry. There are no Ministry of Defence exercise areas, dredging areas, or marine disposal sites in the vicinity and there are no telecommunication cables within the Blocks. There are no designated protected wrecks in the Causeway-Fionn area.</td></tr>
</table>

Potential sources of significant effect

A small number of potential sources of effect from the proposed decommissioning activities were identified, and their likely impact has been assessed along with options to reduce the impact. Those effects deemed minor were not assessed further. In line with BEIS (2018) guidance, potential impacts from the limited amount of material returned onshore and accidental impacts have not been assessed here.

As part of the permitting and consenting process for decommissioning activities, i.e. well plug and abandonment and the subsea programme, as required under the relevant EIA Regulations *The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020*[1], an assessment of accidental impacts as well as a major environmental incident assessment will be carried out.

Seabed disturbance

Sources of physical disturbance to the seabed associated with the decommissioning activities are primarily:

[1] These entered into force 31st December 2020 and replace the EIA regulations The Offshore Petroleum Production and Pipe-lines (Assessment of Environmental Effects) regulations 1999 (as amended)

- Anchoring of the semi-submersible for the Causeway-Fionn well plug and abandonment (contingency use of the semi-submersible for the three subsea appraisal wells has also been considered)
- Removal of pipeline associated infrastructure (valve skid, purge spool)
- Moving/removing protective material (mattresses)
- Lowering/backfilling or rock cover of production and water injection pipeline cut ends

Seabed disturbance will result in direct physical effects which may include mortality of fauna as a result of physical trauma, smothering by excavated sidecast and re-suspended sediment. There are accumulations of historic drill cuttings associated with the Causeway-Fionn wells, however, these are not contaminated with oil based muds (drilled in 2011) and any disturbance of these will not result in the re-suspension of any entrained oil.

Anchoring and cable/chain catenary scarring will not result in changes to sediment characteristics, or significant compaction, with recovery of the seabed through natural sediment mobility expected to be rapid (<1 year). Recovery of faunal communities will also be rapid through a combination of larval settlement and immigration from adjacent seabed. Impacts will be localised to the existing Causeway-Fionn development footprint. If used to cover the cut ends of the production/water injection pipeline, the use of rock for would introduce additional hard substrate into the area. The footprint of this will be localised to these area and hard substrate including natural boulders and cobbles are present in the wider Causeway-Fionn area. The introduction of hard substrate at the scale proposed will result in only a modest expansion of the habitat and associated faunal communities already present.

The pre-decommissioning survey indicated that the OSPAR threatened and/or declining habitat 'Sea pens and Burrowing Megafauna Communities' (i.e. see OSPAR 2008 and 2010a), may be present throughout the Causeway-Fionn area due to the presence of mounds and burrows and as well as the presence of sea pens. The majority of the disturbance from decommissioning will be within the original footprint of the Causeway-Fionn development and if the habitat is present, significant negative effects from seabed disturbance are not anticipated.

Energy use and atmospheric emissions

Emissions will be generated from fuel combustion on the various vessels involved in the decommissioning, the rig during well plug and abandonment operations, helicopter journeys used for crew changes, and ancillary power generation (e.g. use of mechanical cutting tools). Gas emissions will primarily comprise carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), methane (CH_4) and volatile organic compounds (VOCs). Although minor, these will contribute to atmospheric greenhouse gas (GHG) concentrations linked to global climate change and related effects including sea-level rise, ocean acidification; and other effects including on regional acid loading, and tropospheric ozone (resulting from reactions of NO_x, CO and VOCs).

Effects on conservation sites and features

None of Causeway-Fionn infrastructure is located within, or near to a site designated for conservation interest (habitat or species), the closest of these being the Pobie Bank Reef Special Area of Conservation (86km), the North-East Faroe Shetland Channel Nature Conservation Marine Protected Area (108km) and the Hermaness, Saxa Vord, and Valla Field Special Protection Area (124km).

The 2020 pre-decommissioning survey identified the presence of sea pens (*Pennatula phosphorea* and *Vigularia* sp.) and mounds and burrows at many sample sites, there was the potential that the OSPAR threatened and/or declining habitat 'Sea pens and burrowed megafauna communities' (SPBMC) habitat to be present. Although potential indicators of SPBMC were identified from the survey, it is unlikely that this habitat is present due to a number of factors. These includes the presence of sand which is the dominant fraction of the sediment (present at mean value of 85.3%), with smaller proportion of fines and little gravel content, and the absence of megafauna typical of this habitat; data from grab samples did not include any of the larger burrowing crustaceans such as *Nephrops*, *Calocaris*, *Upogebia* or *Callianassa* which typically produce visible burrows and mounds.

There will be seabed disturbance as a result of decommissioning activities, which will have an impact on any fauna present. This disturbance will be relatively small as only one of the umbilicals is being removed, with the rest being decommissioned *in situ.* The disturbance will be localised, temporary in nature (with the exception of new rock, if used) and with the exception of the semi-submersible anchors, occur predominately within the footprint of the original development. Recovery has occurred over the intervening period during field life, with this expected to be the same once decommissioning activities have been completed.

Taking the above into consideration, significant impacts are not anticipated.

Cumulative and transboundary effects

Incremental, cumulative and synergistic effects have been systematically reviewed. Minor incremental or cumulative risks (i.e. effects acting additively or in combination with those of other human activities) were identified in relation to potential impacts; none of these were considered to represent a significant impact in a local or regional context.

Although Causeway-Fionn is relatively close to the UK/Norwegian median line (20km east), the decommissioning activities (well plug and abandonment and subsea scope of work) have a limited likelihood of transboundary effects. Atmospheric emissions from the rig and support vessels are unlikely to be detectable or to significantly affect Norwegian national waters and air quality. As part of the permitting and consenting process for the decommissioning activities, accidental events and a major environmental incident assessment will be carried out, which will take into consideration the potential for transboundary impacts.

Overall conclusions

The overall conclusions of the environmental appraisal of the decommissioning of the Causeway-Fionn facilities are:

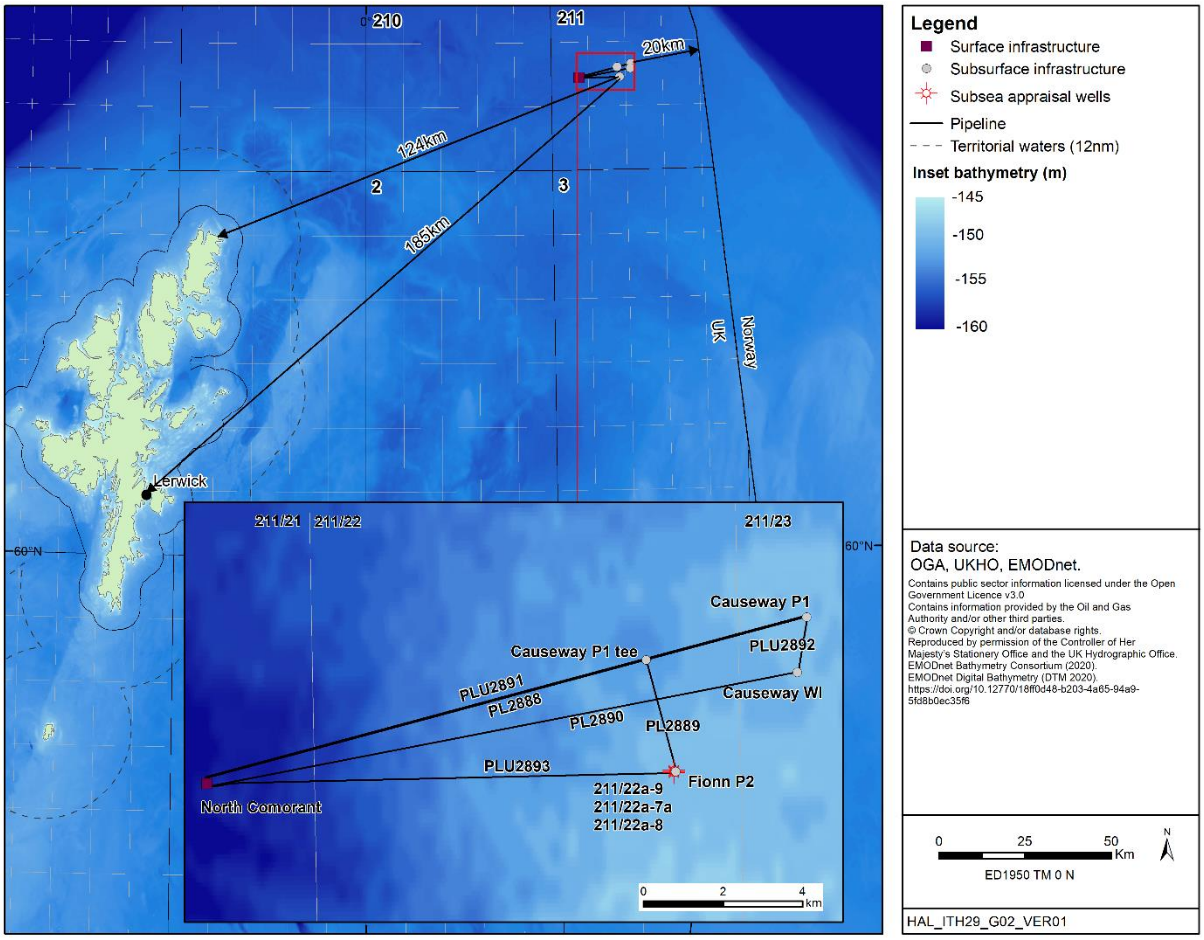
- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant impacts on conservation interests are predicted
- No specific, additional controls were considered necessary on activities beyond application of regulatory requirements, established Ithaca Energy management system processes, operational controls and following industry guidelines where applicable
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

1 INTRODUCTION

1.1 Introduction and Background

Ithaca Energy (UK) Limited (Ithaca Energy) is planning for the decommissioning of the Causeway and Fionn oil fields (Causeway-Fionn), a subsea tie-back development in the northern North Sea, approximately 124km north east of Shetland (Figure 1.1). The Causeway field is located within Block 211/23d and the Fionn field is located within Block 211/22a.

Figure 1.1 – Location of the Causeway and Fionn facilities[1]

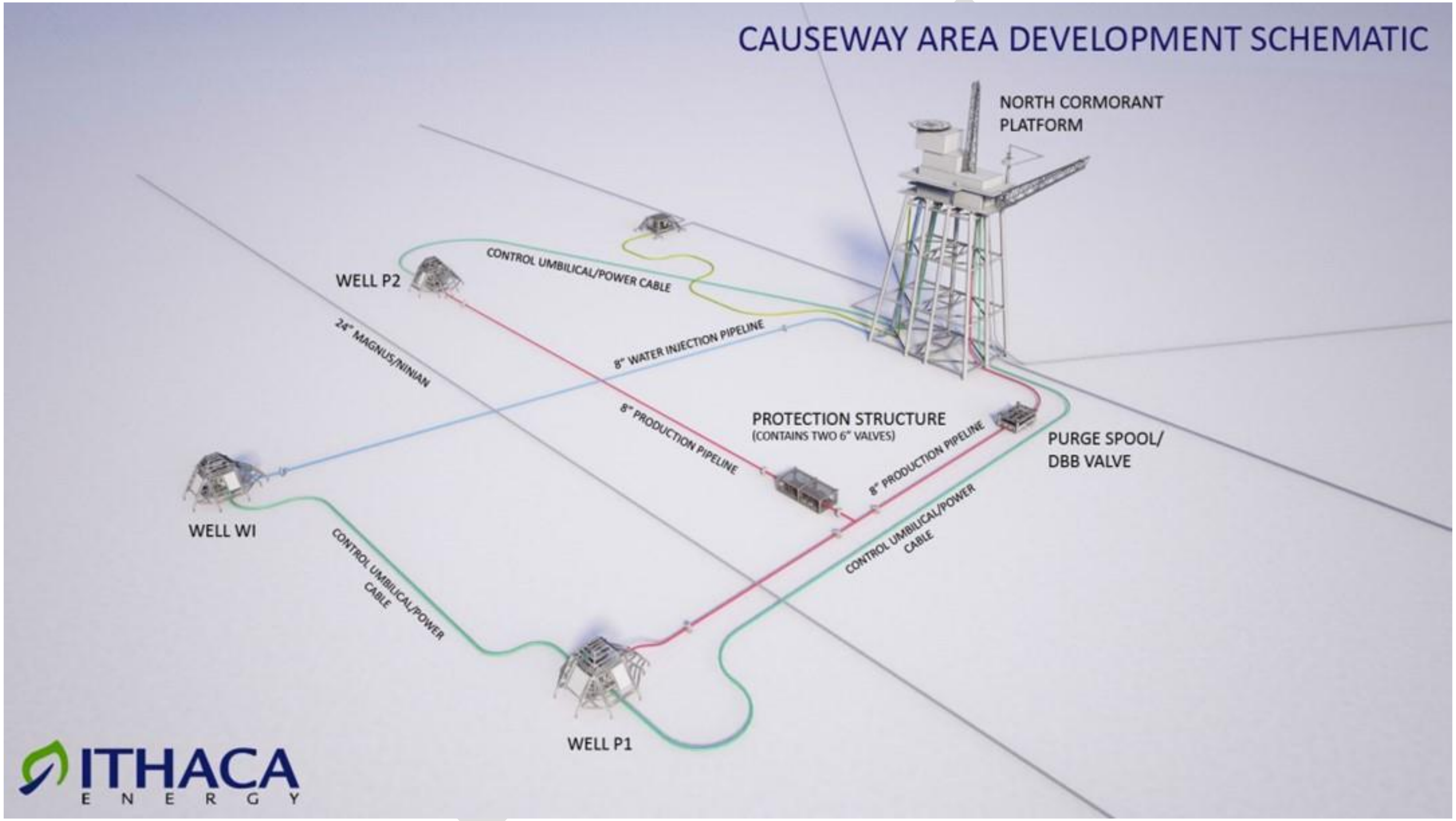


Note: [1]The North Cormorant facility shown was the receiving/processing facility for Causeway and Fionn hydrocarbons and is operated by TAQA and not part of the Causeway-Fionn decommissioning project.

Causeway is comprised of one production well (Well P1) and one water injection well (Well WI) tied back to the TAQA Bratani Limited (TAQA) operated North Cormorant Platform (NCP) in Block 211/21 via a production pipeline, water injection pipeline and control umbilical (Figure 1.2); a separate control umbilical also connects the Causeway water injection (WI) well and the production well. Fionn comprises a single production well (Well P2) which ties into the NCP via a control umbilical and into the Causeway to NCP production pipeline via a spur line and valve skid (called "Protection structure" on Figure 1.2).

Separate Cessation of Production (CoP) notifications for both Causeway and Fionn were submitted on 21st December 2018 and approved on the 15th January 2019, by the Oil & Gas Authority (OGA).

Figure 1.2 – Causeway-Fionn schematic



Note: The North Cormorant Platform is shown here but is not part of the Causeway-Fionn DPs The three appraisal wells also being decommissioning (211/22a-7a, 211/22a-8 and 211/2a-9 are not shown on this field schematic, see Figure 1.1

There is a regulatory requirement for operators proposing to decommission offshore installations[2], wells and/or submarine pipeline, and the other Section 29 holders for the assets, to submit Decommissioning Programmes (DPs) to the competent authority (the Offshore Petroleum Regulator for Environment and Decommissioning, Department for Business, Energy and Industrial Strategy - OPRED).

To fulfil Ithaca Energy's Operational Excellence Policy[3], the requirement under the *Petroleum Act 1998* (as amended) to assess the environmental impacts of decommissioning proposals, and in line with regulator guidance (BEIS 2018), the DP for the Causeway-Fionn facilities are supported by an Environmental Appraisal (EA) which is documented in this report.

1.2 Overview of the Causeway and Fionn Facilities

In consultation with OPRED, Ithaca Energy, as licensed operator of the fields, has prepared a combined DP covering the Causeway and Fionn facilities, namely:

- The Causeway production and water injection wells
- The Fionn production well
- Three subsea appraisal wells
- The Causeway-Fionn pipeline system:
    - 2 x steel production pipelines PL2888 and PL2889, both trenched and mechanically backfilled with natural sediment
    - 3 x umbilicals PLU2891, PLU2892 and PLU2893, all three trenched to below seabed level, but not mechanically backfilled, left open to self-cover
    - 1 x water injection pipeline PL2890, trenched to below seabed level, but not mechanically backfilled, left open to self-cover
    - Pipeline associated structures; valve skid/integrated protection structure and purge spool, both gravity based
- Protective material (mattresses, sand bags and rock) – rock is present in various quantities on all lines except the umbilical PLU2892

The terms of legislative provisions relating to decommissioning such facilities, and decommissioning guidance from the competent authority (BEIS 2018), are such that the Causeway and Fionn wells should be plugged and abandoned and subsea installations should be recovered (see Section 1.3). While not a statutory requirement, a Comparative Assessment (CA) of options to determine the best decommissioning method for the pipelines, water injection pipeline and umbilicals, has been undertaken.

1.3 Offshore Decommissioning Regulatory Context

The OSPAR Convention, OSPAR (1992), is the current agreement on international cooperation on environmental protection in the North-East Atlantic. Under paragraph 2 of OSPAR Decision 98/3, the dumping and leaving wholly or partly in place of disused offshore installations is prohibited within the OSPAR maritime area with derogations only possible in certain specific circumstances, none of which apply to Causeway-Fionn.

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[2] Subsea installations e.g. drilling templates, production manifolds, protective structures, wellheads, risers and riser bases are to be considered an installation (BEIS 2018).

[3] Ithaca Energy has an Operational Excellence Management System into which is integrated the Environmental Management System (EMS) certified to ISO 14001:2015 standard and which is designed to implement the Ithaca Energy environmental policy.

Causeway-Fionn is a subsea tie-back development and as such the only form of installation present which falls under OSPAR 98/3 are "steel installations", such as wellheads and these must be fully removed (BEIS 2018); the pipeline system subsea infrastructure (valve skid/integrated protective structure and purge spool) are pipeline structures which must be completely removed.

The wells, pipelines and related materials must be decommissioned in accordance with relevant BEIS (2018) guidance, with activities associated with the former subject to a screening direction under the EIA Regulations, however, there are no specific statutory requirements that indicate pipelines must be removed.

Under Part IV of the *Petroleum Act 1998* and amendments to the Act through the *Energy Act 2008* (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit a DP, which must be approved by OPRED before decommissioning activities can commence. Although there is at present no statutory requirement to undertake an Environmental Impact Assessment (EIA) at the decommissioning stage, BEIS (2018) guidance states that, "*Under the Petroleum Act 1998, there is a… requirement to undertake an assessment of the potential environmental impacts of the decommissioning proposals…"* and also that an EA must be submitted alongside the DP. The Causeway-Fionn Decommissioning Environmental Appraisal report follows the BEIS (2018) guidance for EA.

Guidance (BEIS 2018) also indicates that an Environmental Issues Identification (ENVID) exercise should also be part of the overall assessment process, the outcome of which should be summarised within the EA (see Section 5).

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) implements the requirement for Appropriate Assessment in relation to approvals, authorisations or consents given under to the *Petroleum Act 1998* (as amended) on the UKCS, for Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) included in the UK national site network.

Relevant sites for habitats and species designated under, for example, *The Conservation of Offshore Marine Habitats and Species Regulations 2017* (as amended) and *The Conservation of Habitats and Species Regulations 2017* (as amended) and OSPAR threatened and/or declining habitats have been identified in the EA, and the potential for effects on these from the decommissioning activities have been considered.

A range of permits, consents and licences are required, under various legislation, in order to undertake activities required to decommission the Causeway-Fionn facilities, including, but not limited to, siting of vessels and the rig, and the use and discharge of chemicals. Approvals for these are contingent on complying with the applicable legislation. This EA will support these applications in due course.

As the Causeway-Fionn development does not include any topside or jacket facilities, a relatively small amount of material will be returned to shore, and while the receiving port for this is still to be determined, this is expected to be in the UK and the *Transfrontier Shipment of Waste Regulations 2007* (as amended) should not be applicable. In the unlikely event that material is taken to a non-UK port, Ithaca Energy will comply with the applicable Regulations for the transport of waste.

Legislation and compliance requirements may change over time and as part of their management system, Ithaca Energy has processes in place to monitor for new legislation relevant to their activities. Ithaca Energy will ensure that all relevant regulations are complied with for the decommissioning of the Causeway-Fionn facilities.

1.4 Environmental Appraisal Process

The environmental appraisal process considers the range of activities relevant to the decommissioning of the Causeway-Fionn facilities and their potential impact on the receiving environment, focusing on those impacts that have been identified as potentially significant. This process is informed by information including engineering studies and the pre-decommissioning survey, amongst others (e.g. ENVID) (see Section 5). This is an integral part of Ithaca Energy's management process which satisfies the company's environmental policy objectives with regards to the identification and assessment of potential risks to the environment from their activities.

The appraisal considers issues and potential effects from offshore activities and describes the proposed measures to avoid, reduce, and if possible, remedy significant adverse effects. Fate of material (including waste) returned to shore is included in summary to provide context, but is not included in the appraisal, this being an onshore issue and not relevant to impacts in the marine environment. Accidental events are also not included in this appraisal, this not being a requirement of the EA supporting the decommissioning programmes; assessment of this, along with a major environmental impact assessment will be included in the permitting and consenting process prior to decommissioning activities being carried out offshore.

This EA report details the results of the environmental appraisal, highlighting environmental sensitivities, identifying potential hazards, assessing/predicting risks to the environment and identifying practical mitigation and monitoring measures to be carried forward into the engineering, execution and legacy of the decommissioning activities. It also forms part of the information base submitted to OPRED in support of the Causeway-Fionn Decommissioning Programmes.

1.5 Marine Planning

The facilities lie within an area covered by Scotland's National Marine Plan (The Scottish Government 2015). Ithaca Energy is congisant of the plan and polices which are relevant to their operations in Scottish waters, including those which are consistent with decommissioning taking place in line with standard practice and as allowed by international obligations (e.g. policy Oil&Gas2).

The decommissioning activities have been assessed against the relevant general principles and oil and gas marine planning policies (Table 1.1).

Table 1.1 – Scotland Marine Plan Policies[1] and the decommissioning of Causeway-Fionn

Policy and topic	Assessment
General Policies	
GEN1 – General planning – activities undertaken in a sustainable manner	The decommissioning activities will be undertaken in a manner consistent with the Marine Plan policies, in a sustainable manner that ensures any potential impacts associated with the activities are kept to a minimum
GEN4 – Co-existence	The project considers other sea users in the decision making process (e.g. assessing other vessel usage of the area), vessels[2] associated with the activities on location for relatively short duration, notification given of rig move and siting on location (marking of anchors), liaising with fisheries bodies and material decommissioned in situ. Aim being to minimise as far as practicable any potential impact on other sea users.
GEN5 – Climate change	Potential opportunities to reduce emissions through minimising flights, supply visits and fuel use, engagement with workforce
GEN6 – Historic environment	Causeway-Fionn is not located near any designated wreck sites or sites of historic significance

Policy and topic	Assessment
GEN9 – Natural heritage	Causeway-Fionn is not located in or near any area with protected species or habitats. The potential for the presence of the OSPAR habitat Sea pen and burrowing megafuna communities and the potential for impact on priority marine features has been assessed.
GEN11 – Marine litter	All vessel associated with decommissioning activities will be equipped to meet MARPOL and related merchant shipping regulations for the prevention of pollution from ships.
GEN12 – Water quality	The decommissioning activities will not result in a deterioration of water quality; the infrastructure will have been cleaned and flushed in preparation of decommissioning and processes and procedures in place for chemical use and discharge, prevention of spills, with all proposed chemical use and discharge assessed through the Regulator permit process.
GEN13 – Noise	There is no explosives to be used during decommissioning activities, the only noise source being the rig and vessels on location for a relatively short period of time; all noise sources will be of a non-pulsed/continuous nature.
GEN14 – Air quality	Emissions will be from rig and vessel engine use (power generation), with emissions associated with the replacement of the materials removed also taken into consideration.
GEN18 - Engagement	Ithaca Energy engage with interested stakeholders (e.g Scottish Fisheries Federation) as well as having early engagement with OPRED and statutory consultees (e.g. JNCC).
GEN19 – Sound evidence	The environmental appraisal to support the DPs for Causeway-Fionn has utilised recent site specific survey data, scientific data and previous experience and knowledge from similar work scopes
GEN21 - Cumulative impacts	Carrying out the decommissioning activities are not expected to have a cumulative impact.
Oil and Gas Policies	
O&G1 – Maximise and prolong O&G exploration and production – activity should be carried out using the principles of BAT and BEP	Well and infrastructure decommissioning uses BAT and BEP principles as far as practicable, e.g. well plug and abandonment following industry practices and aims to reduce waste generated and cement used. Chemicals will be selected for best environmental profile, where technical requirements allow. Comparative assessment for pipeline system decommissioning, with a requirement to leave a clean seabed, and takes account of environmental impact of different options. Assessment of potential impacts associated with the decommissioning of the fields have been screened and those identified as potentially significant, have been further assessed in this environmental appraisal.
O&G2 – where re-use of O&G infrastructure is not practicable, decommissioning must take place in line with standard practice and as allowed by international obligations	Ithaca Energy will endeavour to identify re-use potential for Causeway-Fionn infrastructure, where re-use is not practicable decommissioning activities will be conducted in line with regulations, industry guidelines and best practice.
O&G6 – Operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive	Ithaca will have in place an appropriately approved emergency response plan for the plug and abandonment of the Causeway-Fionn wells, ahead of any offshore activities being undertaken, the contracted rig will have in place an approved NPI OPEP and Ithaca also have an approved onshore plan for Tier 3 responses.

Notes: [1]General policies and Oil and Gas specific policies not applicable to Causeway-Fionn are not included here
[2] Reference to vessels for Causeway-Fionn includes the rig
Sources: Scottish Government (2015)

Block Specific Issues

Specific issues to the Blocks are listed in the OGA 32nd Round compilation of other regulatory issues (OGA 2019[4]), and are given below:

Seasonal concerns				
Block[1]	Period of concern for seismic survey	Period of concern for drilling	Spawning (herring) sites	Special conditions
211/22	January-May	-	-	-
211/23	January-May	-	-	-

Note: [1]The North Cormorant facility is located within Block 211/21 and this also has the same period of concern for seismic as Blocks 211/22 and 211/23, with no other concerns.

There is no seismic survey required as part of the decommissioning of the Causeway-Fionn development.

1.6 Areas of Uncertainty

Contracting has not commenced for a rig/light well intervention vessel (LWIV) and other vessels involved with the offshore decommissioning activities. The flushing and cleaning operations of the lines have not been finalised, nor has final selection been made of the onshore facilities to receive the removed material, although given the relatively small amount of material being returned, the expectation is that it will be a UK port. Where definition is lacking, worst case estimates of seabed disturbance and other sources of interaction are used in the consideration of possible effects.

1.7 Consultation and Stakeholder Engagement

To identify potential environmental issues associated with the decommissioning of Causeway-Fionn, Ithaca Energy engaged with OPRED, the Joint Nature Conservation Committee (JNCC) and the Scottish Fishermen's Federation (SFF) during the planning stage, to ensure:

- awareness of all relevant environmental information for the area
- identification of stakeholder issues and concerns to be considered in the environmental impact assessment process

A summary of the proposed decommissioning activities, the environment of the area and the key issues were presented, with consultees invited to discuss the proposals and raise any questions. Consultees were also given the opportunity to subsequently raise any further issues or concerns and provide details of new relevant information. OPRED had no comment at that time, and JNCC noted that sea pens and burrows were identified from the pre-decommissioning survey and welcomed confirmation this would be included in the Environmental Assessment. SFF advised that UK and non-UK vessels use the area; this has been taken into consideration in assessing effort. The presence of existing hard substrate throughout the area was confirmed, and the main fishing vessels operating there are larger boats, with larger gear designed to account for this.

[4] OGA Other Regulatory Issues https://www.ogauthority.co.uk/licensing-consents/licensing-rounds/offshore-licensing-rounds/#tabs

1.8 Environmental Management and Regulation

Ithaca Energy has an Operational Excellence Management System (OEMS) into which is integrated the Environmental Management System (EMS) certified to ISO 14001:2015 standard. The EMS was last verified as meeting the ISO 14001:2015 standard in April 2021 and is designed to implement Ithaca Energy's environmental policy. This demonstrates a commitment by Ithaca Energy to comply with environmental legislation and Ithaca Energy's standards, processes and objectives for environmental management of their activities across the UKCS, including decommissioning activities.

Ithaca Energy's policy for protecting people and the environment is the primary statement of Ithaca Energy's expectations for health, safety and environmental management, and provides a shared understanding throughout the Company of environmental performance expectations. Ithaca Energy's vision is reflected in the Operational Excellence Policy (Figure 1.3), which is endorsed by the Chief Executive Officer of Ithaca Energy on behalf of the Board of Directors. The policy acknowledges Ithaca Energy's responsibilities in relation to its business activities. This includes commitments to continual improvement, assessment and management of the risks and impacts associated with its activities, to meet legislative requirements and accepted best practice and a willingness to openly communicate these principles to company personnel and the general public.

Figure 1.3 – Ithaca Energy Operational Excellence Policy

ITHACA ENERGY

Ithaca Energy (UK) Limited Operational Excellence Policy

Ithaca Energy (UK) Limited's Operational Excellence (OE) vision is to be recognised and admired by the industry and the communities in which we operate as a world-class performer in process safety, personal safety and health, environment, reliability and efficiency. Ithaca recognises the need to operate in a safe and responsible manner.

We will systematically manage OE with the aim of:

- **Identifying and reducing the risk of major accident hazards including environmental and process safety risks.**
- **Achieving an incident and injury free workplace.**
- **Promoting a healthy workplace and mitigating significant health risks.**
- **Operating incident free with industry leading asset integrity and reliability.**
- **Efficiently using natural resources and assets.**
- **Ensuring continual improvement in all aspects of our business.**

Through consistent application of OE, this policy and our Safety and Environmental Management Systems (SEMS), we aim to address the following:

Leadership

Our leaders are accountable for:

- Providing clear and consistent leadership in accordance with this policy and our tenets of operation.
- Ensuring clear roles, responsibilities and communications.
- Trusting and empowering their teams to apply a risk based approach to decision making in accordance with this policy.
- Creating a culture that is built on our values and behaviours, enabling safe, reliable and secure operations and environmental protection.
- Engaging with community and other stakeholders.
- Ensuring that we comply with all applicable policies, codes and regulations and that we constructively engage in consultation with regard to proposed legislation.

Organisation

Our organisation is fit-for-purpose and is designed to:

- Achieve results in accordance with Ithaca policies.
- Ensure suitable and sufficient control of Major Accident Hazards.
- Ensure that staff and contractors are competent of their roles through the application of the Ithaca Competence Assurance Process.
- Encourage structured and timely decision making.
- Ensure the management of safe work.

A Strong Safety Culture

Based on:

- Our tenets of operation.
- Compliance with the provisions of our safety cases and this policy.
- The identification and management of Major Accident Hazards.
- The involvement of, and consultation with, our staff and contractors.
- The reporting and investigation of incidents and near misses.
- The use of stop work authority.
- The recognition and reward of desired behaviours through the use of stop work authority, performance process and our recognition and award process.
- The implementation of corporate safety initiatives.

Risk Management

Our people, at all levels of the organisation will:

- Systematically assess, prioritise and manage risk.
- Regularly review and re-evaluate risks.
- Maintain the integrity of dedicated systems through fit-for-purpose design and operating practices.
- Ensure that there are multiple, independent barriers in place to prevent Major Accident Hazards including, but not limited to, unplanned releases of hydrocarbons.

Asset Integrity Management

Our facilities, reservoirs and wells are designed and maintained to be fit-for-purpose throughout their lifecycles. This includes

- Designing, constructing, modifying, operating and maintaining our facilities and wells to recognised safety and environmental protection standards, to avoid unplanned releases of hazardous substances and to prevent injury to people or harm to the environment.
- Minimising the potential for human error through the design and operation of our facilities.
- Maintaining the integrity of safety and environmental critical elements.
- Managing risks on a whole of life-cycle basis.
- Managing change in accordance with our management of change process.
- Compliance with all applicable codes, regulations and Ithaca standards.

Monitoring and Audit

Through a process of audit and workplace monitoring, we will examine our processes and operations to confirm:

- That we review and re-evaluate our goals and our organisational capability.
- That our plans and processes are being correctly implemented.
- That we continually improve the effectiveness of our management system including our verification and well examination schemes.
- The suitability and effective implementation of this policy.

Emergency Management

While prevention is the first priority, we are prepared for an emergency and have the tools to mitigate any incident quickly and effectively:

- We maintain a fit-for-purpose command and control system, based on defined scenarios and meet all UK legal requirements.
- We regularly test the effectiveness of the system through audits and exercises.
- We aim to prevent future incidents by identifying and eliminating their root causes.

This policy applies to all offices and facilities operated by Ithaca Energy (UK) Limited.

The Leadership Team shall champion the implementation of this policy across Ithaca and lead the monitoring and auditing of its ongoing effectiveness.

Every individual has a duty to ensure that they always comply with, and hold others accountable for compliance with this policy, and prevent harm to themselves and others, and to the environment. This policy is applicable without distinction between Ithaca employees and contractors working for the company.

This policy meets the requirements of the corporate major accident prevention policy pursuant to Regulation 7 of the Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015.

Bill Dunnett, Chief Executive Officer
Ithaca Energy (UK) Limited

2 DESCRIPTION OF THE DECOMMISSIONING PROJECT

2.1 History and Background to the Causeway and Fionn Fields

The Causeway Field was discovered in 1984 by Tricentrol by an initial exploration well drilled in the western Causeway compartment of the reservoir, with a second exploration well drilled in 1992 by Amerada Hess. Further exploration and appraisal work was carried out in 2006-2008 and Causeway was found to comprise a series of fault blocks. The eventual development exploited the hydrocarbons in what was previously termed the East and Far East Causeway fault block (this being developed under a Field Development Plan (FDP) for the Causeway Field) and the Central Causeway fault block (this being developed under a FDP for the subsequently named Fionn Field); separate field designations were assigned by the Department of Energy and Climate Change (DECC) (now BEIS) in 2011.

Causeway was developed in 2012 by the field operator Valiant Petroleum (via its subsidiaries), as a subsea tie-back to the NCP, and commenced production later the same year with Fionn developed the following year with it tying into the Causeway-North Cormorant production pipeline via a spur line.

In 2013, Ithaca Energy acquired the Causeway and Fionn assets from its acquisition of Valiant Petroleum. In 2016, the Causeway production and WI wells were shut in, with production continuing from the Fionn well until April 2018, when it too was shut in. Production on the Causeway well was re-started in Q4 2018 to appraise well performance after re-start. Cessation of production from both fields was agreed with the OGA in Q1 2019.

2.2 Indicative Timetable and Potential for Alternative Use

The schedule for decommissioning activities is subject to change, but current estimates anticipate well plug and abandonment in 2026, the subsea programme carried out in 2027, along with the debris clearance and post-decommissioning survey. The relevant permits and consents for decommissioning activities can only be sought following the approval of the DP; these will be applied for in the future prior to any offshore activities taking place.

Ithaca Energy has considered the possibility for *in situ* re-use or redevelopment of the fields and facilities. However, no further exploitation of the fields is considered economically viable. Accordingly, decommissioning will focus on the plug and abandonment of the Causeway and Fionn wells, removal of the associated subsea infrastructure and with options derived from the CA of the relevant pipelines, control umbilical/power cable and protective material.

2.3 Facilities to be Decommissioned

A summary of the Causeway-Fionn facilities being decommissioned is provided in Table 2.1, with further details provided in the following sections.

Table 2.1 - Facilities and protective material

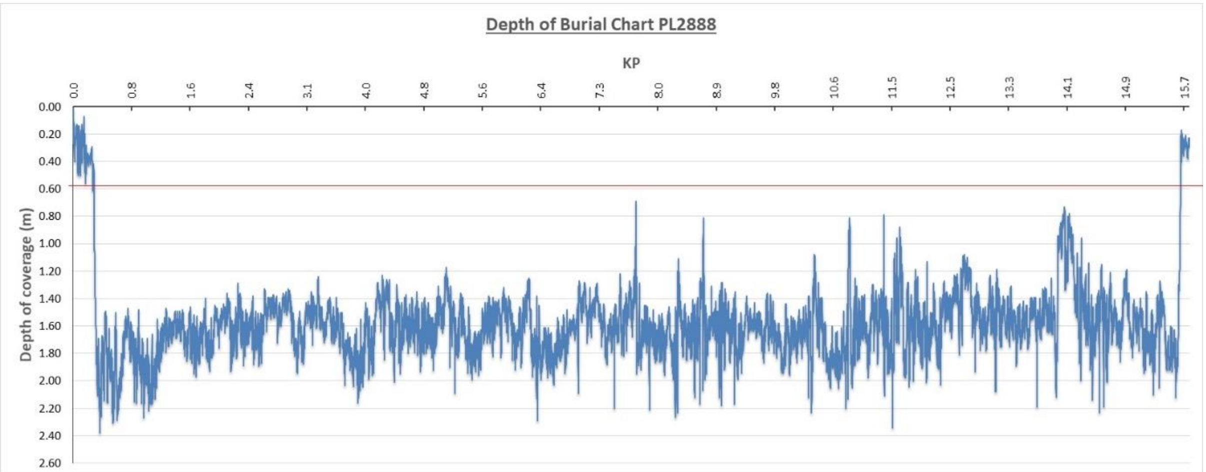
Wells	Description
2 subsea wells at Causeway	1 x production (oil) well (211/23d-17z) 1 x water injection well (211/23d-18), both shut in
1 subsea well at Fionn	1 x production (oil) well (211/22a-6z), shut in
3 subsea appraisal wells	Appraisal wells, 211/22a-8, 211/22a-9, 211/22a-7A
Pipelines and umbilical	
Pipelines trenched to a minimum depth of 1m below seabed level at installation and mechanically backfilled (buried) and remain buried to >0.6m[1]	

PL2888 - Pipeline from Causeway production well to NCP	15.5km, 8" carbon steel production pipeline and associated purge spool and integrated protective structure, within the NCP 500m zone
PL2889 Pipeline from Fionn production well to tie in at Causeway	2.8km, 8" carbon steel production pipeline, the Fionn spur line, that ties into the Causeway-North Cormorant production pipeline (PL2888) and associated valve skid and integrated protective structure
Pipeline and umbilicals trenched to a minimum depth of 1m below seabed level at installation but not mechanically backed filled, but left open to naturally backfill and remain >0.6m[1] below seabed level	
PL2890 Water injection pipeline from Causeway WI well to NCP	14.9km, 8" carbon steel with plastic liner water injection pipeline,
PLU2891 Umbilical from Causeway production well to NCP	16.2km, multi core control umbilical
PLU2892 Umbilical from Causeway WI well to production well	1.7km, multi core control umbilical
PLU2893 Umbilical from Fionn production well to NCP	12.2km multi core control umbilical
Protective material[1]	
Mixture of protective material located at crossing locations, approaches and tie-ins to infrastructure	Concrete mattresses (total quantity 440, total weight 1,917.2 tonnes), this comprised of the following: Causeway: 261 (total), 21 (buried[2]), 24 (at trench transition[2]), 216 (estimated to be recovered) Fionn: 179 (total), 2 (buried[2]), 22 (at trench transition[2]), 155 (estimated to be recovered) Sand bags (480, 12 tonnes) Rock (31,973 tonnes) (to be decommissioned *in situ*)

Note: [1] At installation, trenching and burial was to at least 1m depth, and the production pipelines remain buried – see Figures 2.1a and b. The WI pipeline and umbilical depth of lowering at installation is shown in Appendix B (Figures B1-B4) and these remain >0.6m below seabed level.

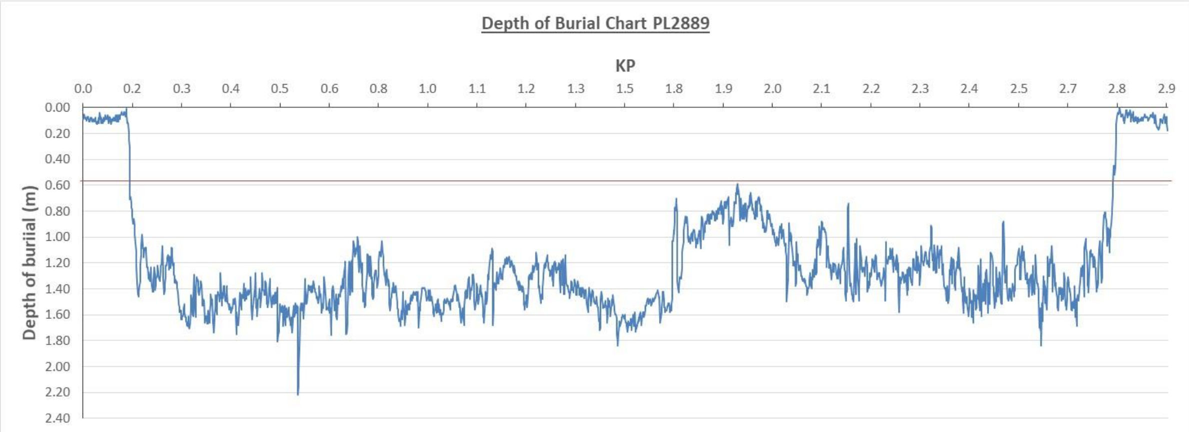
[2]Aim will be to recover all protective materials that become redundant where condition allows (where rock has been used, i.e. at crossings, this will be decommissioned in situ as it continues to provide a protective function, this also includes mattresses which are under the rock and buried), where mattresses are used at trench transitions (and may be partially buried), these to be assessed at time of decommissioning for leaving in situ (in consultation with OPRED) or recovery . Assessment of seabed disturbance (Section 5.1) includes disturbance from material move/removal. Where material is to be decommissioned in situ, this will be appropriately marked on the relevant notifications.

Figure 2.1a – Depth of burial of production line PL2888



Note: horizontal line is the BEIS (2018) minimum depth of burial (0.6m) KP = Kilometre Post

Figure 2.1b – Depth of burial of production line PL2889



Note: horizontal line is the BEIS (2018) minimum depth of burial (0.6m), KP = Kilometre Post

A high level inventory of Causeway-Fionn materials is shown in Tables 2.2a and b; as reuse is not an option, the current intention being to recycle as much of the material as possible (e.g. metals and where possible (subject to assessment and classification) mattresses) and minimise, as far as practicable, the waste to landfill. Wastes generated during the decommissioning activities will be segregated and transported to shore to a licensed waste contractor.

At present, both Causeway and Fionn remain tied back to the NCP; this is not part of the Causeway-Fionn DP and not included within the scope of this assessment.

Table 2.2a– High level inventory of Causeway materials (tonnes)

Causeway Subsea Installation Inventory	
Description	**Mass (tonnes)**
Steel (all grades)	365.5
Non-ferrous	8.3
Total	**373.8**
Causeway Pipeline Inventory	
Description	**Mass (tonnes)**
Steel (all grades)	2940.6
Non-ferrous	62
Mattresses	1283.3
Rock	30,939
Sandbags	12
Rubbers, polymers, coatings	707.5
Total	**35,944.3**

Table 2.2b– High level inventory of Fionn materials (tonnes)

Fionn Subsea Installation Inventory	
Description	**Mass (tonnes)**
Steel (all grades)	153.6
Non-ferrous	6.2
Total	**159.8**
Fionn Pipeline Inventory	
Description	**Mass (tonnes)**
Steel (all grades)	477.1
Non-ferrous	45.9
Mattresses	633.9
Rock	1,034
Rubbers, polymers, coatings	188.7
Total	**2,343.2**

2.3.1 Wells

Six wells are to be decommissioned, as listed in Table 2.1. The Causeway and Fionn wells were drilled in 2011/2012 with cuttings from the top hole sections (drilled with seawater and water based muds) being discharged at the seabed, and cuttings from the lower hole sections, drilled with oil based muds, having been skipped and shipped to shore and not discharged. Small quantities of historic cuttings are expected to be present in the immediate vicinity of the wells as this area does not experience strong currents which would disperse the cuttings (e.g. as typically seen in the southern North Sea). As these are water based mud surface hole cuttings, with no oil based mud present, these do not breach the thresholds in the OSPAR Recommendation 2006/5 guidelines and as such will be left in place to degrade naturally.

The final well decommissioning strategy for all the wells, is in development and will be drafted in accordance with the Oil and Gas UK guidance on well abandonment (OGUK, current version, version 6, 2018) and Ithaca Energy's Operational Excellence Policy.

The Causeway-Fionn wells will be plugged and abandoned using a semi-submersible drilling rig, and, given their locations, three rig moves will be required. A semi-submersible may also be used to plug and abandon the three appraisal wells (211/22a-8, 211/22a-7A and 211/22a-9). There may be the option to use a light intervention vessel to plug and abandon well 211/22a-8, and, given the locations of 211/22a-7A and 211/22a-9, if a semi-submersible is positioned mid point between the wells, only 1 rig move would be required to plug and abandon both wells. For assessment purposes, it has been assumed that a semi-submersible will be used for all wells, and that there will be 3 rig moves for the Causeway-Fionn wells, and 2 for the appraisal wells (total of 5 rig moves).

A rig site survey for final rig positioning at each rig location is expected to be carried out, and a consent to locate application, with appropriate supporting vessel traffic survey will be applied for. Final rig selection is still to be made, but a semi-submersible representative of the type which would be used is shown in Figure 2.2.

Figure 2.2 – Typical semi-submersible rig[5]

This type of rig is effectively a deck supported on pontoons which contain ballast tanks, which floats at all times (i.e. is not directly in contact with the seabed).

The height of the deck above the sea surface can be altered by pumping ballast (sea) water in or out of the pontoons. During operations, the deck is lowered but still kept above wave height.

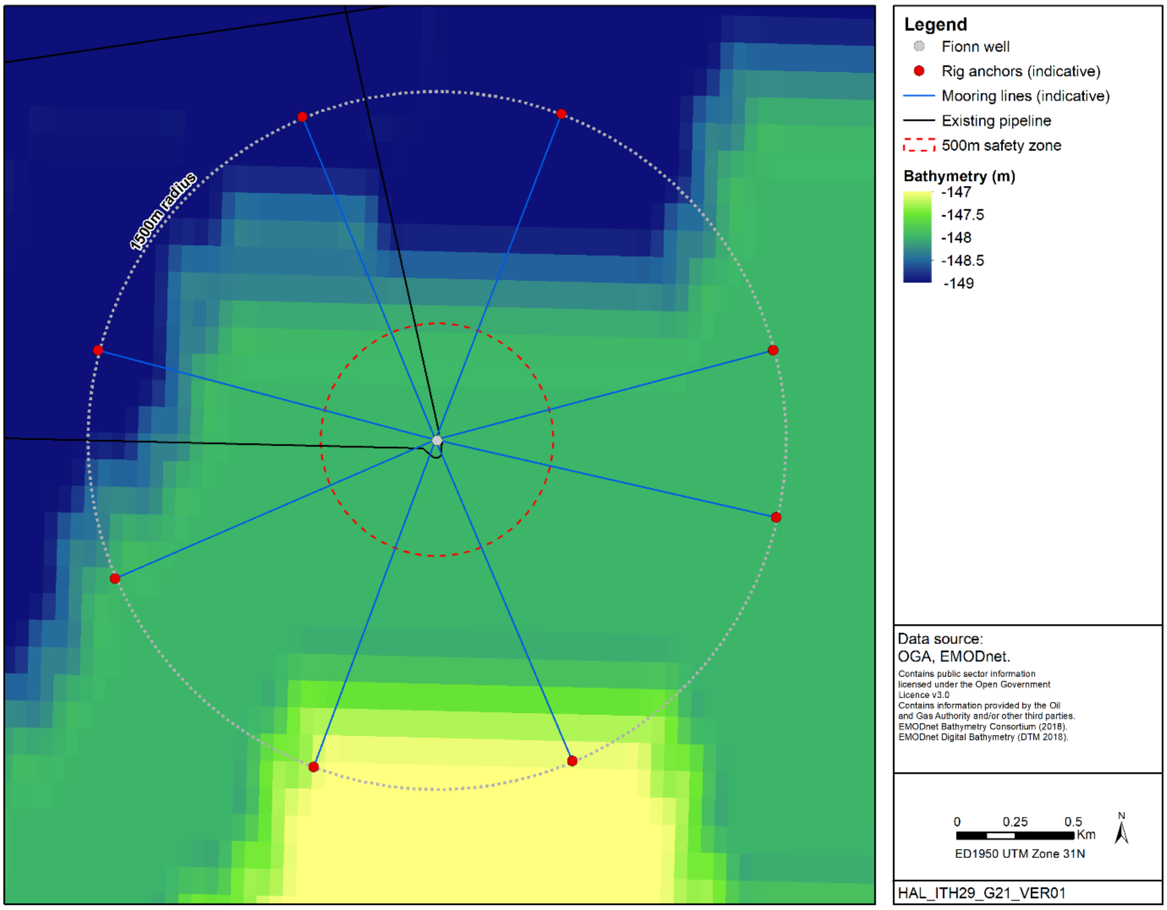
Rigs are towed to location by 2-3 anchor handler tug vessels and are maintained on station using anchors. Rig anchoring typically involves the deployment by anchor handler vessel of eight or more ~12 tonne seabed penetrating anchors.

The anchors are attached to the rig by cable and near the anchor by chain, of which a proportion (a minimum of 100m) lies on the seabed (the catenary contact). Hauling or paying out of cable can make minor adjustments to the rig position following anchor deployment.

The precise arrangement of anchors around the rig will be defined by a mooring analysis which will be undertaken prior to bringing the rig into the field and taking account of water depth, tidal and other current, winds and seabed features. An indicative anchor mooring pattern for an eight anchor spread centred on the Causeway production well position is shown in Figure 2.3.

[5] Rigzone: https://www.rigzone.com/news/image_detail.asp?img_id=3174

Figure 2.3 – Typical mooring pattern for an 8-anchor spread



The relationship between water depth and lateral extent of the anchor pattern is not linear and a typical radius of an anchor patterns for a semi-submersible drilling rig operating in a water depth of 100m (water depths across Causeway-Fionn is 152-164m) is 1300 – 1500m. Upon completion of activities, anchors are retrieved by anchor handler vessels by means of pennant wires which slide down the cable towards the anchor allowing a more or less vertical retrieval, facilitating anchor breakout from the seabed. The rig is then towed off station by the tugs.

It is estimated the rig will be on location for *ca*. 68 days (for Causeway-Fionn wells), assuming an operational and weather contingency of 8 days. The programme for the three appraisal wells is shorter, at *ca*. 21 days (total) including operational and weather contingency (89 days for all wells). The rig will be supported by a standby vessel, supply vessels and personnel transfers via helicopter.

As the well abandonment programme for the wells has yet to be finalised, final chemical use and discharge, including cement, is unknown at this stage. Chemical use and discharge will be kept to a minimum as far as technically practicable, and, as well plug and abandonment involves the setting of cement plugs within the well, the majority of cement used during these operations, by its very nature, is expected to remain downhole. All required environmental permits will be applied through OPRED's permit portal, prior to any offshore activity being carried, out, and this will include a full assessment of chemical use and discharge. Well abandonment will be conducted in accordance with industry guidance at that time (current guidance Oil and Gas UK guidelines on well decommissioning, issue 6, June 2018).

2.3.2 Pipelines, Umbilicals, Subsea Infrastructure and Protective Material

The Causeway-Fionn pipeline system comprises a total of six lines, two of which were trenched and mechanically backfilled at installation (the production pipelines PL2888 and PL2889) and four which were trenched to below seabed level, and not mechanically backfilled but left open to backfill naturally (the water injection pipeline PL28890, and the umbilicals PLU2891, PLU2892 and PLU2893) (see Table 2.1 above). Three of the lines (PL2888, PL2890 and PLU2891), also cross the 24" Magnus to Ninian oil pipeline (PL139).

The Causeway-Fionn lines are all now disused (and notified to OPRED). At time of submission of the DP and supporting documents, the production lines have still to be cleaned and flushed. Options for this cleaning and flushing programme are being discussed with TAQA, the NCP operator, prior to decommissioning, including the potential to bullhead down the wells or discharge via the platform.

The current contents of the lines are: production fluid (reservoir hydrocarbons/produced water) in the production pipelines (PL2888 and PL2889); water in the water injection pipeline (PL28890) and hydraulic fluid/methanol in the umbilicals (PLU2891, PLU2892 and PLU2893). Once the cleaning and flushing is completed, the production pipelines will be left "hydrocarbon free", (with only residual hydrocarbon present) with inhibited (typically biocide, oxygen scavenger, corrosion inhibitor) sea or potable water. Decommissioning activities, including any preparatory work, will only be carried out after the production lines have been cleaned and flushed.

No feasible re-use option for the pipelines has been identified, and in line with regulator guidance[6], a CA has been undertaken to inform decisions relating to the decommissioning of the pipeline system. Drawing from OSPAR 98/3, BEIS Decommissioning Guidance (BEIS 2018) and the OGUK Guidance on Comparative Assessment (OGUK 2015), Ithaca Energy developed a framework for conducting a comparative assessment using qualitative and quantitative data to evaluate alternative decommissioning options for pipeline systems, and has successfully applied this framework to the decommissioning of other assets (Ithaca Energy's Athena, Jacky and Anglia Fields).

After reviewing the framework to ensure it remained fit for purpose, a CA was undertaken and a number of different options considered. These included partial and full removal of all pipelines and umbilicals. Common to all options considered is the removal of the tie-in infrastructure (e.g. spool pieces, jumpers, risers at NCP and the recovery of all exposed protective material). Where protective material (e.g. mattresses) were used in conjunction with rock and are covered in rock or the condition of them is such that recovery is not feasible (subsea works are expected to be carried out in 2027, by which time the protective material will have been on the seabed for *ca*. 16 years), the approach will be to decommission these *in situ*, this will be done in consultation with OPRED. Common to options where the lines are to be decommissioned *in situ*, is leaving the pipeline/umbilical cut ends open; cut ends will not be left on the seabed, but will instead be lowered back below seabed level and if required mechanically back-filled with sediment, (or in the case of the production lines PL2888 and PL2889, there is also the option to cover these with additional rock) to ensure these do not pose a hazard to other users.

Using qualitative and quantitative data on the environment (including the pre-decommissioning survey) and the development, and drawing on the experience and knowledge of the multi-disciplinary CA team, including the pipeline technical authority for the Causeway-Fionn pipeline system. Ithaca Energy evaluated the alternative decommissioning options based on five main criteria: Safety, Environmental,

[6] Pipelines are not covered by OSPAR Decision 98/3, however, the framework for their decommissioning is contained within the Petroleum Act 1998. See Section 10 of BEIS (2018) decommissioning guidance notes and OGUK (2015) Guidelines for Comparative Assessment in decommissioning programmes.

Technical, Societal and Economic. Sub-criteria derived from the main criteria were scored, with scores then weighted according to level of definition and understanding of methods, equipment and hazards. Final scores for each criterion were recorded in a matrix format, with relative ranking for each option derived from the weighted scores.

The preferred options identified from the CA were to decommission all pipelines and umbilicals *in situ*, with the exception of the umbilical PLU2892; this is a short, *ca*. 1.5km line, trenched to below seabed level, but not buried (left to backfill naturally) and, taking into consideration the potential seabed disturbance, which was not deemed to be long term or significant, the complete removal of this line by reverse reel was the preferred option identified from the comparative assessment.

The *in situ* decommissioning of the remaining lines minimises the potential impact on the seabed and related habitats. Remediation (lowering/mechanical backfilling or rock cover) will only be applied to those areas which have been cut and require remediation.

Exposed and Freespan Sections – adequately buried/trenched lines

After installation, currents and wave action at the seabed may lead to scour and pipeline exposure. A freespan occurs where the seabed sediments have been scoured from under a pipeline resulting in an unsupported section of pipe no longer in contact with the seabed. An exposed pipeline is where a section of the pipeline can be seen on the surface of the seabed but is not free-spanning and the pipeline remains in contact with the seabed. Pipeline inspection reports (i.e. iSurvey 2015, DeepOcean 2018) have not identified any freespans along any of the Causeway-Fionn pipeline infrastructure (this is as expected, given this area is not subject to vigorous currents and the sediment type, deep circalittoral sand), or any exposed sections which are lying on the surface of seabed.

Fishing effort in the area is low to moderate with demersal gear the predominant type used. There have been no reported fisheries interactions since the infrastructure was installed; the 2015 inspection survey of the production pipeline PL2888 did identify a lost fishing net to the west of the Causeway Tee/Valve skid location, but no incident was reported and this net was not recorded as an anomaly on the 2018 survey (DeepOcean 2018).

2.4 Rig and Vessel Requirements

Along with the semi-submersible rig and supporting vessels, a variety of different vessels will be required during the Causeway-Fionn decommissioning activities. While final vessel selection is still to be made, the types of vessels required are known, as is their typical fuel consumption and these are summarised in Table 2.3. In the absence of named vessels, this information and estimated duration on locations, forms the basis of estimating vessel atmospheric emissions from the decommissioning activities.

Table 2.3 – Approximate rig and vessel requirements for the Causeway-Fionn decommissioning

Activity	Approximate no. days on site	Fuel consumption rate tonnes/day[1]	Fuel type	Total fuel consumption (tonnes)
Well Plug and Abandon				
Anchor handler/tug (x 3)	2	16 (per vessel)	Diesel	96
Rig on location[2]	89	18	Diesel	1,602

Activity	Approximate no. days on site	Fuel consumption rate tonnes/day[1]	Fuel type	Total fuel consumption (tonnes)
Supply vessels	2 trips per week (25 trips; 1.5 days per round trip)	9	Diesel	338
Standby vessel	89	1	Diesel	89
Helicopter	1 trip per week (13 trips)	1.13 tonnes per trip	Helifuel	15
Subsea infrastructure removal[3]				
DSV (pipeline/umbilical campaign)	29	20	Diesel	580
CSV (umbilical campaign)	5	20	Diesel	100
Tugs x 2 to support DSV if required	29	17	Diesel	986
Surveys				
Survey vessel	4	5.6	Diesel	22
Total Diesel Consumption (all activities (excluding helicopter), including contingency use of rig to decommission the three subsea wells)				**3,813**
Total helifuel consumption				**15**

Note: [1]All times shown include mob and demob; fuel consumption under these condition can be less than that shown, however, for assessment, worse case fuel consumption has been used [2]Rig on location is for the three wells at Causeway-Fionn (ca. 60 days, with an eight day contingency) and the use of the rig for the three subsea appraisal wells (13 days with an eight day contingency). The option to use a LWIV (under dynamic positioning) for decommissioning one of the subsea appraisal wells is being assessed, but contingency rig use included here as this represents the worst case (using vessels would reduce the overall atmospheric emissions, as time on site shorter, and no tugs required). [3]If the option to use rock for cut ends (production/WI pipeline) is used, then a rock placement vessel will be used, (ca 2.5 days, at a daily consumption rate of 20 t/d, with total consumption of 50 tonnes). However, the overall diesel consumption would not expect to increase, as using rock would reduce the time on location of the DSV by an equivalent amount (i.e. part of the DSV scope is to trench and mechanically backfill cut ends).

The rig may require bunkering during the well activities but none of the other vessels are expected to require refuelling while on location. The rig and other vessels will operate to MARPOL standards for Special Areas. A survey vessel will conduct a post-decommissioning survey to confirm no snagging hazards remain.

2.5 Fate of Infrastructure and Post-decommissioning Monitoring

A relatively small quantity of material will be returned to shore for processing, i.e. material from the well (i.e. wellhead, protective structures, well conductors) and the subsea programme (i.e. valve skid). The final receiving port and yard for processing the waste is still to be determined, although Ithaca Energy will ensure the selected port and yard will have the appropriate environmental and operational licenses and consents to receive and process the material. All waste will be documented in a waste inventory, which will record the types, quantities and fate of all waste, following a waste hierarchy consistent with the Waste Framework Directive.

Current aspirations for recycling the material brought back onshore have been estimated, and are as detailed in the DP, with the relatively small amount of materials for which recycling is not an option, including residual marine growth, sent to appropriate disposal.

A post decommissioning survey will be carried out. The approach for Causeway-Fionn will be to carry out the survey similar in scope to a pipeline inspection survey using non-intrusive methods (e.g. ROV, drop-down camera), to identify any significant material remaining on the seabed that could be deemed a snagging hazard. There will be no intervention along the majority of the lines, including at those sections already covered in rock (with intervention only at line ends), therefore the rock will remain overtrawlable. Following decommissioning, the Causeway-Fionn pipeline system, with the exception of umbilical PLU2892, will remain *in situ*, along with the unrecovered protective material, including that protecting the crossings. The post monitoring survey regime for the area will be discussed and agreed with OPRED.

3 EVIRONMENTAL SETTING

3.1 Seabed Topography and Seabed Sediments

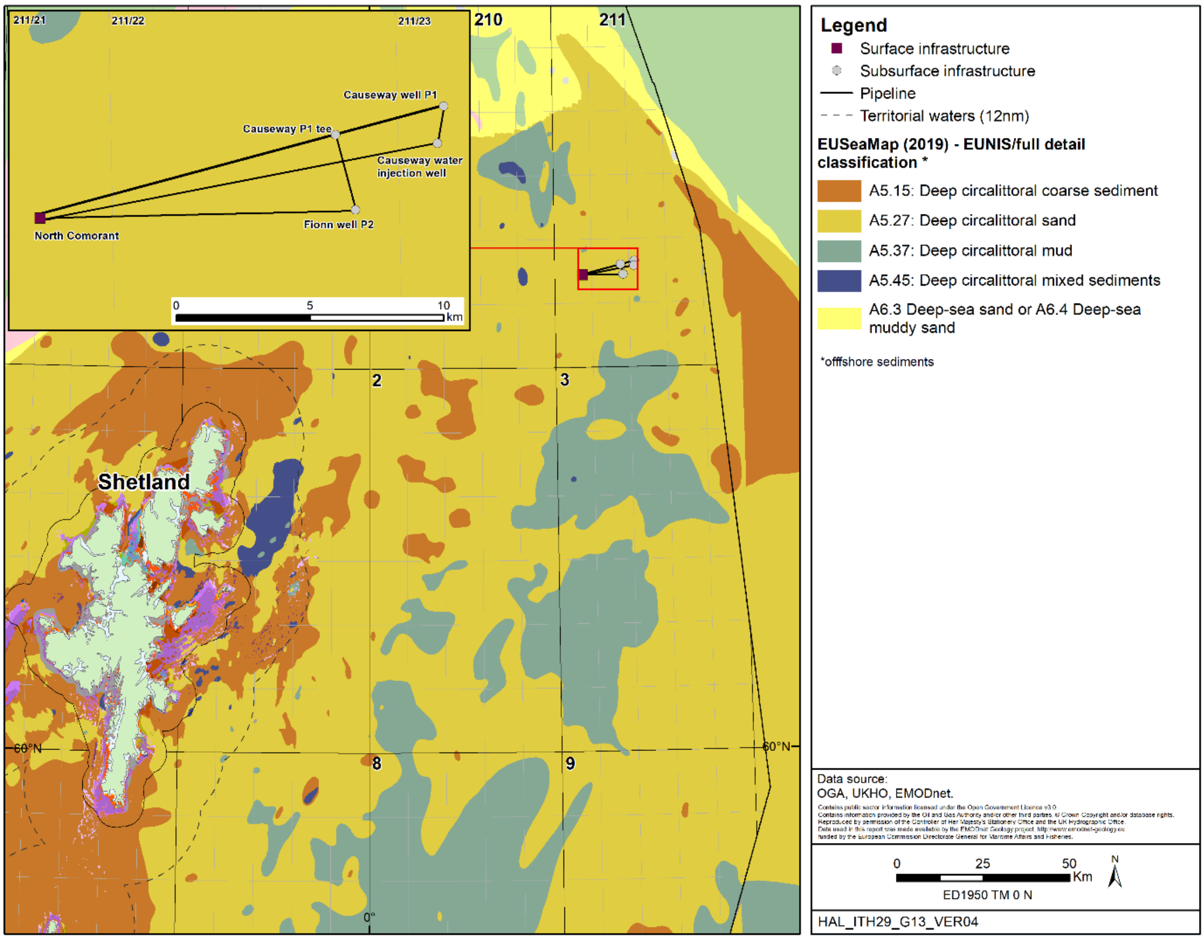
The Causeway-Fionn facilities are located in the East Shetland Basin area of the northern North Sea, in Blocks 211/21, 211/22 and 211/23 (see Figure 1.1 above). The seabed across the area is relatively flat though shoals slightly to the west, with survey data recording negligible gradients and depths ranging from a minimum of 148m at the Fionn P2 well location, and maximum of 160m at the tie-in with NCP (GEMS 2012a, b, c). Depressions are noted on the seabed across the Causeway-Fionn area which are generally minor, isolated features with a low surface expression (most <0.5m) which are sometimes associated with higher reflectivity (i.e. indicating areas of coarser sediment) and boulders. There is a general increase in size of these depressions towards the west, and though most are small, there are some large examples noted close to NCP, measuring approximately 80x50m and 49x40m respectively (GEMS 2012b). GEMS (2012c) note that there was no evidence of shallow gas or gas release that would attribute these to pockmark features. Other topographic features are anthropogenic in origin, and include trawl scars generally orientated north-south and anchor scarring from former rig placements at well sites, with some debris also noted.

The Causeway-Fionn facilities are in an area of deep circalittoral sand (Figure 3.1) and more specifically, survey data (GEMS 2012a, b, c) indicated that across the well sites and pipeline route sediments are silty clayey sand, with frequent shell and shell fragments and occasional boulders. Boulders were recorded along each pipeline route and well location, though were most numerous along the water injection pipeline route (GEMS 2012b). This accords with earlier survey data collected around the NCP (CRN 1986, 1988, 1989, 1991)[7] in which all sediment samples had a mean grain size consistent with fine to very fine sand. These sediments thinly overlie what is interpreted to be the Quaternary glacigenic Sperus Formation (GEMS 2012a, b, c) which tends to thin westward giving way to the underlying Cape Shore Formation (Johnson *et al.* 1993). The uppermost two shallow geological units are both regarded to be part of the Sperus Formation, comprising fine to coarse sand (0-1.7m deep) and a lower stiff silty sandy clay (5-14m deep).

The pre-decommissioning survey conducted by Fugro (2020a, b) is in broad agreement with findings from the earlier surveys, and found the predominant sediment across the survey area was muddy sand (Figure 3.2) with varying proportions of scattered shells, and boulders. Substrate either side of the existing rock placement comprised slightly gravelly, muddy sand, often with scattered cobbles, and was classified as the biotope complex "Deep circalittoral mixed sediment" and considered transitional zones between the soft sediment and the anthropogenic rock placement rather than a prominent habitat type (Fugro 2020a).

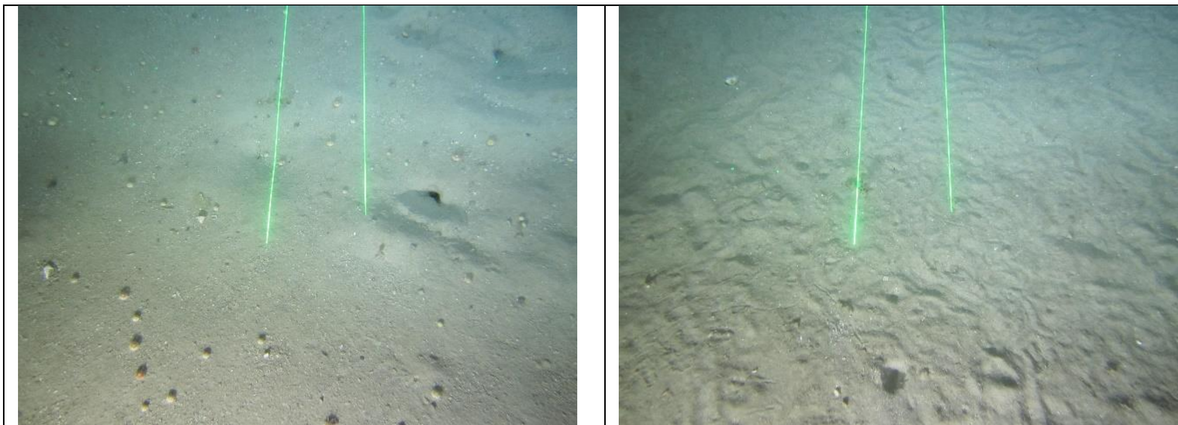
[7] As recorded in UKBenthos 5.10: https://oilandgasuk.co.uk/product/ukbenthos/

Figure 3.1 – Predicted seabed habitats

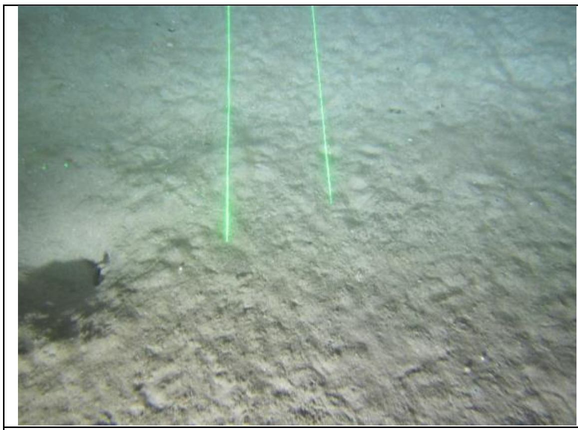
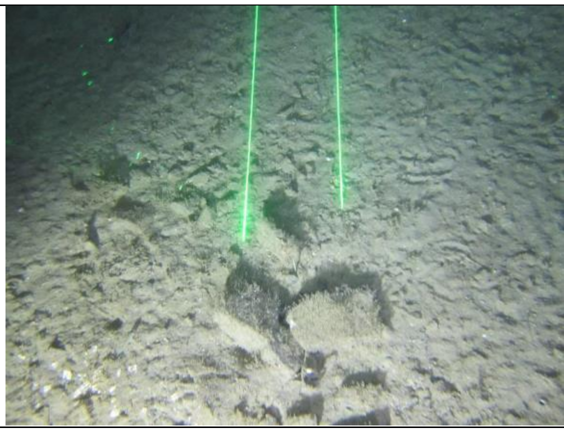


Particle size distribution (PSD) analysis showed sediment was consistent across the survey area; sand being the dominant fraction (ranging from 82.83% to 88.5% - mean value of 85.3%, with low variation), with similar proportions of fines (ranging from 11.3% (10.24% silt and 1.07% clay) to 16.77% (14.92% silt and 1.85% clay) mean of 14.09%, low variation) and little gravel (ranging from 0.03% to 1.28%, mean of 0.61%, moderate variation) content (Fugro 2020b).

Figure 3.2 Typical seabed across the Causeway-Fionn area showing evidence of bioturbation and patches of coarser sediment



Deep circalittoral sand (EUNIS classification A5.27) - site ST03 (Fugro 2020a)	Deep circalittoral sand (EUNIS classification A5.27), with bioturbation – ST06 (Fugro 2020a)

	
Muddy sand, faunal burrows and tracks – TR01 (Fugro 2020a)	Slightly gravelly muddy sand with cobbles, faunal turf (Hydrozoa/Bryozoa), faunal tracks – TR05 (Fugro 2020a))

Notes – Site ST03 and TR01 are located to west of the Causeway Tee, ST06 is located south east of well P1, on the 500m safety zone boundary, TR05 is located to the east of the PL2889 and PL2890 crossing – see Appendix A

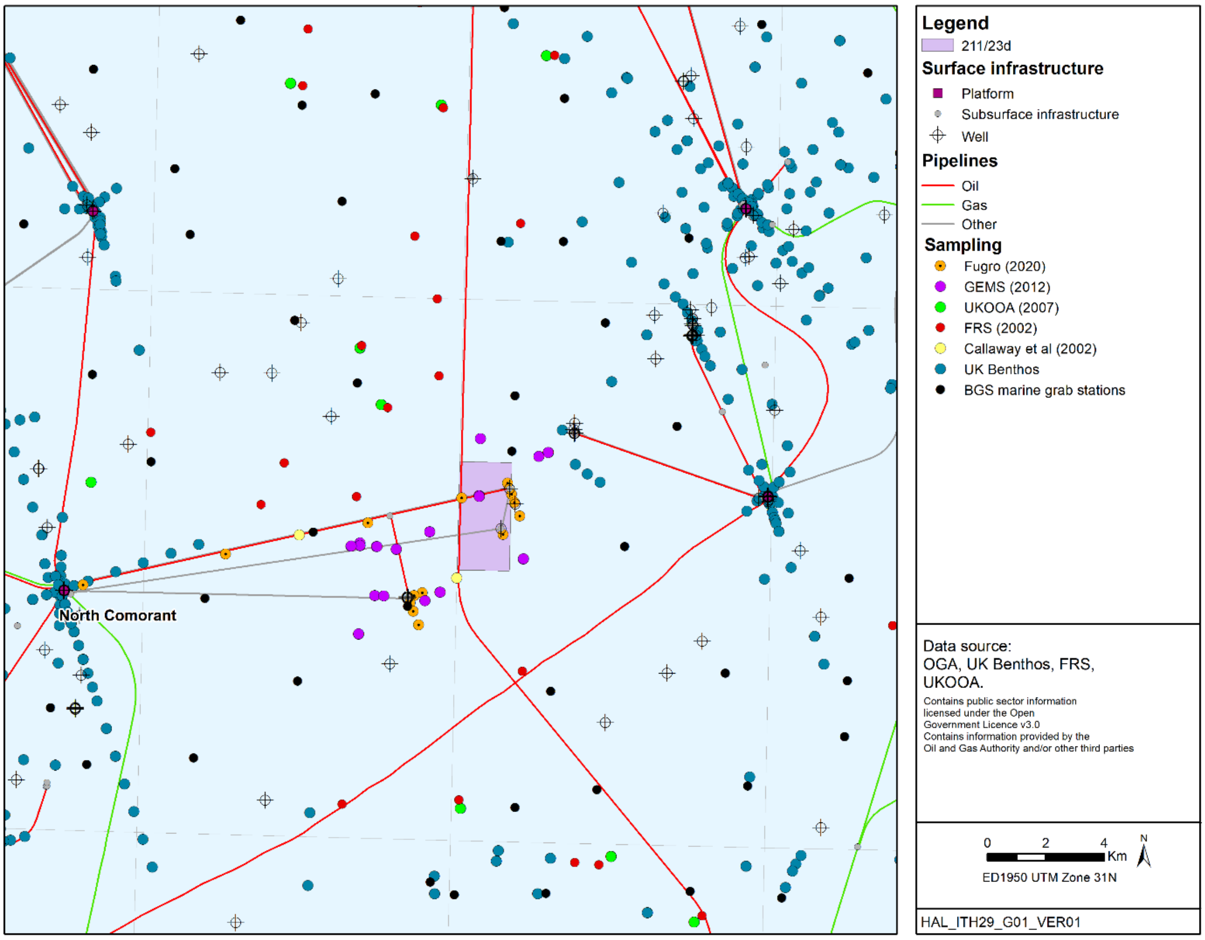
3.1.1 Sediment Contamination

Shipping activity and oil exploration and production activities are the main anthropogenic sources of hydrocarbon contamination of water and sediments in the area (Ahmed *et al.* 2005, Russell *et al*. 2005), this being a mature oil and gas basin in the North Sea.

The pre-decommissioning survey (Fugro 2020) sampled in proximity (200m) to the 3 wells included in the Causeway and Fionn fields development and 500m from the North Cormorant Platform. There was no evidence from the pre-decommissioning survey results of significant changes in sediment particle composition, total hydrocarbon content (THC), heavy and trace metals or macrofaunal at any of the stations sampled close to the Causeway and Fionn wells. The survey concluded that the low levels of hydrocarbons and metals and a homogenous seabed habitat and macrofaunal community suggested the seabed across the survey area was typical of 'background' sediments in the region. The highest, but only slightly elevated, concentrations of THC (10.4µg/g) and barium (3,000µg/g) were recorded at the sampling station closest to the NCP.

The tophole sections of the Causeway and Fionn production wells and the Causeway water injection well were drilled with seawater/WBM with cuttings discharged at the seabed. OBM was used in the lower hole sections and the resulting cuttings were returned to shore for processing. There are no OBM contaminated cuttings piles in the vicinity of the wells.

Figure 3.3 – Sampling stations in the greater Causeway-Fionn area



Note: FRS (2002) is the survey within Russel et al 2005, and included in the bibliography as Russel et al (2005)

3.2 Climate, Oceanography and Hydrography

The climate of the Causeway-Fionn area is mild for its latitude, and is strongly influenced by Atlantic Water inflow (see below) and westerly weather systems, which contain frequent depressions (OSPAR 2000) that are strongly influenced by the North Atlantic Oscillation (NAO) (Turrell *et al.* 2003, Winther & Johannessen 2006). Air temperatures vary seasonally over this area of the North Sea, and are usually in the range 1-16°C except in extended durations of easterly winds, which can lead to extreme cold in winter and warm conditions in summer (UKHO 2012). Air temperatures as low as -5°C are not uncommon in winter, with the summer mean, maximum temperature being around 16°C (UKHO 2012).

Winds in the northern North Sea are variable and may blow from any direction; though are predominantly from the south and southwest. Annual mean wind speed at 100m in the Causeway-Fionn area is ~10.5m/s, varying seasonally as follows: ~10m/s (spring), ~8.2m/s (summer), ~11m/s (autumn) and ~12.7m/s (winter) (ABPmer 2008). In winter, winds of Beaufort force 5 (~9-11m/s) or greater, may be experienced at a frequency of approximately 60-65% in the northern North Sea, reducing to between 22 and 27% in summer (UKHO 2012).

Swell direction ranges from southwest to north throughout the year, with north and northwest swells most common during summer (UKHO 2012). Annual mean significant wave height is approximately 2.7m, varying seasonally as follows: 2.6m (spring), 1.75m (summer), 2.9m (autumn) and 3.7m (winter) (ABPmer 2008). Waves generated under conditions of deep east-moving depressions from the North

Atlantic can reach more than 8 metres in height in winter while conditions where waves of 4 metres are likely to be exceeded occur for 10 percent of the year. As a result, the North Sea is considered to be frequently "rough" from October to March (UKHO 2012). The 100 year extreme significant wave height is 15-16m (HSE 2008).

The mean circulation of the region is governed by the inflow of Atlantic Waters; the north-western route through the Fair Isle Channel (Turrell *et al*. 1992), the northerly route over the east side of the Shetland Islands and a deeper northern inflow over the North Sea Plateau and along the western edge of the Norwegian Trench (Turrell *et al.* 1996, Winther & Johannessen 2006). The main circulation flow in the region is cyclonic, with the primary outflow of water from the North Sea, the Norwegian Coastal Current, flowing northwards along the west coast of Norway in the upper 50-100m of the water column (Ikeda *et al*. 1989).

Tidal currents in the northern North Sea area are generally weak and are readily influenced by other factors such as winds and density driven circulation rather than the tides themselves. This results in a relatively atypical pattern to the tidal currents. Tidal current speed and direction measured at the nearest Admiralty tidal diamond to Block 211/22 (Chart 2182C, diamond B, approximately 62 kilometres from the Fionn P2 well location) show maximum tidal rates of 0.3 and 0.6m/s for neap and spring tides respectively (Hydrographer of the Navy 1993), with modelled data indicating fairly low flows over the wider area of 0.06m/s and 0.11m/s for neap and spring range respectively (ABPMer 2008). Currents are generally fastest at approximately one hour prior to high water during both spring and neap tides.

The water column stratifies thermally in summer (Connor *et al*. 2006, van Leeuwen *et al.* 2015). The thermocline is broken down in winter, with increased wind and convective mixing. Sea surface temperature and salinity values in the northern North Sea are to a large extent influenced by the flow of oceanic Atlantic waters into the North Sea, through the Fair Isle Channel (Turrell *et al*. 1992). Annual mean sea surface temperatures are ~9.6°C, and bottom temperatures ~7.7°C (Berx & Hughes 2009). Surface and bottom salinities are approximately 35ppt and 35.2ppt respectively, with very little seasonal variation (Berx & Hughes 2009).

3.3 Plankton

Plankton consists of microscopic plants (phytoplankton) and animals (zooplankton) including the larval and juvenile stages of benthic organisms (meroplankton). The plankton community in the waters around the Causeway-Fionn area is similar to that found over a wide area of the northern North Sea.

The northern North Sea is characterised by deep, cool, stratified waters (JNCC 2004). The inflowing warm, nutrient rich waters from the north Atlantic are thought to be a factor promoting earlier stratification (Drinkwater *et al*. 2003), conditions suited for successful competitors such as dinoflagellates (Margalef 1973, cited in Leterme *et al*. 2006). The phytoplankton community is dominated by the dinoflagellate genus *Tripos* (*Tripos fusus, Tripos furca and Tripos lineatus*), with diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. also abundant. Dinoflagellates typically comprise a greater proportion of the phytoplankton community than diatoms from June to October, when waters will be most stratified (McQuatters-Gollop *et al*. 2007). The spring bloom in this region is stronger, relative to the autumn bloom, than elsewhere (Longhurst 1998). Harmful algal blooms observed in the region include the diatom *Pseudo-nitzschia*, a cause of amnesic shellfish poisoning, and the dinoflagellate *Alexandrium tamarense*.

Zooplankton species richness is higher in the northern North Sea than in the southern North Sea and the community displays greater seasonal variability (Lindley & Batten 2002). The zooplankton community is dominated by calanoid copepods, although other groups such as *Paracalanus* and *Pseudocalanus* are also abundant. There is also a high biomass of *Calanus* larval stages present in the region. Euphausiids, *Acartia*, and decapod larvae are all important components of the zooplankton assemblage. Jellyfish are typically less abundant in northern and eastern coasts of the UK, although species commonly sighted include *Aurelia aurita*, *Cyanea capillata* and *Cyanea lamarckii* (Pikesley *et al*. 2014).

3.4 Benthos

Benthic communities are traditionally considered as two groups: infauna and epifauna. The infauna live within the seabed sediment, and represent the most commonly surveyed and well-known benthic community. Epifauna live on the surface of the sediment, are generally larger than infauna, and may be sessile, such as sponges and hydroids; or mobile, such as echinoderms and crustaceans.

In regional-scale classifications of North Sea benthos, Künitzer *et al*. (1992) indicated that benthic infaunal communities in waters north of the 70m depth contour, were typified by finer sediments and the indicator species *Spiophanes kroyeri*, *Prionospio cirrifera* and *Myriochele* spp. (polychaetes). Similarly, Reiss *et al*. (2010) identified a northern and central North Sea infaunal assemblage in water depths of 96m (range 40-185m) characterised by *Myriochele* spp., *Amphiura filiformis* (echinoderm), *Spiophanes* spp. and *Paramphinome jeffreysii* (polychaete).

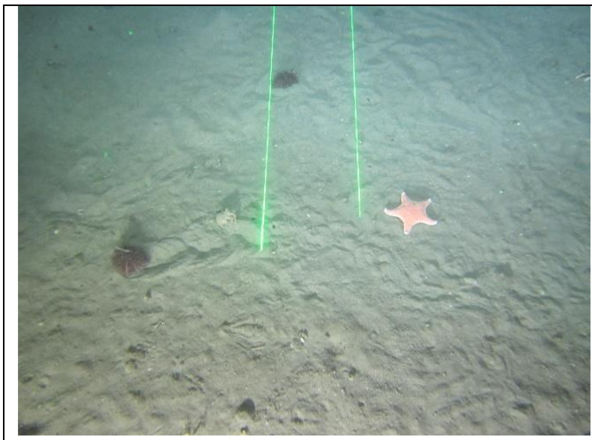
Callaway *et al*. (2002) described the area as a region of transition in the epibenthic community with species typical of water >100m deep such as *Astropecten irregularis* (echinoderm), *Hyalinoecia tubicola* (polychaete), *Echinus* spp. (echinoderm), *Anapagurus laevis* and *Pagurus pubescens* (crustaceans), and the anemone *Hormathia digitata*, as well as species more characteristic of shallower water, including crabs *Hyas coarctatus* and *Pagurus bernhardus*, the whelks *Neptunea antiqua* and *Colus gracilis*, starfish *Asterias rubens* and the hydroid *Hydractinia echinata*. Reiss *et al*. (2010) reported a similar transition between epifaunal communities in the area.

Analysis of grab samples taken during the 2012 Causeway-Fionn survey showed that approximately 46% of taxa were annelids, 22% arthropods, 21% molluscs, 6% echinoderms, and 5% other phyla (e.g. sipunculans, flatworms, cnidarians) (GEMS 2012). The polychaetes *Owenia fusiformis* and *Galathowenia oculata* were the dominant species recorded over the survey area, and accounted for 20% of the total number of individuals recorded, but no single species was dominant across all the stations. No Annex I habitats were considered to be present within the survey area, based on review of the side scan sonar data, video footage, camera stills and environmental ground truthing at representative locations (Fugro 2020a, b; GEMS, 2012a-c).

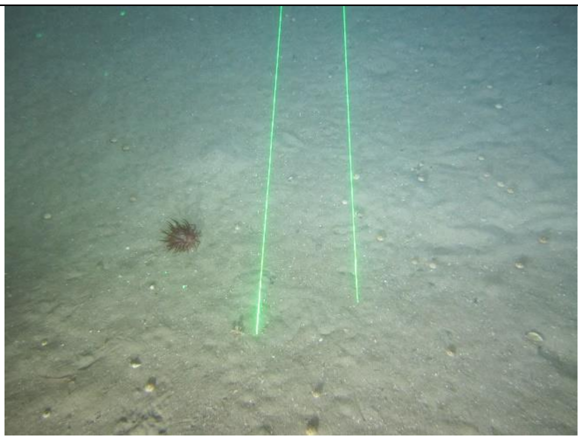
Macrofaunal analysis from the 2020 survey was comparable to the 2012 survey and found that approximately 51% of taxa were annelids, 21% arthropods, 18% molluscs, 5% echinoderms and 6% other phyla (specifically enteropneusta, nemerteans, phoronids and sipunculids. Sampling of fauna indicated the polychaete *Galathowenia oculata* was numerically abundant, this also being the dominant species, with the second and third most abundant species being *Phoronis ovalis* and *Eclysippe vanelli* respectively (Fugro 2020b).

Across the dominant habitat (deep circalittoral sand), benthic epifauna was generally sparse, with observed taxa including sea pens (*Virgularia* sp. and *P. phosphorea*), (see also Section 4.9) urchins (Echinidae, including *Gracilechinus acutus* and *Spatangus* sp.), polychaete worms (Hyalinoeciinae and Sabellidae), starfish (Asteroidea, including possible *Astropecten irregularis* and *Luidia sarsii*), hermit crabs (*Paguridae)* and cushion stars (Goniasteridae including *Hippasteria phrygiana*) (Figure 3.4). Other taxa observed included brittlestars (Ophiuroidea), anemones (Actiniaria, including possible Hormathiidae, *Epizoanthus* sp. and *Bolocera tuediae*), possible sponges (Porifera) and faunal turf (Hydrozoa/Bryozoa). Fish included flatfish (Pleuronectiformes) and Ling (*Molva molva*) and faunal tubes, tracks, mounds and burrows and necklace shell eggs were also observed (Fugro 2020b). Stills from the survey show burrows, although many of these appear to be from urchins, the faunal tracks of which are also visible (Figure 3.4).

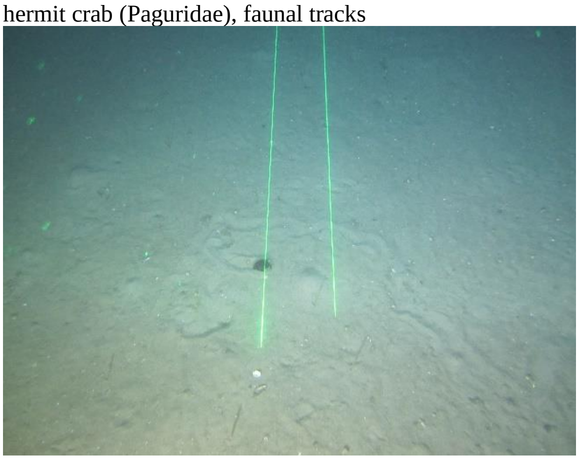
Figure 3.4 – Seabed images from the Causeway-Fionn pre-decommissioning survey



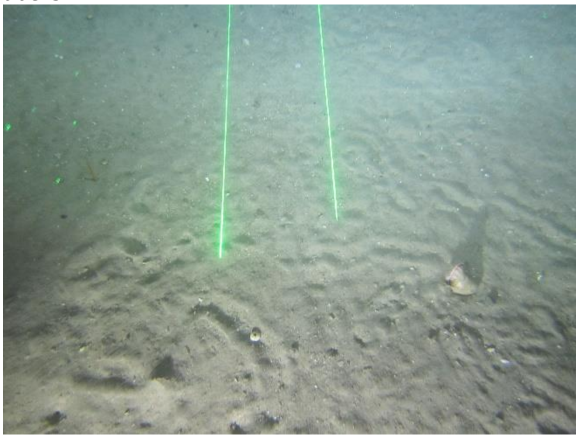
Seabed image from ST06, muddy sand, with scattered shell, showing urchins (*Spatangus* sp.), cushion star (Goniasteridae, including *Hippasteria phrygiana*) and hermit crab (Paguridae), faunal tracks



Seabed image from ST07, muddy sand with scattered shell fragments, showing anemone (*Bolecera tuediae*), urchins (Echinidae, including *Gracilechinus acutus*) and faunal tracks



Seabed image from ST11, muddy sand with shell fragments, showing sea pens (*Virgularia* sp.) and urchin (*Spatangus* sp.), faunal tracks



Seabed image from ST12, muddy sand with shell fragments, showing sea pen (*Virgularia* sp.), anemone (*Actiniaria*, possible Hormathiidae), faunal tracks and burrow

Sources: Fugro 2020a

Fauna was also typically sparse across the other two biotopes present, classified as "Deep-sea artificial hard substrate", hard boulders installed for protection as part of the original development, and "Deep circalittoral mixed sediment", slightly gravelly, muddy sand, often with scattered cobbles, sediments considered a transitional zone between the soft sediment and the anthropogenic rock placement, therefore not considered a prominent habitat type in the area (Fugro 2020b). In both areas, squat lobsters (Galatheoidea), hermit crabs (Paguridae), starfish (Asteroidea), sea pens (*Virgularia* sp.) and fish (including Sebastidae) were observed, while anemones (Actiniaria, including *B. tuediae*), cushion stars (Goniasteridae, including *H. phrygiana*) and urchins (Echinidae), were also observed from the hard substrate biotope (Fugro 2020b).

3.5 Cephalopods

Cephalopods are short-lived, carnivorous invertebrates with rapid growth rates that play an important role in marine food webs. Whales, dolphins, seals, birds and predatory fish will take large quantities of squid. As cephalopods tend to rapidly concentrate heavy metals and other toxic substances in their tissues, they play an important role in trophic bioaccumulation of pollutants (Hastie *et al*. 2009).

Oceanic inflows from the Atlantic, coupled with the numerous shallow inshore habitats, make the northern North Sea a region of greater cephalopod diversity and abundance than the southern North Sea. Among the most frequently recorded species are: the long-finned squids, *Alloteuthis subulata* and *Loligo forbesii*; the short finned squid, *Todarodes sagittatus*, *Gonatus fabricii* and *Onychoteuthis banksii*; the bobtail squids, *Rossia macrosoma*, *Sepia atlantica* and *S. oweniana*; and the octopus, *Eledone cirrhosa*. Other species that may be encountered in the region include: *Illex coindetii*, *Todaropsis eblanae*, *Rossia glaucopis*, *Sepiola aurantiaca*, *Sepiola pfefferi* and *S. elegans*.

Short-finned squid are powerful swimmers, typically found in open, oceanic waters and are perhaps more likely to be found offshore in waters around the Causeway-Fionn area than long-finned squid - which are more associated with coastal waters.

The stout bobtail *Rossia macrosoma* is a neritic, benthic species occurring in moderate and cool, shallow coastal waters and continental shelf areas. It has been found in waters all around the UK, although in Scottish waters, it is apparently more common on the west coast than the east coast at around 50m deep (Yau 1994, cited in Hastie 2009); a maximum depth of 515m was reported by Collins *et al*. (2001) and it is usually found over sand-mud substrata (Roper *et al*. 1984). It is restricted to the central and northern North Sea as it requires higher salinities than are found in the southern North Sea (de Heij & Baayen 2005). Spawning migrations to inshore areas are known to take place from March to November (Mangold-Wirz 1963, cited in Hastie *et al*. 2009), with the largest individuals usually arriving earlier in the season (Jereb & Roper 2005, cited in Hastie *et al*. 2009).

3.6 Fish and Shellfish

Callaway *et al*. (2002) analysed catches from surveys conducted using 2m beam trawls and otter trawls to establish epibenthic and fish communities throughout the North Sea. Catches from the beam trawl in this part of the northern North Sea were characterised by long rough dab (*Hippoglossoides platessoides*) and hagfish (*Myxine glutinosa*). Otter trawl results found Norway pout (*Trisopterus esmarkii*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), herring (*Clupea harengus*), plaice (*Pleuronectes platessa*) and lemon sole (*Microstomus kitt*) to be most common species. Similarly, analysis of bottom trawl survey data by Reiss *et al*. (2010) showed the demersal fish community to be dominated by haddock, long rough dab, whiting and grey gurnard (*Eutrigla gurnardus*). Many of these species are valuable commercially.

The Causeway-Fionn area lies in ICES Rectangle 51F1; 51F1 overlaps reported spawning grounds of Norway pout (January-April), haddock (February-May), saithe (*Pollachius virens*, January-April) and cod (*Gadus morhua*, January-April), along with nursery grounds of Norway pout, haddock, blue whiting (*Micromesistius poutassou*) and mackerel (*Scomber scombrus*) (see Table 3.1 and Figure 3.5 and 3.6) (Coull *et al*. 1998). Additional surveys also have spawning grounds for whiting overlapping the Causeway-Fionn area (Ellis *et al*. 2012) (Figure 3.5). Nursery grounds described in Ellis *et al*. (2012) overlapping 51F1 include blue whiting, hake (*Merluccius merluccius*), herring, ling (*Molva molva*), mackerel, spurdog (*Squalus acanthias*) and whiting. Ellis *et al*. (2012), describes the spawning ground for cod (Figure 3.5) and the nursery ground for blue whiting (Figure 3.6) as high intensity, with both areas overlapping the Causeway-Fionn area.

The features are dynamic and likely to show some degree of spatial and temporal variability (Coull *et al*. 1998).

Marine Scotland has identified a period of concern from January to May for seismic surveys in Blocks 211/22, 211/23 and 211/21 (in addition to all neighbouring Blocks) due to the potential adverse effect on fish spawning. No seismic survey will be carried out as part of the decommissioning activities.

Table 3.1 – Spawning periods for fish and shellfish in ICES Rectangle 51F1

Species	Spawning grounds	Spawning period (peak spawning)	Nursery grounds
Norway pout*	✓[1]	January-April[1] (February-March)	✓[1]
Haddock	✓[1]	February-May[1] (February-April)	✓[1]
Saithe*	✓[1]	January-April[1] (January-February)	-
Cod*	✓[1,2]	January-April[1] (February-March)	-
Whiting*	✓[2]	February-June[1]	✓[2]
Blue whiting*	-	-	✓[1,2]
Mackerel*	-	-	✓[1,2]
European hake	-	-	✓[2]
Herring*	-	-	✓[2]
Ling*	-	-	✓[2]
Spurdog*	-	-	✓[2]

*Source: [1]Coull et al. (1998), [2]Ellis et al. (2012) * Species considered Priority Marine Features in Scottish waters*

NatureScot and the Joint Nature Conservation Committee (JNCC), along with Marine Scotland, developed a list of Priority Marine Features (PMFs) in Scotland to help focus future research, planning and conservation (NatureScot website[8]).

Of the five species known from the literature to have spawning grounds in the area, four are PMFs in Scottish waters: Norway pout, saithe, cod and whiting, all of which are pelagic spawners, releasing eggs into the water column. Norway pout are generally found in waters of 80-200 m over sandy and muddy substrates, but also occur in waters of up to 450 m depth in the Norwegian Deep. The majority of the fish spawn for the first time when they are in their second year, but some may do so when they are one year old (Raitt & Mason 1968). During June and July, the pelagic 0-groups (fish within the first year of their lives), are thought to migrate vertically within the water column, spending most of the daylight hours close to the seabed, and moving in to midwater at night (Bailey 1975).

Saithe are found at depths of between 0-200m around northeast Atlantic coastlines, usually entering coastal waters in spring and migrating back to deeper sea in winter. They grow to 60-90cm and have a diet of fish and small crustaceans. Saithe reach maturity between the ages of 4-6 years and individuals of 25 years old have been reported (Gordon 2006). They spawn in winter and spring, later in the year for populations further north. Cod show a preference to spawn in waters with temperatures between 5-7ºC and high salinities, over coarse sand with a low tidal flow (González-Irusta & Wright 2015) and spawning is thought to be more widespread than suggested by Coull et al. 1998 (Ellis *et al*. 2012).

Whiting are widespread around European coasts at depths of 10-200m over sandy or muddy ground. They typically grow to 30-40cm in length and may reach 20 years of age, although 7 or 8 is more common (Gordon 2006). Their diet comprises mainly crustaceans and fish, with a greater proportion of fish as they get older. Spawning can take place as early as January in the southernmost areas of its distribution and as late as July in more northerly areas. Whiting spend their first 2-3 months near the surface, often associating with Cyanea jellyfish blooms (Hay *et al*. 1990), after which they adopt a demersal way of life.

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[8] Nature Scot website: priority marine features https://www.nature.scot/professional-advice/protected-areas-and-species/priority-marine-features-scotlands-seas

Figure 3.5 – Spawning areas around Causeway-Fionn

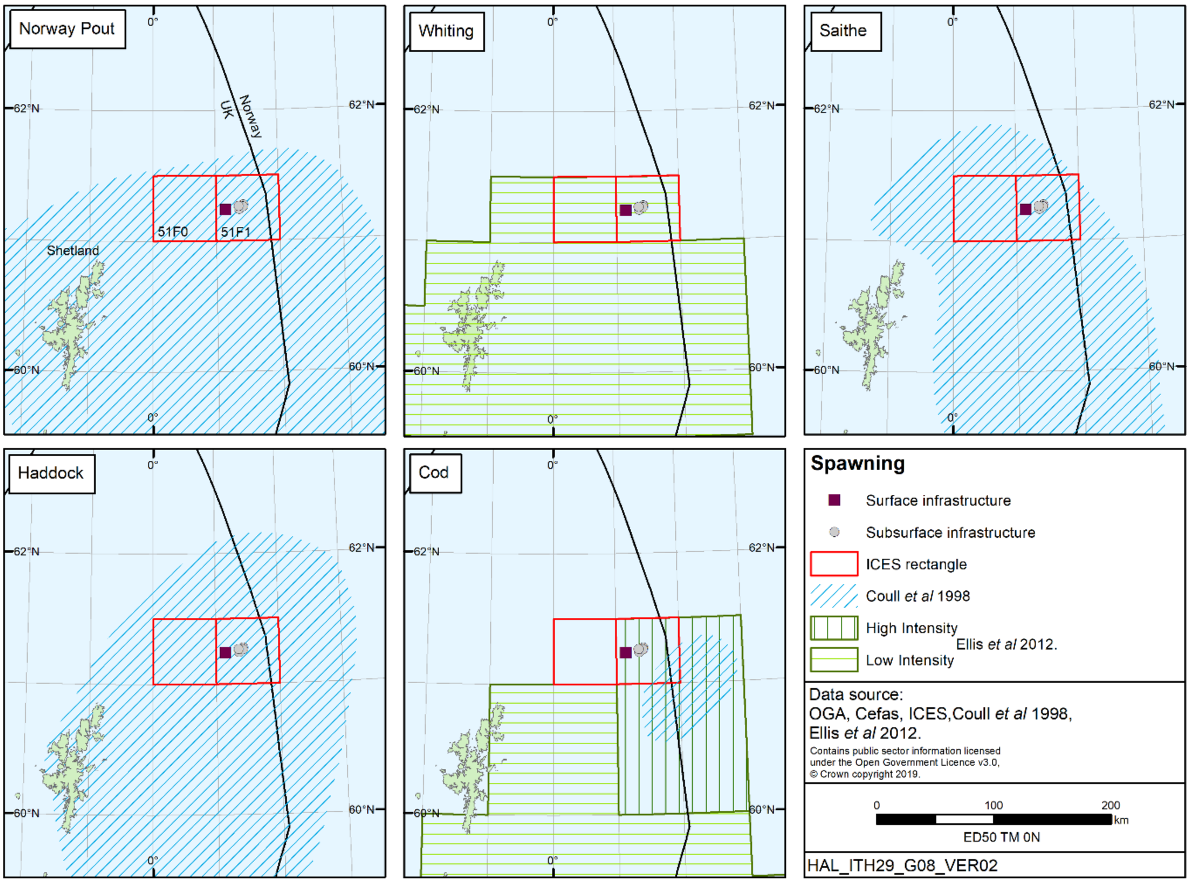
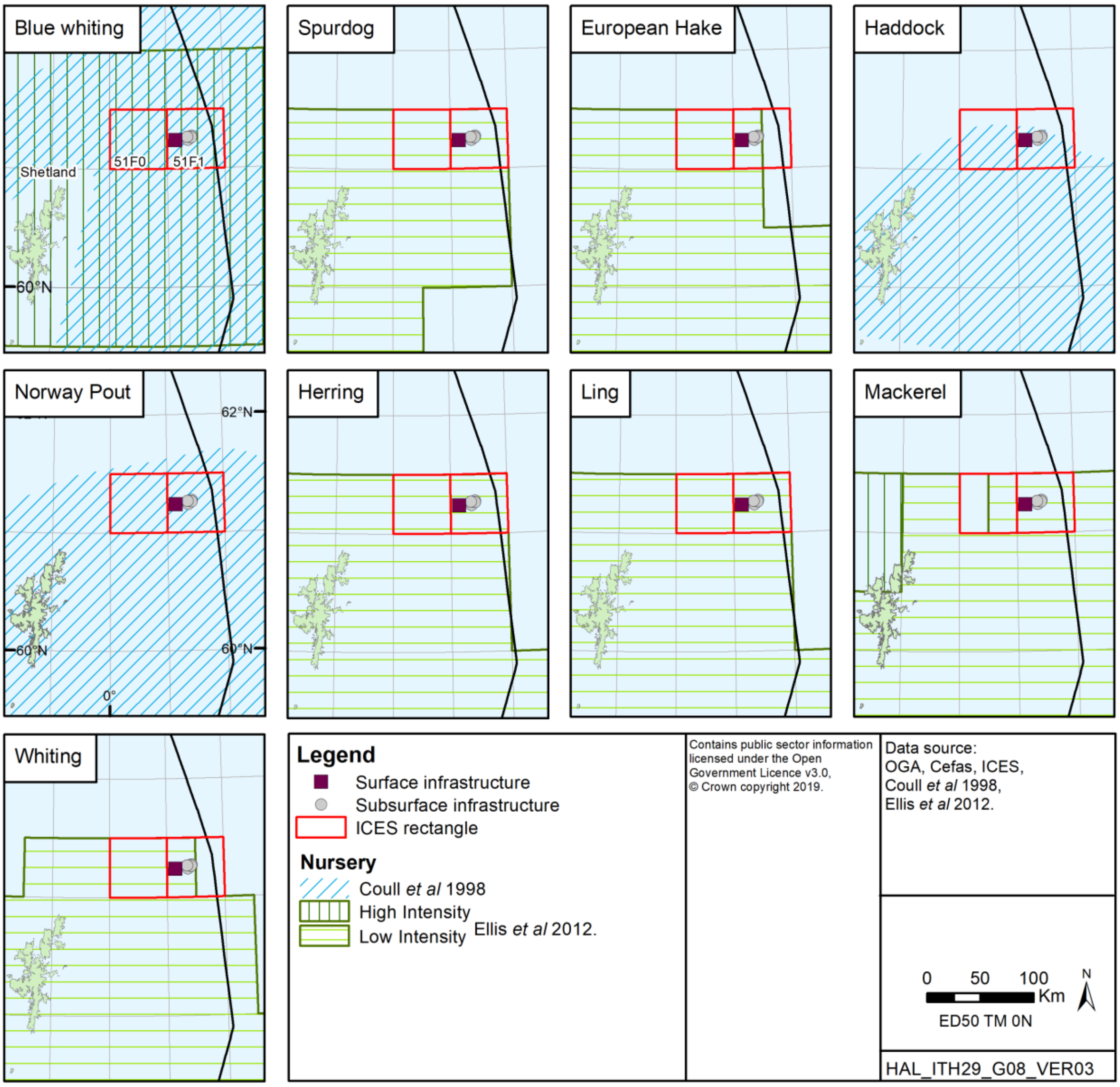
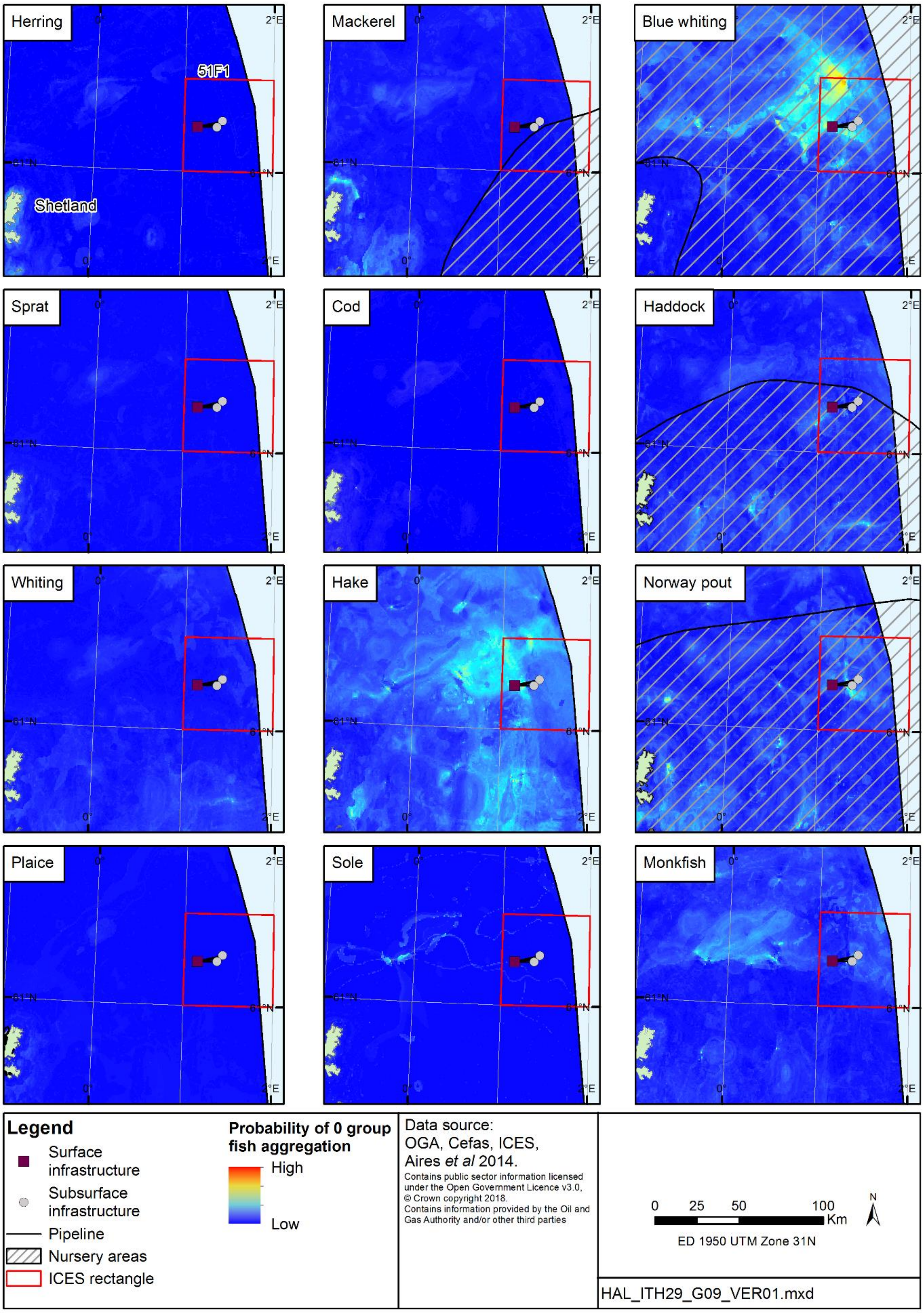


Figure 3.6 – Nursery areas around Causeway-Fionn



A study conducted by Aires *et al*. (2014) produced maps of modelled predicted probability of aggregations of 0-group fish (fish within the first year of their lives); there is evidence of moderate to high probability of aggregations of juvenile blue whiting and hake in the wider Causeway-Fionn area (Figure 3.7).

Figure 3.7 – Nursery and juvenile aggregation areas in the region



3.7 Birds

The UK is of international importance for its breeding seabirds and wintering waterbirds and the importance of Shetland for its breeding seabirds has been recognised through numerous national and international designations (see Section 3.9 below). A number of publications (e.g. Tasker & Pienkowski 1987, Skov *et al*. 1995, Furness 2015) describe the distribution of seabirds in the North Sea and the seasonal variation in bird distribution in the greater Causeway-Fionn area, is summarised in Table 3.2.

Table 3.2 – Bird distribution in the greater Causeway-Fionn area throughout the year

Month	Summary of distribution
January	Common guillemots return to Shetland waters during this month, northern fulmar are present in most offshore areas of the northern and central North Sea and are commonest off Shetland. Breeding birds can attend nest sites from early winter, but as this species can forage vast distances, nest attendance during this time may be sporadic. Eider and long-tailed duck present in Shetland Sounds, with great northern diver and black guillemot present in waters round Northern Isles with the latter species concentrated in shallow, sheltered waters
February	Guillemots around southern half of Shetland, puffins present in large numbers and widely distributed in northern North Sea and northern gannets returning to area, although more important areas at this time tend to be off south east Scotland and north-east England. Eiders remain in large numbers in waters off eastern Scotland, large numbers of over-wintering great northern diver. Peak numbers of long-tailed duck in Scapa Flow (Orkney). Red-throated diver can return to nest sites during the month.
March	Main concentrations of black-legged kittiwakes in northern North Sea, off Orkney and Shetland, and more northern gannets return to the area. Highest densities of northern fulmar present off main breeding areas, herring and great black-backed gulls from Norway return north-eastwards, gulls remaining in the area are breeding birds. Marks the start of the return of many wintering species to their breeding grounds. Eiders start moving back towards UK breeding grounds.
April	Breeding season for some seabirds begins at the end of the month. Many birds returning to colonies and pre-breeding feeding, both close to colonies and further offshore. Black-legged kittiwakes remain widely distributed particularly in north near main breeding areas. Large numbers of northern gannets found near colonies. Great skuas return to breeding grounds in Shetland. Terns return in greatest numbers. Eiders continue to return to breeding grounds including Shetland. Other wader species that breed on Shetland include curlew, lapwing, oystercatcher and redshank with breeding typically commencing in April. Spring migration of great northern diver.
May	Start of breeding season for most seabirds, birds away from colonies likely to be immature. Important areas for auk species include the Shetland Isles, Manx shearwater, storm petrels and Arctic skua start arriving back in the northern North Sea. Waterbirds that have wintered on sites on this coastline return to breeding sites, such as great northern diver, migration of divers continues through the North Sea. Red-throated diver chicks can hatch as early as late May. Red-necked phalarope, primarily an arctic-breeding wader (the UK on the southern edge of its breeding range), start returning to Shetland to breed.

Month	Summary of distribution
June	Peak of breeding season. Majority of seabirds in coastal areas, foraging in waters around colonies; some species, such as northern fulmar and northern gannet can forage >120km from the colony. Large numbers of common guillemots in Shetland, & important concentrations further south, with northern gannet, black-legged kittiwake, razorbill and Atlantic puffin also present in important numbers. Most migrant birds that spend winter on/pass through coasts of North Sea have returned to breeding grounds. Eiders, the only seaduck that breeds in any great numbers around the North Sea are found at main colonies including Shetland. End of breeding season for wader species on Shetland. Female red-necked phalarope, start to leave breeding grounds.
July	The nesting season for many species of seabird ends in late June/early July, and adult and juvenile birds start to move south to wintering grounds or move to areas where they form moulting flocks. The area of the Shetland Basin, over some of the banks of the central North Sea and off the Moray Firth and Aberdeenshire coasts support large concentrations of birds than at any other time of the year. Birds widely dispersed so many areas of the North Sea can hold vulnerable populations. Flocks of common eider (including moulting (flightless) adults, found off Shetland and Scapa Flow. Young and male red-necked phalarope start to leave breeding grounds through July and August.
August	The highest number of auks occurs off east coast of Scotland and areas further south. Black guillemots moult at this time and are found at specific moult sites concentrated in sheltered inshore waters around Shetland. Atlantic puffins disperse rapidly from colonies. Young northern gannets start to leave and northern fulmar disperse out to offshore areas, with large numbers present to the east of Shetland. Remaining young and male red-necked phalarope leave breeding grounds for their wintering areas (winter at sea). Start of main influx of wading birds and ducks into North Sea, with flocks of common eider still present. Some may remain in area for winter or stop to feed before onward migration southwards. Shetland area not as important for wintering birds than areas to the south.
September	Distribution of auks spreads outwards into the North Sea. Off the eastern coast of Scotland and north-east England remains important for birds, but the width of the area away from the coast is greater than in August. An area in the centre of the northern North Sea is of primary importance for guillemots. Great skuas become widespread in North Sea as they leave their breeding sites and move south. Northern fulmars are numerous and widespread across most of northern and central North Sea, with autumn migration typically peaking in this month. Flocks of common eider present through to early September, in sheltered voes and sounds.
October	Southward shift in common guillemot and razorbill populations, however the inshore band of Scotland and northern England still hold large numbers. Black-legged kittiwake distribution moves south. Small numbers of little auks arrive in northern North Sea. Northern fulmars remain common throughout most of the northern North Sea. Adult red-throated divers that breed on Shetland mostly overwinter along Scottish coasts, with some birds remaining in Shetland. Autumn migration of great northern diver occurs in late October in Shetland.
November	Areas off eastern coast of Britain remain important for common guillemots and razorbills. The east coast of Scotland holds relatively few birds compared to other times of the year, with the exception of areas further south than Shetland (e.g. the Firth of Forth and its approaches). Flocks of black-legged kittiwake found around fishing fleets and several winter visitors become more common in northern North Sea: an obvious change is the arrival of gulls in offshore waters, with herring gulls from Norway moving south-west across the North Sea to areas including the Fladen Ground to the south. Important flocks of turnstone appear on Shetland and areas further south including the Aberdeenshire coasts, while important sites for purple sandpipers include Shetland and Orkney.
December	Northern fulmars are commonest in northern North Sea and widespread. Important flocks of turnstone and purple sandpiper remain around Shetland and other areas further south, great northern diver can arrive during the month to winter in the area.

Source: Tasker & Pienkowski (1987), Skov et al. (1995), Tasker (1996), Furness (2015), DECC (2016), SOTEAG (2018), O'Brien et al (2018). Miles & Mellor (2019), Smith & McCallum (2014)

Shetland has a number of seabird colonies, the boundaries between which are often indistinct and along with the colonies on the north-east of Scotland are amongst the most important areas for offshore seabirds in Europe (DECC 2016). Inshore and offshore areas are also important, providing feeding grounds for breeding seabirds, as well as migratory and on-passage birds. The area is influenced by North Atlantic waters, and the nutrient inflow from these waters support a productive food chain, important for foraging seabirds (Skov *et al*. 1995). In general, nearshore waters of Shetland hold vulnerable concentrations of birds virtually throughout the year and after the breeding season, species that feed further offshore such as northern fulmar, northern gannet, black-legged kittiwakes, guillemot, Atlantic puffin and razorbill leave coastal waters and move to offshore areas, with some migrating out of the area completely to wintering grounds.

When they disperse, adult and juvenile auks (common guillemot and razorbill) move offshore where adults undergo a post-breeding moult, and, along with the flightless young, form rafts on the sea surface and then start moving south through the North Sea (e.g. Furness 2015). Young northern gannets are flightless for a short period when they leave the colonies, with areas close to colonies containing vulnerable concentrations; fledglings ringed on the sea below the colony at Noss moved on average 60km/day during the first 10-16 days indicating they do not remain flightless for long (Wanless & Okill 1994, as cited in MacArthur Green 2016).

As well as breeding seabirds, Shetland is also very important for breeding red-throated diver and red-necked phalarope, both of which are relatively scarce breeding birds in the UK, the latter of these a primarily Arctic breeding wader, and the former being more widespread during winter.

The Northern Isles and their coastal waters are less important for over-wintering migratory species relative to other areas further south with more estuarine coastal areas. However, the east coast of Shetland is a stronghold for wintering great northern diver and large concentrations of seaduck (SNH 2014), which has led to the area being designated as a Special Protection Area (SPA, see Section 4.9) and a Shetland wide census conducted in August 2015 of moulting common eider found >4,500 birds (including juveniles); the next census is scheduled for August 2019 (SOTEAG 2018).

Large numbers of common eider and long-tailed duck have been recorded from annual winter counts as part of the ornithological monitoring programme in Shetland conducted on behalf of the Shetland Oil terminal Environmental Advisory Group (SOTEAG). Previous surveys conducted for SOTEAG around areas such as Sullom Voe, have recorded wintering species including golden eye, red-breasted merganser and Slavonian grebe (SOTEAG 2017, 2018). The lochs on the south of the Shetland mainland have also been designated for their wintering numbers of Icelandic Whooper swan (JNCC website), while recent waterbird surveys estimated >400 herons present during the winter on Shetland, at sites where breeding does not occur, with birds thought to originate from Scandinavia (Frost *et al*. 2019).

Vulnerability to oil pollution

The vulnerability of seabird species to oil pollution at sea is dependent on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) was developed by JNCC (Williams *et al*. 1994, JNCC 1999) but and a new revised index, the Seabird Oil Sensitivity Index (SOSI), has now been published (Webb *et al*. 2016).

The SOSI was developed (Webb *et al*. 2016)[9] based on previous indices by Williams *et al*. (1994) and method refining by Certain *et al*. (2015) using seabird survey data collected from 1995-2015 from a

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[9] See JNCC: http://jncc.defra.gov.uk/page-7373.

variety of survey techniques (boat-based, visual aerial and digital video aerial). This survey data was combined with an individual seabird species sensitivity index value, these values being based on a number of factors considered to contribute towards a species sensitivity to oil pollution such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate and potential annual productivity. The SOSI is presented as a series of monthly UKCS block gridded maps, with each block containing a score on a scale of low to extremely high; these scores indicate where the highest seabird sensitivities might lie, if there were to be a pollution incident.

It should be noted that low data availability is indicated for part of the Causeway-Fionn area for a number of months, (see Table 3.3 and Figure 3.8). Updated JNCC guidance describes a method to help reduce the extent of coverage gaps (JNCC 2017). For Causeway-Fionn the first of these steps, using data from adjacent months and using data from adjacent Blocks, has been sufficient to populate the majority of these gaps which are marked in red in Table 3.3, with Step 2 used in one case for an adjacent Block (Block 211/19, Sept), and marked in blue; the months with coverage have values in black or white. For a number of Blocks, coverage gaps could not be reduced by using either step 1 or 2 and these have been denoted by N and highlighted yellow; only one of these (May) remain for all of the Blocks of interest (shown in bold below).

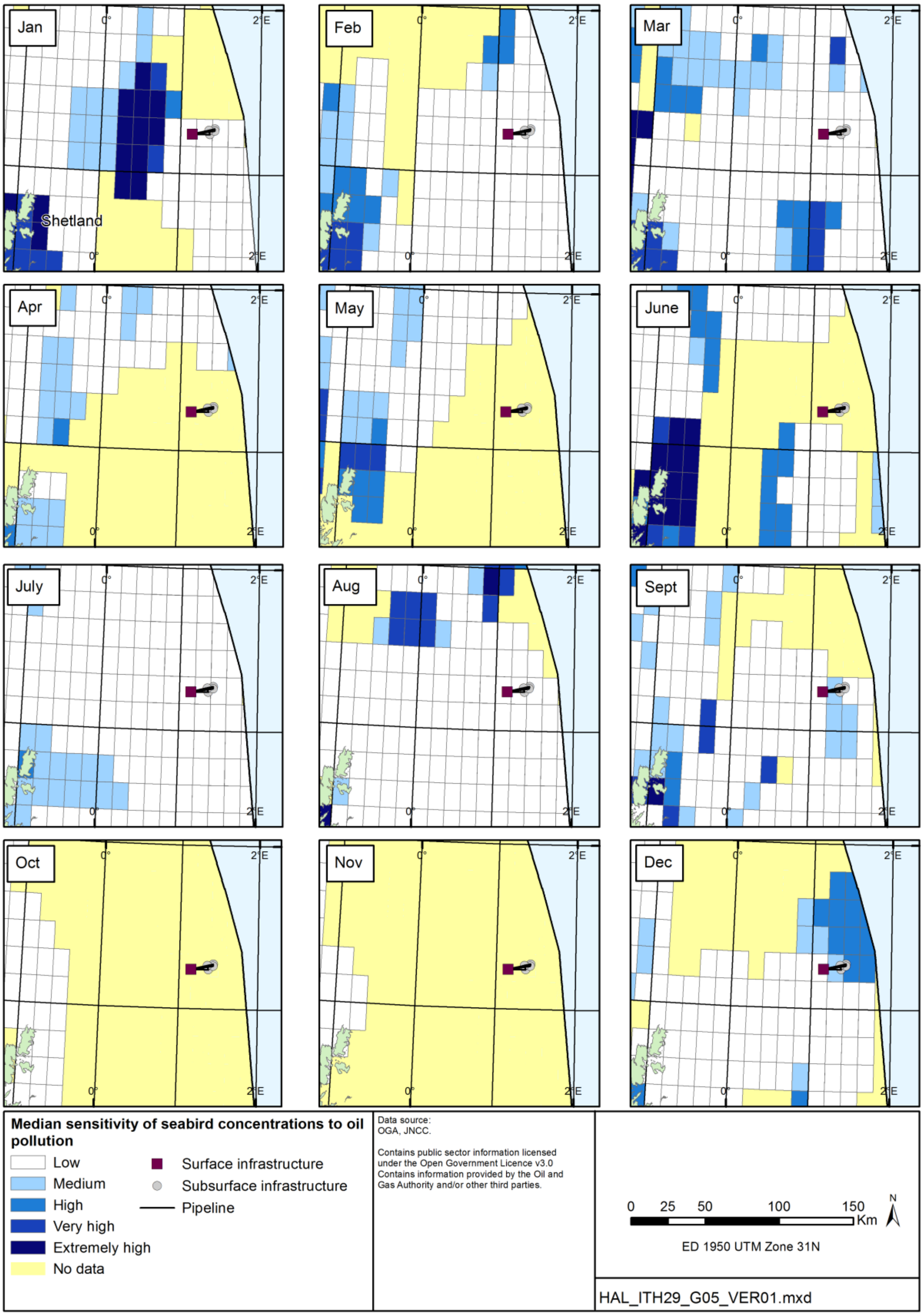
The seabird sensitivity in Block 211/23 is high for one month of the year, and medium for two months of the year in Block 211/22, this rising to two months and four months respectively, when the JNCC method is applied. All remaining months in the Blocks of interest (when the JNCC method is applied), are low.

Table 3.3 – Seabird oil sensitivity in and around the Causeway-Fionn facilities

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
210/20	2	5	5	5	N	5	5	5	5	5	4	4
211/16	4	5	5	5	N	5	5	5	5	5	4	4
211/17	3	5	5	5	N	5	5	5	5	N	3	3
211/18	3	5	5	5	N	5	5	5	5	N	3	3
211/19	3	5	5	5	N	5	5	5	5	N	3	3
210/25	5	5	5	5	N	5	5	5	5	5	5	5
211/21	**5**	**5**	**5**	5	**N**	5	**5**	**5**	**5**	**5**	**5**	**5**
211/22	**5**	**5**	**5**	5	**N**	5	**5**	**5**	**4**	**4**	**4**	**4**
211/23	**5**	**5**	**5**	5	**N**	5	**5**	**5**	**5**	**5**	**3**	**3**
211/24	5	5	5	5	N	5	5	5	5	5	3	3
210/30	5	5	5	5	N	5	5	5	5	5	5	5
211/26	5	5	5	5	N	5	5	5	5	5	5	5
211/27	5	5	5	5	N	5	5	5	4	4	5	5
211/28	5	5	5	5	N	5	5	5	4	4	5	5
211/29	5	5	5	5	N	5	5	5	5	5	5	5

Notes:
1 = Extremely high 2 = Very high 3 = High 4 = Medium 5 = Low N = No coverage

Figure 3.8 – Monthly seabird oil sensitivity index scores



Note: Values presented in Webb et al. (2016) are the median, minimum and maximum of the smoothed SOSI scores in each oil licence block, the median value represents the central point of the smoothed values calculated for any given block and represent the most likely assessment of seabird sensitivity to oil pollution. Source: Webb et al. (2016)

3.8 Marine Mammals

Cetaceans

While the central and northern North Sea has a moderate to high diversity and density of cetaceans, only a few species are likely to be regularly present in the offshore shelf waters of the Causeway-Fionn area; these include harbour porpoise (*Phocoena phocoena*), white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and minke whale (*Balaenoptera acutorostrata*).

The harbour porpoise is the most common cetacean in the area; they are sighted frequently throughout the central and northern North Sea, in both coastal and offshore waters. While seen throughout the year, peak numbers are recorded generally in summer months from June-October. Abundance in the northern North Sea fell between the first (1994) and second (2005) SCANS surveys as the species underwent a southerly shift in distribution (Hammond *et al.* 2013) - a situation which appears to have persisted (Hammond *et al*. 2017).

White-beaked dolphins are encountered regularly in coastal and offshore waters of the central and northern North Sea, although sightings are less common at latitude above that of Shetland and the waters off the north-east Scottish mainland appear to be of greater importance (Hammond *et al*. 2013, 2017). Whilst recorded throughout the year, sightings tend to be slightly more frequent from July-October (Reid *et al*. 2003). Atlantic white-sided dolphin appear to be present seasonally in the North Sea, where they are sighted infrequently in waters >10km from the coast in the northern and central North Sea from June-September; they are observed more frequently and in greater numbers to the north and west nearer the shelf edge and deeper water beyond (Reid *et al*. 2003).

Minke whales are also present, appearing to move south into the North Sea at the beginning of May and remaining until October. During this time, they are well distributed throughout the central and northern North Sea, particularly in the west off the east coast of Scotland and northern England; their occurrence in offshore waters appears to peak in July (Reid *et al.* 2003).

Several other species have been sighted in offshore waters of the northern North Sea, such as killer whale (*Orcinus orca*), bottlenose dolphin (*Tursiops truncatus*) and beaked whales, but infrequently and/or in small numbers only (Reid *et al*. 2003).

The most recent density estimates for cetaceans in the Causeway-Fionn area are from the SCANS-III survey; the relevant stratum is 'U' - an area of 60,000 km straddling the UK-Norway median line which was surveyed by aircraft in July 2016 (Hammond *et al*. 2017). For the most frequently sighted species, the density (animals per km^2) was estimated as 0.321 harbour porpoise and 0.015 minke whales. Sightings of a limited number of white-sided dolphins further south in the stratum resulted in an estimated density of 0.003, while a sighting of Sowerby's beaked whale (rare at this depth) resulted in an estimated density of 0.001. White-beaked dolphin were not sighted in this stratum, but were observed in stratum 'T' to the west, where density was estimated at 0.037 animals/km^2.

Seals

The JNCC and SNH have developed a list of Priority Marine Features (PMFs) in Scotland to help focus future research, planning and conservation. The list, adopted in 2014, includes grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals and most species of cetaceans occurring in UK waters, including all those species mentioned above which may be present in the area (Tyler-Walters *et al*. 2016). Colonies and haul-out sites of harbour and grey seals are widely distributed around the coasts of north and east Scotland, Orkney and Shetland (SCOS 2017), the coastal waters of which support some of the highest densities of these species in UK waters (Russell *et al*. 2017). Several of these colonies are designated as Special Areas of Conservation (see Section 3.9).

Model-based assessments of the at-sea distribution of grey and harbour seals around the UK and Ireland have been derived from satellite tagging data and haul-out count data, including many dozens of each species tagged at colonies around northern Scotland and the Northern Isles (Jones *et al.* 2015; Jones & Russell 2016; Russell *et al.* 2017). Results show that the highest densities of animals are observed in coastal waters adjacent to colonies. In their wider distribution, grey seals use offshore areas (up to 100km from the coast) connected to their haul-out sites by prominent corridors, while harbour seals primarily stay within 50km of the coastline (Jones *et al.* 2015). At over 100km from the nearest landfall at Unst, Shetland, the occurrence of grey and harbour seals in the Causeway-Fionn area is very limited; for both species, models predict fewer than one seal per 5x5km grid cell (Russell *et al*. 2017).

3.9 Conservation Sites

The closet UK coastline to the Causeway-Fionn infrastructure is the north eastern coast of Shetland. The importance of this region is reflected in the designation of a number of international and national inshore and offshore conservation sites. These include Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), designated under *The Conservation of Offshore Marine Habitats and Species Regulations 2017* and *The Conservation of Habitats and Species Regulations 2017* (as amended) and Ramsar sites, Nature Conservation Marine Protected Areas (NCMPAs) designated under the *Marine (Scotland) Act 2010* in Scottish territorial waters and by the Marine and Coastal Access Act 2009 in offshore waters. Globally, the value of the Shetland Islands in bird conservation has also been recognised, with a number of areas listed as Important Bird Areas by Birdlife International.

The nearest SPA site to Causeway-Fionn is Hermaness, Saxa Vord and Valla Field, located approximately 124km from Causeway-Fionn; designated not only for its important breeding populations of seabird and diving bird species (great skua, Atlantic puffin, northern fulmar, red-throated diver, northern gannet, European shag, black-legged kittiwake and guillemot), but also designated for its seabird assemblage, regularly holding over 150,000 birds during the breeding season. Thaxter *et al.* (2012) conducted a literature review in order to quantify the representative foraging ranges of those species studied during the breeding season as a tool for identifying possible marine protected areas. From this, a table of maximum and mean maximum breeding season foraging ranges (km) was compiled for twenty-five species. Of those seabird/diver species designated at the Hermaness, Saxa Vord and Valla Field SPA for their breeding populations, some, such as northern fulmar and northern gannet, have the potential to forage out to the Causeway/Fionn area during the breeding season, based on the maximum range listed in Thaxter *et al*. (2012) (taking into consideration confidence levels in data presented, i.e. with some based on few supporting studies).

Numerically, areas in Shetland are not as important for wintering birds, or birds on passage compared to areas of estuarine coast further south, such as those found around the Cromarty or Dornoch Firths, which regularly support >42,000 and >30,000 birds respectively (or areas along the English coast which regularly support in excess of 100,000 birds (Frost *et al.* 2019)). However, the importance of the area for wintering great northern diver, common eider, Slavonian grebe, long-tailed duck and red-breasted merganser including the waters off the mainland coast within which they feed, has been recognised through the proposed designation of a new SPA.

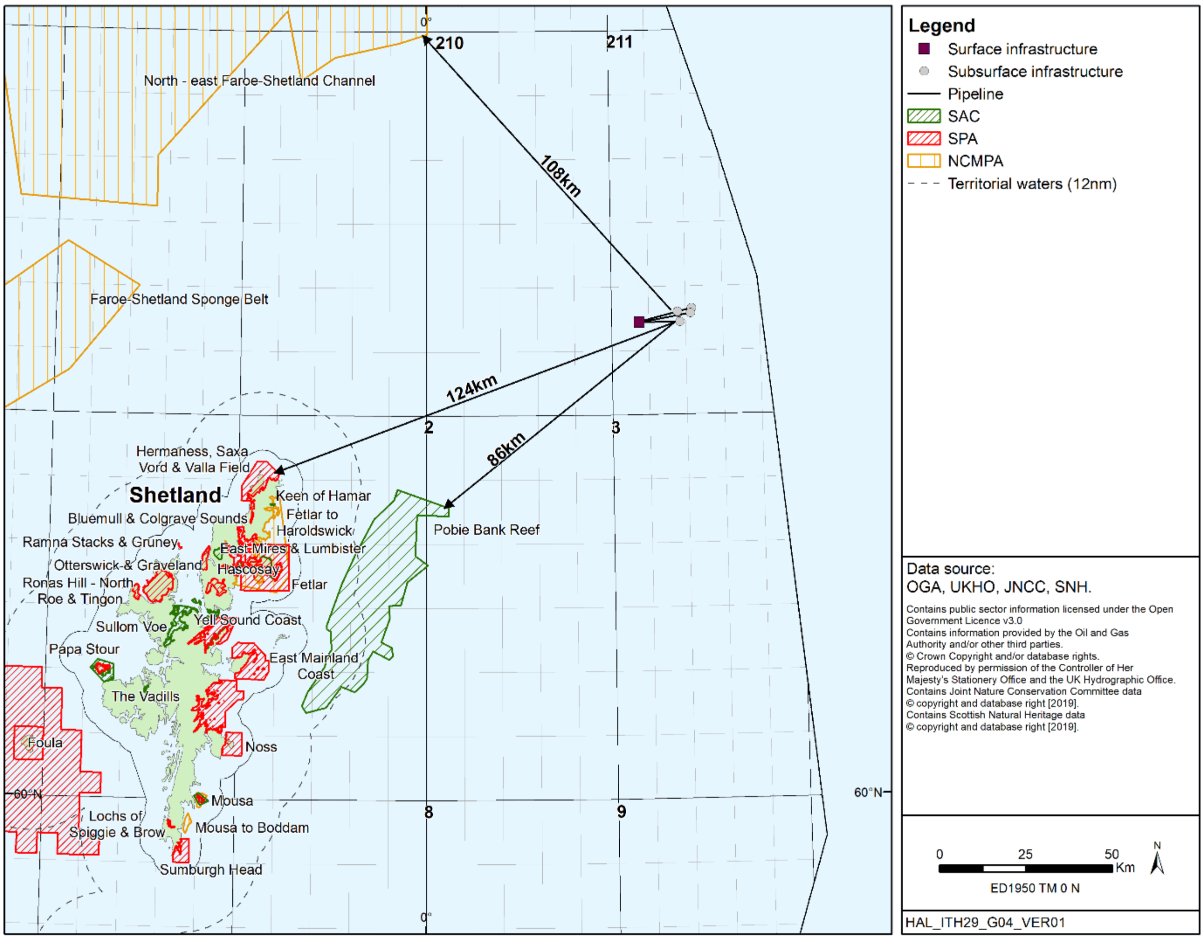
The nearest SAC to Causeway-Fionn is the Pobie Bank Reef (86km), designated for stony and bedrock reef and the nearest NCMPA is the North-East Faroe-Shetland Channel (108km), designated for deep sea muds, offshore subtidal sands and gravels, deep sea sponge aggregations and a range of geological and geomorphological features. The relevant SACs, SPAs and NCMPAs currently designated or proposed are shown in Table 3.4 and Figure 3.9, including distances to Causeway-Fionn area.

Table 3.4 – Relevant conservation sites and their features (listed in order of increasing distance)

Name	Status	Distance from Causeway-Fionn[1] km	Summary of features
Pobie Bank Reef	SAC	86	Reefs
North-East Faroe-Shetland Channel	NCMPA	108	Deep-sea sponge aggregations, offshore seep-sea muds, range of features representative of the West Shetland Margin Palaeo-depositional Miller Slide and Pilot Whale Diapirs Key Geodiversity Areas
Hermaness, Saxa Vord & Valla Field	SPA	124	Breeding great skua, Atlantic puffin, northern fulmar, red-throated diver, northern gannet, European shag, black-legged kittiwake, guillemot. Seabird assemblage of international importance during the breeding season (157,500 individuals).
Fetlar to Haroldswick	NCMPA	116	Black guillemot, circalittoral sand and coarse sediment communities, horse mussel beds, kelp and seaweed communities on sublittoral sediment, maerl beds, shallow tide-swept coarse sands with burrowing bivalves
Fetlar	SPA	120	Breeding dunlin, great skua, northern fulmar, whimbrel, red-necked phalarope, Arctic skua, Arctic tern. Seabird assemblage of international importance during the breeding season (22,000 individuals).
Bluemull & Colgrave Sounds	SPA	127	Breeding red-throated diver
Hascosay	SAC	135	Blanket bogs (primary reason and priority feature) Qualifying reason but not primary: Otter
East Mainland Coast	SPA	145	Breeding red-throated diver and wintering great northern diver, common eider, Slavonian grebe, long-tailed duck and red-breasted merganser
Yell Sound Coast	SAC	148	Otter, harbour seal
Noss	SPA	166	Breeding great skua, Atlantic puffin, northern fulmar, northern gannet, black-legged kittiwake, guillemot. Seabird assemblage of international importance during the breeding season (35,000 individuals).
Mousa to Boddam	NCMPA	186	Sandeels
Mousa	SPA	187	Breeding storm petrel, Arctic tern
Mousa	SAC	187	Qualifying reason but not primary: reefs, submerged or partially submerged sea caves. Qualifying reason but not primary: harbour seal.
Sumburgh Head	SPA	199	Breeding northern fulmar, black-legged kittiwake, Arctic tern, guillemot. Seabird assemblage of international importance during the breeding season (35,000 individuals).

Note: [1]Distances taken from the Fionn well. Other SAC sites are shown on Figure 3.9 below but not included in the table, as these do not have a marine element with the potential to be impacted by decommissioning activities and have as their qualifying reasons for designation habitats such as grasslands, screes, dry heaths, blanket bogs and fens (i.e. Keen of Hamer, East Mires & Lumbister and North Fetlar).

Figure 3.9 – Designated sites in and around the Causeway-Fionn area



OSPAR threatened and/or declining habitats

Several marine species occurring in the central and northern North Sea are of conservation concern. These are listed in a variety of international and national documents including the OSPAR Initial List of Threatened and/or Declining Species and Habitats, which includes the habitat "Sea pen and burrowing megafuna communities" (SPBMC). This habitat is defined (OSPAR 2010a) as:

Plains of fine mud, at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature of the sediment surface with conspicuous populations of sea-pens, typically Virgularia mirabilis and Pennatula phosphorea. The burrowing crustaceans present may include Nephrops norvegicus, Calocaris macandreae or Callianassa subterranea. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins.

The OSPAR definition has been interpreted to mean that sea pens may or may not be present (e.g. may have been removed by anthropogenic activity), that any burrowed areas of mud would be deemed to be this habitat and, while the habitat predominately occurs in fine mud sediments, examples of the habitat have been identified in areas of sandy muds; regardless of the grain size composition of the sediment, where there is clear evidence of the relevant biological assemblages (burrowing megafauna), such habitats can be classified as "Sea-pen and burrowing megafauna communities"(JNCC 2014). The habitat does need to include multiple burrows or mounds from associated megafauna (JNCC 2014).

As the presence of burrows was assessed as frequent or higher on the SACFOR scale, across the survey area, the survey concluded there is the potential that the SPBMC was present (Fugro 2020a, b). However, it should be noted that the majority of the area comprises sandy sediment (ENUIS classification Deep Circalittoral Sand); sand being the dominant fraction (mean 85.3%) (see Section 3.1) and the stills/grab samples showed a sparse fauna the most numerically abundant (and dominant) species being the polychaete *Galathowenia oculata*. Fauna typical of SPBMC is *Nephrops* (MarLIN website), which, while identified from the survey, is absent from the majority of sites and the infauna of this biotope may contain significant populations of polychaetes (specifically *Pholoe* spp., *Glycera* spp., *Nephtys* spp.), spionids, bivalves (*Nucula sulcata*, *Corbula gibba* and *Thyasira flexuosa*, and echinoderm (*Brissopsis lyrifera*) (MarLIN and JNCC websites) – not identified from the 2020, or 2012 surveys (Fugro 2020b, GEMS 2012).

Given the dominant fraction in the sediment is sand (>80%) and from the seabed photos there is no evidence of large burrows or ejecta mounds, a characteristic of 'sea-pen and burrowing megafauna communities' (JNCC 2014), the habitat 'sea-pen and burrowing megafauna communities' is not considered present. In addition, data from grab samples in the Environmental Baseline Survey report (Fugro 2020a,b) did not include any of the larger burrowing crustaceans such as *Calocaris*, *Upogebia* or *Callianassa* which typically produce visible burrows and mounds; *Nephrops* were identified as present, at some sample locations, but absent from the majority of these (11 from 19) (Fugro 2020b).

3.10 Other Users of the Offshore Environment

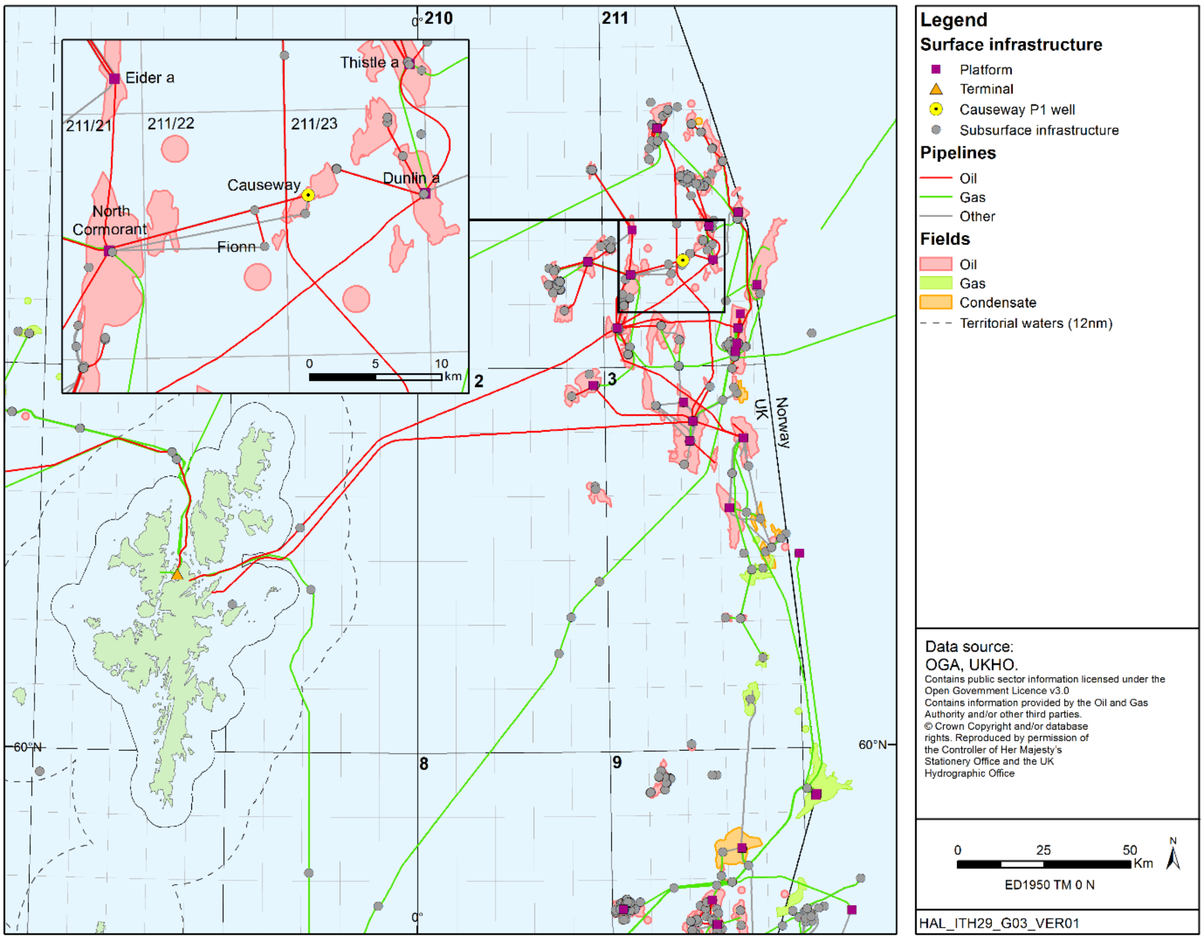
Offshore Energy

In the northern North Sea, oil is the dominant hydrocarbon resource produced (DECC 2016). Production is primarily located on a north-south axis along the median line from quadrants 29/30 in the south to quadrant 211 in the far north east of Shetland. Causeway-Fionn is located within the mature East Shetland Basin (Figure 3.10). This area has an array of fixed surface infrastructure, including production and accommodation platforms and floating production, storage and offloading (FPSO) vessels, numerous wells and a connecting network of infield and export pipelines. Major pipeline landfalls in the region include those at Sullom Voe, Shetland and the Flotta terminal, Orkney. Installations from the East Shetland Basin also export into the St Fergus gas terminal in north east Scotland (DECC 2016). Causeway-Fionn is tied into NCP which exports via the Brent pipeline system to Sullom Voe.

Not including the NCP, the closest platforms to the proposed decommissioning activities (measured to the nearest location, i.e. NCP or the Causeway well) are Dunlin A (approximately 9km, East of the Causeway well), Thistle A (13km, NE, Causeway well), Eider A (13km, N, NCP), Tern (13km, WNW, NCP) and Cormorant A (16km, S, NCP). The Magnus to Ninian (24 inch) oil pipeline runs along the eastern edge of Block 211/22 with north-south orientation.

Consistent with the maturity of the area, many of the developed fields are at a mature stage of production and have already either been decommissioned, (e.g. North West Hutton), are subject to their own Decommissioning Plans (e.g. the Brae and Brent fields, the Ninian Northern Platform and associated fields, and the Dunlin and Merlin fields), or are likely to be subject to decommissioning planning in the coming years.

Figure 3.10 – Oil and gas infrastructure



UK offshore wind capacity has, to date, been concentrated in the southern North Sea in part due to its advantageous water depths and grid connection opportunities.

There are no operational, under construction and consented wind farm developers/demonstrators in and around the Causeway-Fionn and wider area, the closest of these being the Beatrice Offshore Windfarm in the Moray Firth, over 390km to the south west; Moray Offshore Windfarm East and West are also consented and under initial consultation respectively (The Crown Estate Scotland website). Two turbines were installed at the Bluemill Sound offshore tidal array (Shetland) in 2016, with a third deployed in 2017; in 2018 an extension to the existing seabed lease until 2041 was granted by the Crown Estate Scotland creating the opportunity for further development of and longevity for the project.

There are also a number of areas around the Orkney Isles being used for tide and wave test sites (Emec website), as well as various lease areas available around Shetland and Orkney.

Fisheries

ICES rectangles are used for fisheries data recording and management. The Causeway-Fionn area lies within ICES rectangle 51F1. The most recent data available on the weight and value of landings for 51F1 are presented in Table 3.5.

Table 3.5 – Live weight and value of fish and shellfish taken from ICES rectangle 51F1, 2017-2019[1]

Species type	2017		2018		2019	
	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)	Liveweight (tonnes)	Value (£)
Demersal	545	824,054	846	1,381,095	1,205	2,136,673
Pelagic	0	0	1	637	175	59,457
Shellfish*	<1	1,711	1	3,272	3	12,507
Total	**545**	**825,765**	**848**	**1,385,004**	**1,383**	**2,208,637**

Notes: [1]Landings into UK ports.

Source: Marine Scotland data, Scottish Government website, accessed December 2020

In 2017-2019, landings were dominated by demersal fish; pelagic catches (quantity and value) were significantly higher in 2019 compared to previous years. Saithe, cod, ling, haddock, whiting, megrim, monkfish, pollack and hake account for the majority of the landings, although over a dozen other finfish species, plus several ray species, were also landed.

Logbooks submitted by fishermen allow an examination of the gears operated and seasonal patterns in fishing effort (Table 3.6). Over the period 2017 to 2018, fishing effort was low, and centred around late spring/summer months, with an increase in activity in 2019, extending throughout the year, with only low effort in summer months.

Table 3.6 – Number of days[1] fished per month (all gears) in ICES rectangle 51F1, 2017-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2017	0	D	D	13	D	9	D	D	D	D	D	D	**22**
2018	D	10	D	27	14	D	7	17	18	19	D	0	**112**
2019	11	18	14	32	9	D	D	18	38	21	6	D	**167**

Note: [1] Monthly fishing effort by UK vessels >10m; 'days fished' includes time travelling within rectangles; green = 0-19 days fished, yellow = 20-39, D = disclosive data.

Source: Marine Scotland data, Scottish Government website, accessed December 2020

Figures 3.11 and 3.12 illustrate the landings weight and value in 51F1 and surrounding ICES rectangles for 2019 for each species type. It shows landings from the rectangle to be substantially lower than from rectangles immediately to the south west, across species type.

Figure 3.11 – Landings weight for ICES rectangle 51F1 and surrounding rectangles 2019

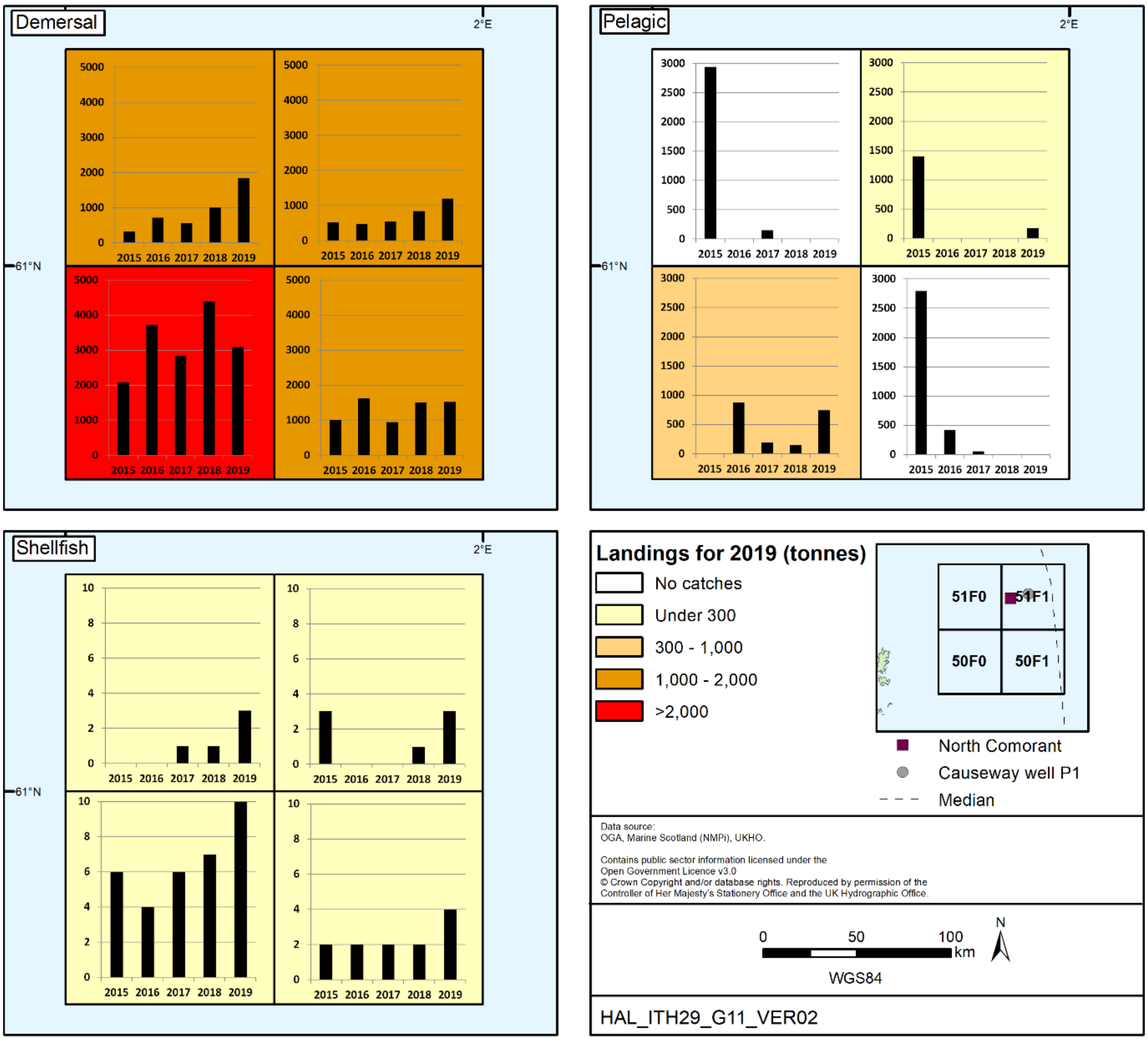
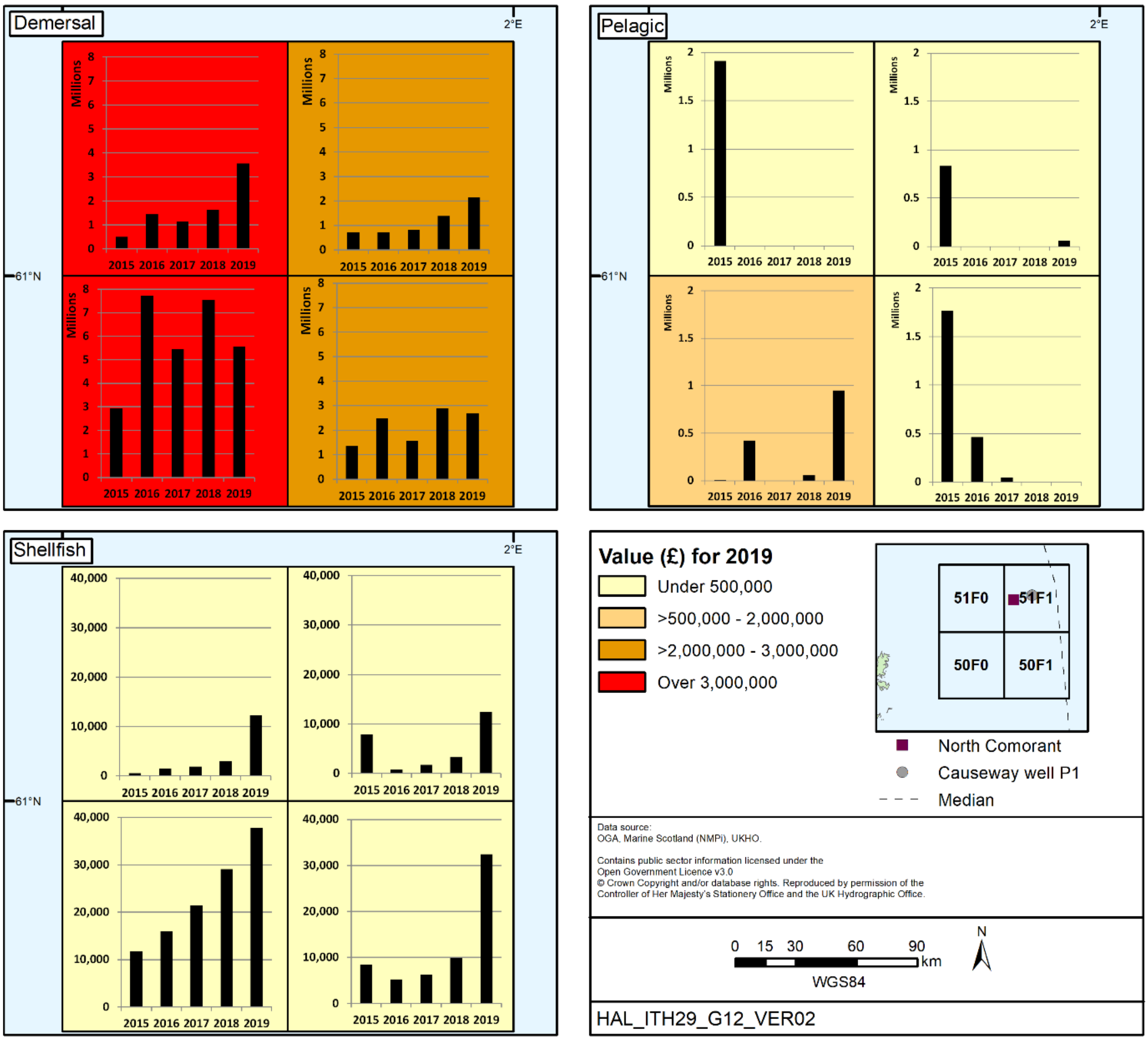


Figure 3.12 – Landings value for ICES rectangle 51F1 and surrounding rectangles 2019



Vessel Monitoring System (VMS) data show low to moderate levels of fishing effort in the Causeway-Fionn area for UK vessels (Figure 3.13) and non-UK vessels (Figure 3.14); a closer examination of fishing intensity along the relevant pipeline routes further demonstrates this, noting that the Magnus-Ninian oil pipeline running north-south *ca*. 1.5km west of the Causeway wells experiences moderate to high fishing intensity (Figure 3.15).

Figure 3.13 – Fishing effort by UK vessels (>15m length) in 2019

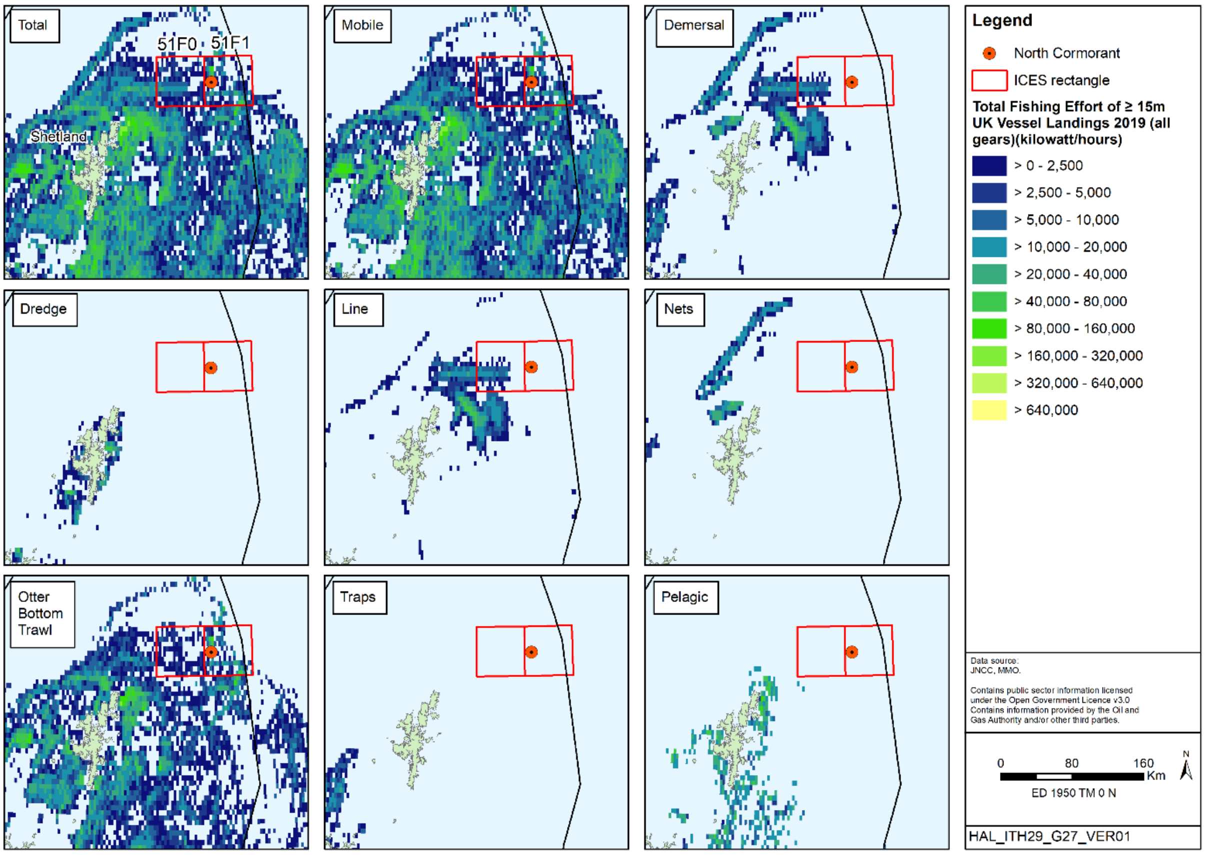


Figure 3.14 – Fishing effort by non-UK vessels in 2017

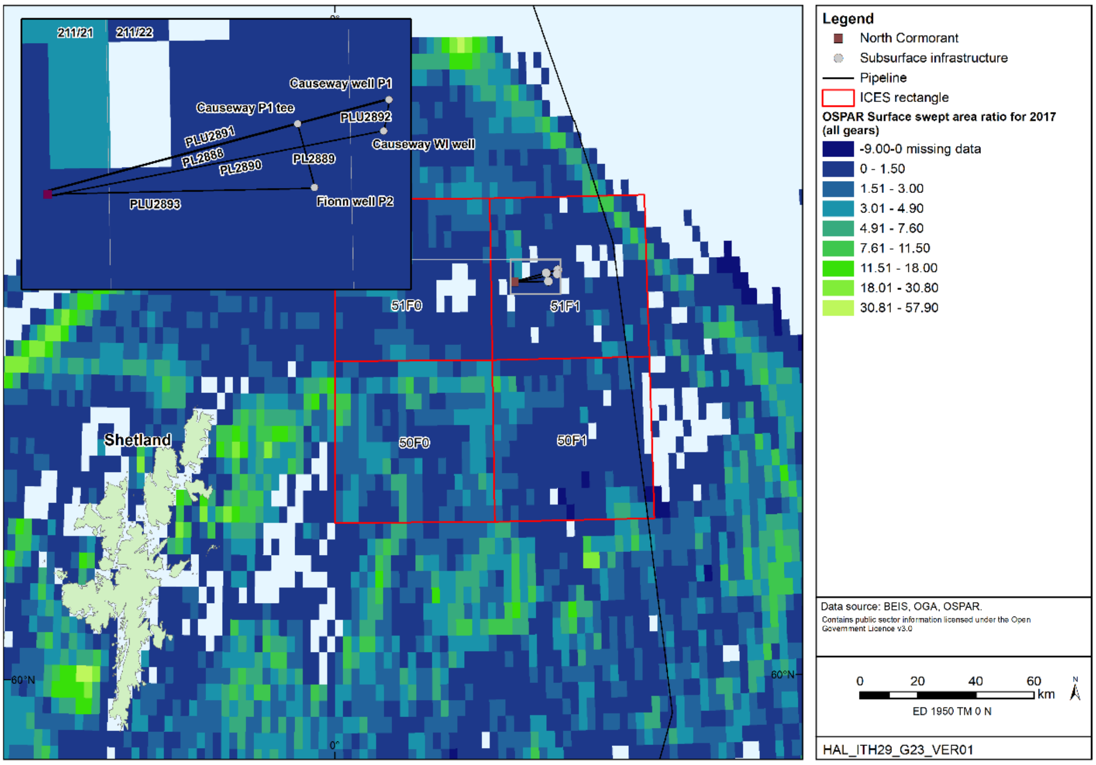
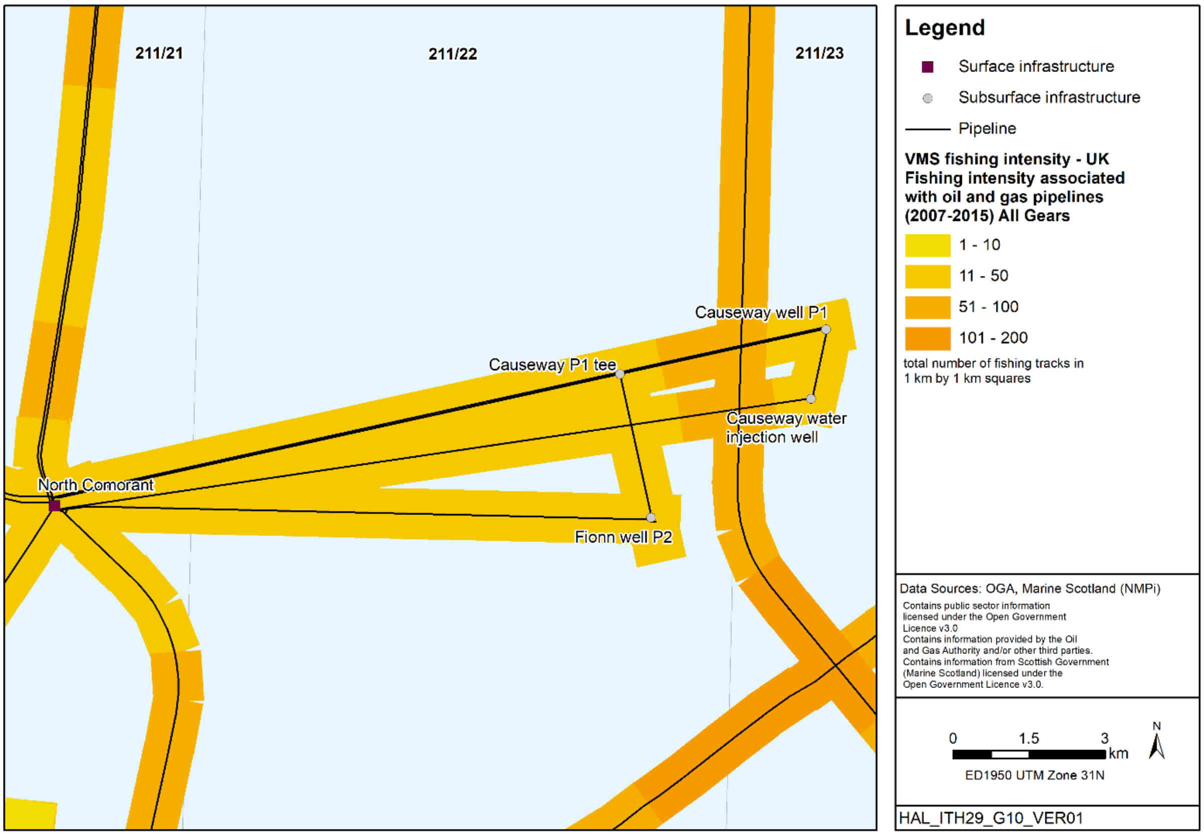


Figure 3.15 – Fishing intensity (<15m) along pipeline and cable routes in and around the Causeway-Fionn area, from data collected 2007-2015



Note: This map was created by calculating the number of fishing tracks in a 1km x 1km corridor along the length of each pipeline. It represents the activities of vessels <15m using four types of mobile demersal gears: otter trawls, pair trawls, beam trawls and dredges.
Source: Scottish Government (2017).

Navigation, cables and aggregate extraction

Shipping density data (OGA website[10]), shows Blocks 211/21, 211/22 and 211/23 as all having low levels of shipping; vessel density (2020) around the Causeway-Fionn area is shown in Figure 3.16. Typical vessels in the area are likely to be oil and gas supply and support vessels the routes of the majority of which are expected to originate from service ports in Peterhead and Aberdeen out to the Shetland Basin.

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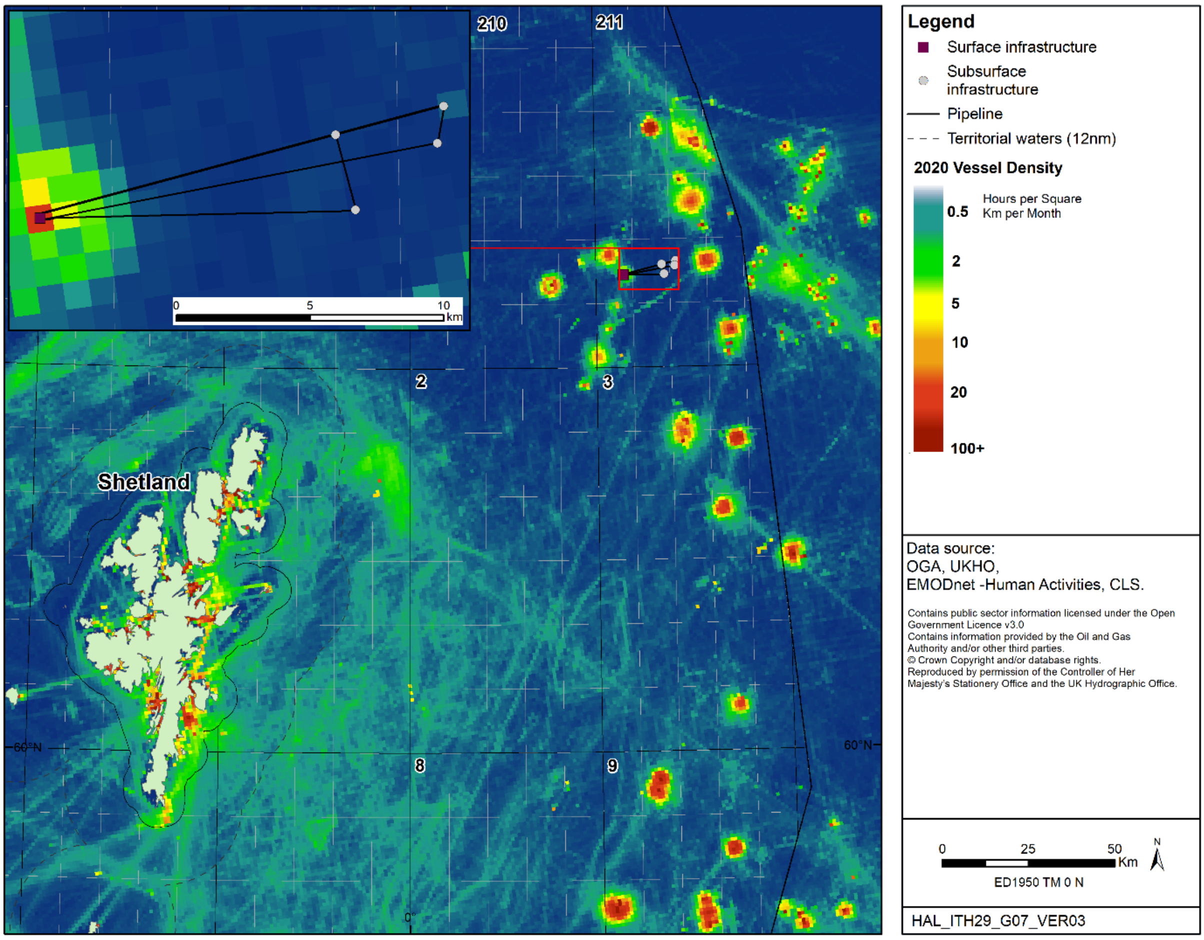
[10] OGA website, information on levels of shipping activity (29th Seaward Licensing Round) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/540506/29R_Shipping_Density_Table.pdf

Figure 3.16 – Vessel density around Causeway-Fionn and wider northern North Sea, 2020



A study of shipping routes in the Causeway-Fionn area was carried out by Anatec (2012). This identified the routes within a 10 nautical mile radius of the well locations. In total, an estimated 1,410 ships per year pass within 10 nautical miles of the wells, which corresponds to an average of 4 vessels per day, the majority of which (78%) were offshore vessels servicing the oil and gas industry; a new vessel traffic survey will be carried out and will support the environmental permit applications for the decommissioning activities; these will be completed and submitted to the regulator at a future date and prior to commencement of offshore activities.

There are no traffic separation schemes/IMO routeing measures close to the Causeway-Fionn infrastructure; there are IMO routeing measures around the Shetland Islands, with a precautionary area around the eastern coast, the border of which is approximately 90km from Causeway-Fionn. Following the Braer oil spill (5th January 1993), the Donaldson Inquiry of 1994 proposed the establishment of Marine Environmental High Risk Areas (MEHRAs) to protect marine areas of high environmental sensitivity at risk from shipping. An assessment was carried out to identify the environmental sensitivity of the UK coastline and coastal waters and thirty-two MEHRAs have been established covering approximately 9% of the UK coastline, two of these are in Shetland. The location of these is indicated by markings on UK Hydrographic Office charts and through Notices to Mariners, and Marine Guidance Notices issued by the Maritime and Coastguard Agency (DECC 2016).

No ferry routes traverse the area, the closest ferry routes being the Northern Isles ferries from Aberdeen to Orkney (Stromness) and Shetland (Lerwick), to the west of the Causeway-Fionn area.

There are no submarine cables within the Causeway-Fionn development area the closest of these being the CANTAT 3 line, approximately 74km to the north east of Causeway-Fionn in Norwegian waters.

Defence

There are no Ministry of Defence (MoD) practice and exercise areas (PEXAs) located within the vicinity of the Causeway-Fionn area (DECC 2016), the closest of these being an airforce area off Orkney, approximately 260km away. There are also no recorded chemical or conventional weapon dumping areas in the vicinity (OSPAR 2010b).

Tourism and Recreation

Tourism to the Shetland Islands is socially and economically important (Shetland Islands Council 2018a). Shetland Islands Council, in partnership with VisitScotland, conduct biannual visitor surveys to assess the sector and in 2017 just over half (51%) of visitors to Shetland were leisure visitors (Shetland Islands Council 2018b). Visitors to the Islands were predominately from the UK, with the largest proportion of overseas visitors coming from Europe, with smaller numbers coming from North America and Australia/New Zealand (Shetland Islands Council 2018b).

Coastal areas, wildlife and the sea can provide a variety of tourism and recreational opportunities and these can generate a considerable amount of income for the local economy and be a mainstay for small businesses. Shetland has four marinas at Lerwick, Bressay, Scalloway and Skeld, with smaller marina or pontoon facilities around the islands; in 2017 Lerwick Harbour received 70 cruise liners, with over 50,500 passengers, compared to 42 and 11,000 respectively in 2001 (Shetland Islands Council 2018a).

The area is popular for its beaches and scenery, in 2019 five of Shetland's beaches were awarded Beach Awards, by Keep Scotland Beautiful[11], having met the required standards across a number of criteria, including cleanliness (Keep Scotland Beautiful website), while walking, bird and wildlife watching, photography and painting opportunities are also popular with visitors. The Islands Viking heritage is celebrated every January with the Up Helly Aa festivities, attracting many people to the Islands and local crafts, knitwear and other products are also popular, as is traditional music with an annual folk festival. Yachting is also important, with several regattas held every year, as well as the annual Pantaenius Shetland Race, a yacht race from Bergan in Norway, across the North Sea, to Lerwick and back.

Archaeology and Wrecks

No archaeological sites or artefacts have been identified in the Causeway-Fionn area to date and no wrecks were identified during the Causeway-Fionn development site survey (GEMS 2012). There is a charted wreck located approximately 2km south west of the NCP and a second approximately 9km to the north east of the Causeway well, neither of which are protected and both marked as non-dangerous (UKHO wreck database).

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[11] Keep Scotland Beautiful has been running their beach award scheme for over 25 years, and proposed beaches must satisfy criteria recognising excellence in beach management to reflect the needs of beach users.

4 INITIAL ISSUE IDENTIFICATION

4.1 Introduction

Activities associated with the decommissioning of Causeway and Fionn have the potential to affect the environment in a number of ways, including physical and other disturbance, emissions and other discharges, waste generation and accidental events. This section describes the process used to identify and screen the relative significance of the potential environmental issues associated with the proposed decommissioning activities.

4.2 Issue Identification and Screening of Potential Effect

Ithaca Energy held an Environmental Impact Identification (ENVID) workshop to identify activity/environment interactions, and raise awareness within the decommissioning team of the baseline environment and potential sources of environmental effects from decommissioning activities. At the workshop, the decommissioning activities were systematically considered for their potential interactions with the environment and in the context of legislative and policy requirements. These were identified using a range of data sources including:

- Regional and site specific environmental data, including from previous surveys of the Causeway-Fionn area, the Causeway-Fionn pre-decommissioning survey and engineering documents
- Typical semi-submersible drilling rig specification (for well plug and abandonment)
- Typical vessel specifications (e.g. for subsea infrastructure decommissioning and support)
- Experience of analogous projects in the North Sea and elsewhere, including in areas of conservation importance
- Reviews and assessments of the environmental effects of offshore oil and gas operations
- Peer reviewed scientific papers on the effects of specific interactions and habitat processes
- Other publicly available “grey” literature
- Offshore Energy Strategic Environmental Assessment Environmental Reports and underpinning studies (e.g. DECC 2016)
- Conservation site designations, potential designations and related supporting site information
- Applicable legislation, guidance and policies
- Consultee and stakeholder engagement and feedback (see Section 1.7)

Following the ENVID, and based on the current level of activity definition and stakeholder feedback, the environmental assessment took both qualitative and quantitative approaches to the identification of the likely magnitude of effects, as appropriate. Defined severity criteria were used to assist in describing the magnitude of environmental effect from the decommissioning activities. These also allowed for the consideration of the likelihood, scale and frequency of potential effects (see Table 4.1) and the results are shown in Table 4.2

Table 4.1 – Criteria for the identification of potential environmental effects from Causeway-Fionn decommissioning

Effect	Consequences
None Foreseen	No detectable effects
Positive	Activity may contribute to recovery of habitats Positive benefits to local, regional or national economy
Negligible	Change is within scope of existing variability but potentially detectable.
Moderate	Change in ecosystem leading to short term damage with likelihood for recovery within 2 years to an offshore area less than 100 hectares or less than 2 hectares of a benthic fish spawning ground Possible but unlikely effect on human health Possible transboundary effects Possible contribution to cumulative effects Issue of limited public concern May cause nuisance Possible short term minor loss to private users or public finance
Major	Change in ecosystem leading to medium term (2+ year) damage with recovery likely within 2 - 10 years to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Transboundary effects expected Moderate contribution to cumulative effects Issue of public concern Possible effect on human health Possible medium term loss to private users or public finance
Severe	Change in ecosystem leading to long term (10+ year) damage with poor potential for recovery to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Major transboundary effects expected Major contribution to cumulative effects Issue of acute public concern Likely effect on human health Long term, substantial loss to private users or public finance

Frequency with which Activity or Event Might Occur	Likelihood
Unlikely to occur	**Unlikely**
Once during decommissioning activity	**Low**
Once a year	**Medium**
Once a month or regular short term events	**High**
Continuous or regular planned activity	**Very High**

	Likelihood				
Consequences	Very High	High	Medium	Low	Unlikely
Severe					
Major					
Moderate					
Negligible					
Positive					
None foreseen					

Issues requiring detailed consideration in the EA

Positive or minor or negligible issues

No effects expected

Notes:

1. The criteria to the left include consideration of issues of known public concern
2. In addition to screening on the basis of these criteria, issues/interactions raised during stakeholder consultation will be treated as requiring detailed consideration. These issues/interactions will be indicated in Table 4.2 by C (raised in stakeholder consultation).

Table 4.2 – Initial screening matrix

Key: Potential for significant | Minor issue

Activity/Source of Potential Impact	Summary Consideration: Land, soil, water, air, climate			Biological, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC						Material assets, other users, onshore					
	Climate/air quality	Water Quality	Seabed and sediments	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Conservation sites/species	Fisheries	Shipping	Other users	Landfill/onshore resources	Population and human health	Transboundary issues
Vessels (applicable to rig, subsea scope and post-decommissioning monitoring)															
Power generation (rig and all vessels)	Potential for significant														Minor issue
Rig tow in/out	Minor issue											Minor issue			
Rig positioning and anchoring			Potential for significant	Potential for significant					C (Potential for significant)						
Physical presence of rig/vessels										Minor issue	Minor issue	Minor issue			
Machinery space, deck, sewage & other discharges		Minor issue													
Underwater noise						Minor issue	Minor issue	Minor issue							
Airborne noise								Minor issue							
Surface lighting								Minor issue							
Well plug and abandonment															
Discharge of well P&A chemicals		Minor issue	Minor issue	Minor issue	Minor issue										
Fugitive emissions from fuel and chemical storage	Minor issue														

Potential for significant	Significant
Minor issue	Minor

Activity/Source of Potential Impact	Summary Consideration: Land, soil, water, air, climate			Biological, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC						Material assets, other users, onshore					
	Climate/air quality	Water Quality	Seabed and sediments	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Conservation sites/species	Fisheries	Shipping	Other users	Landfill/onshore resources	Population and human health	Transboundary issues
Other solid and liquid wastes to shore													Minor	Minor	
Subsea activities															
Disconnection and lowering/burial of pipelines/umbilical tie-ins (spools, jumpers, risers)			Significant	Significant	Minor	Minor			Significant (C)	Significant (C)	Minor				
Removal of protective material			Significant	Significant	Minor	Minor			Significant (C)						
Chemical/residual hydrocarbon discharge		Minor			Minor	Minor									
Full removal of umbilical PLU2892 (reverse reel)			Significant	Significant	Minor	Minor			Minor				Minor	Minor	
Presence and degradation of material left *in situ*)			Minor	Minor	Minor	Minor			Minor	Minor	Minor	Minor			
Onshore[2]															
Offloading decommissioned material (e.g. wellhead, casings etc)													Minor	Minor	
Emissions from material recycle/replacement	Significant													Minor	
Onshore waste treatment and disposal	Minor												Minor	Minor	
Road transport of materials/waste	Minor													Minor	
Treatment of NORM/LSA scale[3]													Minor		

Legend
Potential for significant
Minor issue

Activity/Source of Potential Impact	Summary Consideration: Land, soil, water, air, climate			Biological, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC						Material assets, other users, onshore					
	Climate/air quality	Water Quality	Seabed and sediments	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Conservation sites/species	Fisheries	Shipping	Other users	Landfill/onshore resources	Population and human health	Transboundary issues
Removal of marine growth (onshore)													Minor issue	Minor issue	
Use of non-UK based receiving yard											Minor issue				Minor issue
Accidental events[2]															
Vessel collision		Minor issue								Minor issue	Minor issue	Minor issue			
Accidental spill from rig/vessel (diesel)		Minor issue			Minor issue	Minor issue		Minor issue		Minor issue	Minor issue	Minor issue			Minor issue
Chemical spill (well P&A)		Minor issue		Minor issue	Minor issue	Minor issue	Minor issue	Minor issue		Minor issue					Minor issue
Dropped objects			Minor issue	Minor issue						Minor issue	Minor issue	Minor issue			

Notes: [1]includes offshore renewables, oil and gas, military activities, subsea cables, recreational yachting etc. [2] Current guidance (BEIS 2018) states there is no requirement to assess impacts associated with wastes taken and processed onshore (*as this is associated with onshore and not marine) or accidental impacts; emissions associated with material recycle/replacement has been included as this is a requirement. Onshore and accidental are included here for context but not included for further assessment (Section 5). The quantity of material being returned to shore will be small (i.e. well material and subsea infrastructure) and the recycling aspirations for the this material brought ashore, and estimated quantity of material being disposed of, are as described in the Causeway-Fionn DP and Ithaca Energy will compile a full waste inventory of all materials returned to shore and ensure appropriate waste segregation and treatment is undertaken. Assessment of accidental events, along with a major environmental incident assessment, in line with regulatory requirements applicable at the time, will be included in the term permits (i.e. MATs and SATs) applied for the well and subsea decommissioning activities. [3]NORM/LSA scale not expected as no history of this from the fields. This has been included here as contingency*

4.3 Consideration of effects

Effects considered minor

A number of potential sources of effect from Table 4.2 above have been considered minor and these have not been assessed further. A consideration of these is shown in Table 4.3 below.

Table 4 3 – Environmental effects considered minor

Potential source of effect	Summary consideration
Vessels (applicable to rig, subsea scope and post-decommissioning monitoring)	
Drilling rig tow in/out	Drill rig movements will create temporary, short term and small scale increment to physical presence whilst transiting the North Sea. Notification to mariners, operations are within an area of existing oil and gas associated shipping movements, small increment to existing traffic. Significant effects not likely.
Physical presence	Rig and vessel physical presence during well P&A and subsea scope will create temporary and short term increment to other vessels in the area. Rig locations will be over existing 500m safety zones, and vessels will not be excluded from area during the subsea programme. Operations are within an area of existing oil and gas associated shipping movements and decommissioning will represent a small increment to existing traffic. Notifications to mariners will be made. Significant effects not likely.
Machinery space, deck, sewage and other discharges	Discharges will contribute to local water quality changes and associated interactions with water column biota. However, discharges will be small. In view of location, current/wave action and dilution of discharges, significant effects are not likely.
Underwater noise	The primary contributor to underwater noise from the activities will be rig and vessel activity. The primary receptor of noise impacts are marine mammals. It is noted that the Causeway-Fionn area does not overlap and is not close to any designated or proposed marine protected areas for marine mammals, and is not an area identified as of particular importance to marine mammals. The density of grey and harbour seals in the area is expected to be very low. The increased vessel activity associated with decommissioning will add to the overall ambient noise in the wider Causeway-Fionn area; however, noise characteristics are such that injury will not occur to marine mammals, fish or birds. The noise sources will be temporary and minimised by a phased approach to decommissioning such that vessel time in the field is minimised. Sound from vessels may result in some temporary influence on the behaviour of individual marine mammals within the vicinity of the operations, however, such effects will be short-term, localised, and in the context of existing levels of shipping activity in the region. Consequently, significant negative effects at the population level are not anticipated.
Airborne noise	Small increment to current levels, local, and short term. Significant effects are not likely.
Surface lighting	Incremental surface lighting from rig and associated vessels will be temporary and of short duration, and will not significantly add to existing lighting levels in the area. Significant effects are not likely
Well plug and abandonment	
Well P&A chemical discharges	Small quantity and variety of chemicals to be used and discharged, predominately cement, the majority of which will remain downhole. Chemicals selected for best environmental performance where technically feasible to do so. A risk assessment will be carried out and the use and discharge of chemicals approved prior to use offshore. Discharges will contribute to local water quality changes and associated interactions with water column and benthic biota. Impacts will be short term and localised. Significant effects not likely.
Fugitive emissions from fuel and chemical storage	Emissions include those from cement tanks, diesel storage and cooling/refrigeration systems and have the potential to make minor contribution to air quality effects. Such emissions are minor in the context of those from

	combustion of fuel for power generation and in view of the location and prevailing meteorological conditions, these emissions are not considered to be a significant source of air pollutants. Significant effects not likely.
Other solid and liquid wastes to shore	Materials returned to shore contribute to well-regulated onshore activities such as materials processing and landfill. Significant effects are not likely.
Subsea activities	
Chemical/residual hydrocarbon discharges	Discharges resulting from production/water injection pipeline and umbilical ends being cut, and discharge to sea. Due to hydrostatic pressure, an initial, small discharge would be expected, with the full contents being discharged over time. Production pipelines will be cleaned and flushed prior to decommissioning activities, with only residual hydrocarbons remaining. The contents of the production/water injection pipelines at the time decommissioning associated activities will be carried out, will be inhibited (e.g. biocide) sea or potable water; a small quantity and variety of chemicals will be used. Contents of umbilical includes hydraulic fluid. Contribution to local water quality changes and associated interactions with water column and benthic biota. Chemicals selected for best environmental performance where technically feasible to do so, discharges expected to dissipate from area. Significant effects not likely
Presence and degradation of material left *in situ*	The production pipelines remain buried for the majority of their lengths and degradation will occur over a long period of time, as pipelines degrade material covering lines will sink into the spaces created; the lines are only 8" diameter and the resulting profile after degradation will not be too dissimilar to the existing profile, or natural seabed undulation. The degradation of lines trenched but not covered, will occur at a faster rate, however, these are at the bottom of trenches (at least 1m depth) and their degradation will not result in changes to the seabed profile. Cut ends being lowered, or in the case of the production pipelines, the potential use of new rock to cover these, is not expected to result in a significant effect on other user, these sections represent relatively short sections (a length of 10m has been assumed in each case) compared to the rest of the lines, they will be below seabed level, or covered in rock, with rock already present at crossing locations. Fishing effort in the area is low to moderate, both from UK and non-UK vessels, these vessels currently fish throughout the area, with the exception of the 500m safety zones around the well locations and valve skid, natural hard substrate (cobbles and boulders) are present in the area and the bigger vessels utilise the areas, with gear suited to the seabed conditions (i.e. presence of natural hard substrate). Significant effects are not likely.
Reverse reeling of umbilical PLU2892 (1.5km)	There will be disturbance of the sediment and fauna within the trench during reverse reeling: the seabed sediments of the Causeway/Fionn area are predominantly sands (~85%) and tidal currents are weak so it is anticipated that there is limited sediment cover over the umbilical in the trench and, as the sheathing of the umbilical is smooth, during reverse reeling overlying sediment is expected to slide off within the trench and not generate impacts on the surrounding seabed. Whilst there will be disturbance of sediments and fauna within the trench, this effect is considered minor.

Ithaca Energy is aware of Scotland's National Marine Plan (see Section 1.5) and the responsibilities of the oil and gas industry, including during decommissioning, to interact positively with other users for mutual benefit, and to live within environmental limits to minimise the impact of activities. Other users (including the fishing and navigation industries) will be kept notified of project schedules and progress as appropriate, so impacts on their activities may be minimised and mitigated as far as possible

Potential effects to be considered further

A small number of environmental interactions were identified with the potential to result in significant effects. The major sources of potentially significant effect have been grouped against those activities identified as likely to, directly or indirectly, affect one or more relevant environmental factors (and interactions between these). These have been listed below (Table 4.4) and are described and assessed in detail in Section 5.

Table 4 4 – Environmental effects considered further in Section 5

Issue	Potential Source of Effect (activity area)	Section
Seabed disturbance	• Disturbance of seabed from rig installation, (well P&A, semi-submersible anchors) • Removal of subsea infrastructure and moving aside/removal of protective material (subsea activities) • Trenching/backfilling or rock cover of cut ends (subsea activities)	5.1
Energy use and Atmospheric emissions	• Rig power generation and vessel operation (well P&A, subsea activities) • Material recycling and replacement of material decommissioned *in situ* (well and subsea infrastructure material removal)	5.2
Transboundary issues	• Hydrocarbon, diesel and other (e.g. chemical) spills (well P&A)	5.3
Cumulative effects	• Possibility of interactions with other developments in the North Sea or proposed activities/developments in the wider area (including other decommissioning activities)	5.4

5 OVERVIEW OF POTENTIAL ENVIRONMENTAL IMPACTS

Introduction

For each source of effect identified as being potentially significant (Section 4, Tables 4.2 and 4.3), a description of the potential impacts is expanded upon below.

In addition to regulator acceptance of Decommissioning Programmes being required, decommissioning activities are regulated and will be subject to individual consenting mechanisms which the EA will support (e.g. under the *Offshore Chemical Regulations 2002* (as amended)). Ithaca Energy will also maintain awareness of any additional provisions which come into force during decommissioning planning and implementation.

5.1 Effects of Seabed Disturbance during Decommissioning

Potential Impacts

Physical disturbance to the seabed will be associated with a number of decommissioning activities, primarily:

- Anchoring for semi-submersible for the Causeway-Fionn well plug and abandonment (contingency use of the semi-submersible for the three subsea appraisal wells has also been considered here)
- Removal of pipeline associated infrastructure (valve skid, purge spool)
- Moving/removing protective material (mattresses)
- Remediation of cut ends, or rock use on production and water injection pipeline cut ends if this option is executed; burial of cut ends would result in temporary disturbance of the seabed, whilst addition of rock would be permanent

The removal of umbilical PLU2892 by reverse reel, including flexible jumpers at tie-in to the water injection well and the Causeway production well, is not expected to result in any significant seabed disturbance. This line was trenched at installation (to a minimum depth of 1m) and has not been covered (buried) by natural backfill. As the line is reeled onto the vessel, any sediment that has settled onto the line is expected to remain in the trench. Therefore, this line is not considered further in this section – see Table 4.3 above.

Rig anchoring

Anchors will be used for the semi-submersible rig used to plug and abandon the Causeway-Fionn wells, and, for assessment purposes, to represent the worst case, the use of a semi-submersible has also been assumed for the decommissioning of the subsea appraisal wells. Although final rig selection is still to be made, it is assumed it will have an eight point mooring system, typically comprising an anchor and chain/cable element. The anchor type and arrangement pattern will be subject to a detailed mooring study and the estimated seabed disturbance from rig use is shown in Table 5.1. Other vessels involved in decommissioning activities will be kept on station using dynamic positioning and seabed disturbance will be minimal.

Removal of subsea infrastructure, protective material and remediation of cut ends

The removal of the valve skid, purge spool, protective material, the trenching of pipeline and umbilical cut ends, and removal of the flexible spools/risers/jumpers, will cause some seabed disturbance, the majority of which will be within their existing physical footprint of the original development. Where rock occurs at crossing locations, this will be left in place for both the pipelines and umbilicals. The exception is PLU2892, which has no crossings and no rock protection, and the umbilical is being removed. The base case is that all mattresses and sand bags, which are not covered by rock cover, will be removed (see Section 2.3/2.3.2).

The pipeline/umbilical cut ends, will be lowered into the seabed using mass flow excavation and back filled with the natural sediment where required. Mass flow excavation is proven technology where a flow of water is directed at the seabed to displace the sediment. This disturbance would be localised to areas where the sediment is displaced to lower the exposed ends into the seabed. For the production and water injection pipelines, there is also the option to cover these with rock; as this would be placed over the cut ends, the footprint extent has been assessed as comparable to that of trenching and lowering the sections into the seabed (in each case a length of 10m and corridor width of impact of 4m has been assessed) the difference being the use of rock introduces additional hard substrate and will be permanent. The estimated area of seabed disturbance for these activities has been calculated and this is shown in Table 5.1.

Following removal of the subsea infrastructure, and informed by the post-decommissioning survey, any items of debris located on the seabed will be removed using an ROV and grab. The removal of such items will represent a minor increment to seabed disturbance generated during decommissioning.

Table 5 1 – Estimated seabed disturbance from Causeway-Fionn decommissioning activities

Item	Activity	Estimated disturbance of sediment m^2 (km^2)
	Well plug and abandonment activities	
1	Semi-submersible rig anchors and anchor chains (Causeway-Fionn wells)[1]	180,175 (0.2)
2	Semi-submersible rig anchors and anchor chains (Appraisal wells)[2]	120,116 (0.1)
	Total	**300,291 (0.3)**
	Subsea decommissioning activities	
3	Removal of purge spool and valve skid[3]	39 (0.00004)
4	Moving/removing of protective material[4]	11,676 (0.01)
5	Recovery of spool pieces/jumpers/risers (Production/WI pipeline)[5]	1,360 (0.001)
6	Recovery of spool pieces/jumpers/tie-ins (umbilicals)[6]	1,690 (0.002)
7	Trenching/backfill of cut ends (Production/WI pipeline)[7]	240 (0.0002)
8	Trenching of cut ends (umbilical)[8]	240 (0.0002)
9	Removal of 1.5km umbilical[9]	0
	Total	**15,245 (0.02)**
	TOTAL m^2 (km^2) of seabed disturbed, from decommissioning activities (assuming semi-submersible rig use for all wells) (If rock is used for remediation of cut ends (#7), then 240m^2, (0.0002km^2) of this total would represent a permanent footprint)	**315,536m^2 (0.3km^2)**

Notes

[1]Based on 3 rig moves at 60,058m^2/0.06km^2 each, calculated based on 8 anchored vessel, assuming 750m of length of anchor chain on seabed, with catenary movement of 10m, and based on a length and width of anchor of 5.6m and 1.3m respectively.

[2]Based on 2 rig moves, based on same parameters as described in note #1. If an LWIV is used for well 211/22a-8 and only 1 rig move is used for wells 211/22a-7A and 9, then this will only be 1 rig move and the disturbance from item 2 will be 60,058m^2/0.06km^2

[3].Based on a valve skid measuring 6m x 4m with a buffer, so size assessed = 7m x 5m and purge spool measuring 1m x 1m with buffer, so size assessed = 2m x 2m

[4] Based on mattress size of 7m x 4m (i.e. 6m x 3m with 1m buffer) and assuming 240 recovered for Causeway and 177 recovered for Fionn (these include those mattresses at transition, to be assessed at time of decommissioning activities being undertaken (see Table 2.1). Depending on the scheduling of

decommissioning activities, there may be the requirement to move aside mattresses in order to gain initial access to infrastructure. If this is required, this will be assessed through the OPRED environmental permit process prior to any works being carried out offshore.
[5]. Based on 680m of production/WI pipeline material (spools/jumpers etc) being recovered with a corridor width of disturbance of 2m
[6] Based on 845m of umbilical material (spools/jumpers etc) being recovered, with a corridor width of disturbance of 2m
[7] Based on 60m length of production/WI pipeline section at cut locations being remediated (i.e. 6 locations, 10m length at each) (either trenched/mechanically backfilled where required, or covered with new rock), with a corridor width of disturbance of 4m If used, disturbance from rock has been estimated as the same as for the trenching, with rock placed using a fall pipe, and rock use kept to a minimum. However, if used, rock would be a permanent footprint
[8] Based on 60m length of umbilical section at cut locations being remediated (i.e. 6 locations, 10m length at each) (trenched/mechanically backfilled where required, with a corridor width of disturbance of 4m
[9] Umbilical PLU2892 was trenched at installation but not mechanically backfilled, Recovery by reverse reel is not expected to result in any discernible seabed disturbance.

Seabed disturbance will result in direct physical effects on benthic communities which may include mortality as a result of physical trauma, smothering by excavated and re-suspended sediments. Disturbance during decommissioning activities would be limited to the benthic fauna present where anchors and anchor chains contact the seabed, fauna colonising the hard surfaces of the protective material to be lifted, and the soft sediment fauna along the umbilical route and the biota present on and immediately around the subsea structures.

The response of benthic macrofauna to physical disturbance has been well characterised, with increases in abundance of small opportunistic fauna and decreases in larger more specialised fauna (e.g. Eagle & Rees 1973, Newell *et al*. 1998, van Dalfsen *et al*. 2000, Dernie *et al*. 2003). The duration of effects on benthic community structure are related to individual species' biology and to successional development of community structure. The majority of seabed species recorded from the northern North Sea are known or believed to have short lifespans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid population recovery, typically between 1 to 5 years (Jennings & Kaiser 1998), such that any effect will be temporary.

The infauna of the Causeway-Fionn area is characterised by a range of small, short lived species, which have a widespread distribution and are characteristic of the sandy sediments, while seabed imagery and grab samples from the surveys, showed the larger visible fauna to be relatively sparse. Mortality of pennatulid sea pens (*Virgularia* spp. and *Pennatula phosphorea*), both recorded from survey in the area (Section 3.4 and 3.9), may be high following physical disturbance, but crustaceans are probably able to restore burrow entrances following limited physical disturbance of the sediment surface (a few cm). *P. phosphorea* spawns annually and its fecundity is high (Edwards & Moore 2008), information on the reproduction of *Virgularia* spp is sparse but based on its wide distribution and abundance is considered likely to be similarly fecund. Gates & Jones (2012) suggest that re-establishment of pennatulids is likely to take in excess of five years due to their slow growth rate (based on the Arctic species *Halipteris willemoesi*).

Relevant information on the recovery of benthic habitats to smothering mainly comes from studies of dredge disposal areas (see Newell *et al*. 1998). Recovery following disposal occurs through a mixture of vertical migration of buried fauna, together with sideways migration into the area from the edges, and settlement of new larvae from the plankton. Defaunated sediments will be rapidly recolonised; Harvey *et al*. (1998) suggest that it may take more than two years for a community to return to a closer resemblance of its original state (although if long lived species were present this could be much longer). In contrast to habitats in energetic shallow waters, a stable sand and gravel habitat in deeper water is believed to take years to recover (see Newell *et al*. 1998, Foden *et al*. 2009).

Survey data (e.g. GEMS 2012a,b,c, Fugro 2020a,b) indicates the existing presence of harder substrate (coarser sediment, identified as shell fragments, and cobbles and boulders) and the material introduced as a result of the decommissioning activities, and the addition of more rock, if used for the production/WI pipeline cut ends, is not expected to effect a physical change to another seabed type. In areas of predominately sand sediments, the introduction of hard substrate (deposits of protective material including rock), might facilitate biological colonisation, including by non-indigenous species, by allowing species with short lived larvae to spread to areas, using these "stepping stones" where previously they were effectively excluded. A concern of introducing hard substrate to a seabed area where currently there is none, is this could result in changing the seabed from one type to another, adversely affecting species with habitat preferences. No species of conservation concern have been identified from any of these surveys; the pre-decommissioning survey identified sea pens *Pennatula phosphorea* and *Virgularia* sp, mounds and burrows and the presence of the OSPAR listed threatened and/or declining habitat "sea pens and burrowing megafauna communities" was considered likely to occur within the survey area, however, based on sediment type and surface features, the consideration is that the habitat is not present. It can be expected that, if used, the rock protection will be colonised by epifaunal assemblages of various densities and compositions, as has been seen with the hard material used in the initial development of the fields.

Operational Controls and Mitigation

Ithaca Energy's contractor selection process takes into consideration a prospective contractors ability (including resources and experience) to undertake work in an environmentally sound manner, with interfaces detailing responsibilities, including environmental responsibilities, and regular HS&E meetings, as required. Applications will be made to deposit rock for cover if required, with the rock quantity to be minimised and placed as accurately as possible from the vessel; a condition of the permit will be to deposit material at and within coordinates applied for.

Project planning includes minimising, as far as practicable, rig/vessel movements, including the use and movement of anchored vessels; the semi-submersible rig will predominantly be located within the existing 500m zones and footprints of the wells, unless on transit. It also includes assessing the nature and scale of seabed disturbance by ROV inspection and/or debris clearance survey, post-decommissioning.

No specific additional mitigation was considered necessary beyond application of established operational controls.

Conclusion

The great majority of seabed disturbance will be within (and considerably less than) the development footprints of the Causeway-Fionn fields and temporary (with the exception of rock if this is used for cover). Natural redistribution of disturbed sediments is expected.

Anchor and catenary scars will be formed by the semi-submersible rig anchoring, but these are not expected result in changes in sediment characteristics, significant compaction or faunal effects; the physical aspects of anchoring, the anchor scars, will be more persistent, but the biological effects on fauna that relate to this are not. The removal of the subsea infrastructure and associated protective material will also cause some seabed disturbance and sediment re-suspension principally within the existing footprint, but this is temporary and will not result in changes in sediment characteristics. If rock is used for covering the production and water injection pipeline cut ends, this will introduce new hard substrate into the area. Previous surveys, including the recent pre-decommissioning survey indicate that the existing areas of rock cover, subsea infrastructure and associated protective material and existing natural hard features (cobbles, boulders) have been colonised by a range of epifaunal species. The potential introduction of hard substrate, on the scale estimated for decommissioning is minor in the context of that already present.

The area of total physical disturbance from decommissioning activities is relatively small (315,536m^2, 0.3km^2), all of which is considered temporary, if the cut ends of the pipeline/WI lines are trenched. If rock is used to bury these ends, then an estimated 240m^2 (0.0002km^2) of the (315,536m^2, 0.3km^2) total, would represent a permanent footprint. The area affected is negligible in the wider context of the northern North Sea.

In view of the potential effects described and recovery potential of the seabed, significant effects from physical disturbance are not considered likely.

5.2 Effects of Energy Use and Atmospheric Emissions

Potential Impacts

Anthropogenically enhanced levels of greenhouse gases (GHGs, principally CO_2) have been linked to global climate change (IPCC 2013). Predicted effects include *inter alia* an increase in global temperate (Kirtman *et al.* 2013, Collins *et al.* 2013), rising sea-levels (Lowe *et al.* 2009, Church *et al.* 2013, Horsburgh *et al.* 2020), changes in ocean circulation (Collins *et al.* 2013) and potentially more frequent extreme weather events (Wolf *et al.* 2020), and other effects including ocean acidification generated by enhanced atmospheric acid gas loading, deposition and exchange (see Humphreys *et al.* 2020). These effects, most recently summarised in the Intergovernmental Panel on Climate Change (IPCC) 5th assessment report (IPCC 2013, also see Dolan 2015), are the rationale on which global carbon dioxide reduction measures such as the Paris Accord and the UK Government commitment to achieving net zero GHG emissions on 1990 levels, by 2050, are based.

In addition to effects associated with atmospheric greenhouse gases, emissions also have the potential to have negative effects on air quality. Poor air quality can result in effects on human health, the wider environment and infrastructure. Reduction in local air quality through inputs of contaminants such as oxides of nitrogen (NO_X), volatile organic compounds (VOCs) and particulates (e.g. PM_{10}, $PM_{2.5}$), may contribute to the formation of local tropospheric ozone and photochemical smog, which in turn can result in human health effects (see WHO 2013, EPA 2017).

The principal GHG of concern is CO_2 as it constitutes both the largest component of global combustion emissions (generally ~80% of total GHG emissions) and has a long atmospheric residence time such that emissions made today continue to contribute to radiative forcing for some time[12]. Emissions of relevant gas species and their associated Global Warming Potential (GWP) have been estimated for the activities associated with the decommissioning of the Causeway-Fionn facilities. This has involved the use of standard Environmental and Emissions Monitoring System (EEMS) conversion factors (DECC 2008) and the most recent GWP metrics (Myhre *et al.* 2013, Table 5.2). The result is a value in tonnes of CO_2 equivalent (CO_2 eq.) based on the radiative forcing effect of each GHG species relative to CO_2 and the atmospheric residence time of each gas. The GWP factor therefore changes depending on the "time horizon" considered (see IPCC 2001, 2007, Myhre *et al.* 2013, and Shine 2009 for a synthesis and critical review). GWP factors for CO have previously been calculated as 1.9 at 100 years, and that for NO_x is considered highly uncertain (Forster *et al.* 2007), and these are therefore not calculated.

For the purposes of this assessment, a 100 year time-horizon has been used, in line with its adoption by the United Nations Framework Convention on Climate Change and use in the Kyoto protocol (Myhre *et al.* 2013), and nationally for the calculation of carbon dioxide equivalent emissions (Shine 2009).

[12] Figures vary widely from between 5-200 years (Houghton *et al.* 2001) to ~1,000 years (Archer 2005)

Table 5.2 – Emissions Factors

Gas	CO2	N_2O	CH_4	CO	NOx	SO_2	NMVOCs
Diesel (engine)	3.2	0.00022	0.00018	0.0157	0.0594	0.004	0.002
Aviation fuel (helicopter)	3.15	0.00012	0.00035	0.00953	0.012	0.0009	0.00306
GWP at 100 years	1	265	28	-	-	-	-

Notes: [1]sulphur content of marine diesel fuel assumed to be 0.1% based on requirements for Emissions Control Areas: IMO website (accessed November 2017).
Source: IPCC (1996), DECC (2008), Myhre et al. (2013), AEA-Ricardo (2015)

Atmospheric emissions were identified in Section 4 as being a potential source of effect from activities associated with the decommissioning programmes. Sources of emissions include:

- Drilling rig power generation, supporting vessels and helicopter traffic
- Combustion emissions from vessels involved in the subsea decommissioning campaign
- The recycling of materials returned to shore and the loss of materials left *in situ* for future use, and the possible related lost opportunity to displace primary materials from certain material supply chains

Removal of the causeway-Fionn subsea infrastrcture

The well abandonment programme is the primary source of emissions (6,982tCO_2eq) and together with the decommissioning of the Cause-Fionn Pipeline System (5,437 tCO_2eq), results in an estimated total emissions from decommissioning the facilities of 12,419tCO_2eq. (Table 5.3a and b). The emissions calculations are based on a range of assumptions relating to vessel type and timings, which are outlined in Section 3.

Table 5.3a – Estimated emissions from Causeway-Fionn well decommissioning activities

Gas	Rig (fuel use 1,602 tonnes)	ERRV (89 tonnes)	Anchor handler (96 tonnes)	Supply vessel (338 tonnes)	Helicopter (15 tonnes)	Total	GWP	Total (tCO_2eq.)
CO_2	5,126	285	307	1,082	47	6,847	1	6,847
N_2O	0.352	0.020	0.021	0.074	0.002	0.47	265	124
CH_4	0.288	0.016	0.017	0.061	0.01	0.39	28	11
SO_2	6.408	0.356	0.384	1.352	0.01	8.51		
CO	25.151	1.397	1.507	5.307	0.14	33.51		
NO_x	95.16	5.29	5.7	20	0.18	126		
VOC	3.204	0.178	0.192	0.676	0.05	4.30		
							GWP (tCO_2eq) at 100 years	**6,982**

Table 5.3b – Estimated emissions from Causeway-Fionn subsea decommissioning activities

Gas	DSV (pipelines and umbilical) (fuel use 580 tonnes)	CSV (single umbilical) (100 tonnes)	Tugs to support DV (if required) (986 tonnes)	Total	GWP	Total ($tCO_2eq.$)
CO_2	1,856	320	3,155	5,331	1	5,331
N_2O	0.13	0.02	0.22	0.37	265	97
CH_4	0.1	0.02	0.18	0.3	28	8
SO_2	2.32	0.4	3.94	6.66		
CO	9.11	1.57	15.48	26.16		
NO_x	34.45	5.94	58.57	99		
VOC	1.16	0.2	1.97	3.33		
					GWP (tCO_2eq) at 100 years	**5,437**

Emissions associated with material recycling

A high level breakdown of the dominant material components of Causeway-Fionn are indicated in Tables 2.2a, b in Section 2.3. To provide a more complete indication of the emissions associated with decommissioning Causeway-Fionn, emissions relating to the fate of the materials have also been estimated (Table 5.4) (note that re-use options have not been identified for the infrastructure). Emissions are primarily from steel associated with recovered pipeline and umbilical material (negligible as much relates to pipeline and umbilical ends other than for the water injection umbilical) and the recovered well completion tubulars and a portion of each well casing. The remaining materials include protective material recovered, with some minor non-ferrous metal and plastic components (e.g. pipeline coatings).

Table 5.4 – Estimated emissions relating to recycling of materials associated with Causeway-Fionn decommissioning

Activity	Material recovered (t)					Emissions ($tCO_2eq.$)
	Steel	Aluminium	Copper	Plastics	Concrete	
Valve skid	36	0	0	0	0	35
Pipelines and umbilicals	91	2	2	61	1,588	428
Recovered well casing and tubular sections	519	0	0	0	0	498
Emissions estimated from production of equivalent material from primary source						1,579
Estimated emissions avoided from material recovery						619
Estimated lost opportunity from materials left *in situ*						7,219
Estimated net emissions						6,601

Notes: All figures rounded to nearest whole tonne. Emissions have been estimated based on the typical embodied carbon of primary materials and materials containing typical proportions of recycled components ($tCO_2eq./t$), with factors based on those from Hammond & Jones (2011) and IoP (2000).

Most materials to be recovered are recyclable (e.g. steel) and therefore have a strong end-of-life benefit through the displacement of virgin material in the wider materials supply chain (Hammond & Jones 2011, Weinzettel *et al*. 2009, Yellishetty *et al*. 2012), which also has wider implications than just emissions. The benefit of displacing primary materials has been taken to be the difference in emissions from producing an equivalent unit of recycled material. Conversely the leaving of some components *in situ* results in a loss of future use of that material, and the emissions associated with generating the equivalent materials from primary sources have been calculated, assuming that these would otherwise displace such primary material. However, the leaving of the material *in situ* negates additional vessel time in the field to recover and transport these to shore, emissions from which would be greater than the lost opportunity of recycling these materials.

Causeway-Fionn emissions in context

In 2019[13], UK emissions of the basket of seven greenhouse gases covered by the Kyoto are provisionally estimated to be 435.2 million tonnes CO_2 eq.; CO_2 being the most dominant of these, accounting for ~81% of the emissions (361.5 million tonnes (Mt)). The total emissions were 3.6% lower than the 2018 figure of 451.5 million tonnes CO_2 eq., and net CO_2 emissions were 3.9% lower than the 2018 figure (365.7 Mt); primarily related to a decrease in the use of coal in electricity generation (BEIS 2020a). Approximately 13.2 $MtCO_2$ was attributable to installations in the UKCS in 2018 (OGUK 2019).

To place the decommissioning of Causeway-Fionn in the context of UK CO_2 emissions, these would represent an increment of *ca*. 0.003% on those emitted from all UK sources in 2019. In view of when the decommissioning activities are proposed to take place (*ca*. 2026-2027), it has been estimated that they would contribute to approximately 0.002% of the relevant carbon budget covering 2023-2027, which has a total budget of 1,950$MtCO_2$eq.[14].

Operational Controls and Mitigation

As part of their standard programme management and planning, Ithaca Energy look to minimise vessel time in the field as far as practicable and will make use of vessel synergies where possible. The above estimates are based on representative vessels presently in operation, with timings and related emissions representing a probable worst-case, whereas Ithaca Energy's contractor selection process enables Ithaca Energy to select contractors with, for example, modern and fuel efficient vessels, where available, while satisfying the other selection criteria. Emissions are also reduced by following relevant industry best practices and minimising fuel consumption where possible.

Emissions from material flows are minimised by using a waste hierarchy approach consistent with the Waste Framework Directive 2008/98/EC and relevant legislation; establishing where there is scope for equipment and material recycling, with disposal only taking place where no feasible alternative is available.

It is considered that there is limited scope for additional mitigation measures to reduce the residual effect on atmospheric GHG loading, or any local effects on air quality. However, these latter effects are naturally mitigated through the area being relatively far offshore (~124km), the predominant air flow in the region and relatively short duration of activities.

[13] It is noted that BEIS (2021) includes provisional figures of GHG emissions for 2020. Due to the anomalous nature of that year (a decrease of total GHGs by 8.9%) due to the impacts of the COVID-19 pandemic, 2019 figures have been used for the purposes of comparison.

[14] The mechanism under the *Climate Change Act 2008* (as amended) which sets targets to progressively reduce the level of GHGs which the UK should be emitting, set by UK Government on advice from the Climate Change Committee, with a view to reducing net emissions by 57% in 2030, and 100% by 2050 (on 1990 levels).

Conclusion

Causeway-Fionn decommissioning activities will lead to emissions of gases which contribute both to localised and short-term increases in atmospheric pollutants, and to global atmospheric GHG concentrations. In the context of wider UK emissions these effects are considered to be negligible, and there will be a minor reduction in net emissions associated with the return of recyclable materials to shore which will have a future use and offset the extraction and transport of primary raw materials. Overall effects are considered to be negligible and temporary.

5.3 Cumulative Impacts

Current guidance (BEIS 2018) requires the assessment to consider the cumulative effects arising from decommissioning activities in the context of all other activities taking place in the area, where relevant to do so. Ithaca Energy has given consideration to cumulative effects and has followed the guidance to *The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020* (BEIS 2020b) where it states *The assessment should also consider the impacts of other existing, consented or planned activities in the development area, and determine whether there are likely to be any significant in-combination or cumulative impacts*. Ithaca Energy have also looked to DTI 2003, which defined three categories of "additive" effects in the context of Strategic Environmental Assessment:

Incremental effects are considered within the assessment process as effects from licensing exploration and production (E&P) activities, which have the potential to act additively with those from other oil and gas activity, including:

- Forecast activity in newly licensed areas
- New exploration and production activities in existing licensed areas
- Existing production activities
- Forecast decommissioning activities
- Legacy effects of previous E&P activities, post-decommissioning (e.g. unrecovered debris)

Cumulative effects are considered in a broader context, to be potential effects of decommissioning activities which act additively or in combination with those of other human activities (past, present and future); given the existing uses of the sea in and around the Causeway-Fionn area and the decommissioning activities, the cumulative effects have the potential to arise with other activities, notably:

- Fishing
- Shipping and navigation
- Other oil and gas decommissioning activities
- Oil and gas and other industrial related activity (e.g. exploration, appraisal, development, marine aggregate extraction)

Synergistic effects – synergy occurs where the joint effect of two or more processes is greater than the sum of individual effects – in this context, synergistic effects may result from physiological interactions (for example, through inhibition of immune response systems) or through the interaction of different physiological and ecological processes (for example through a combination of contaminant toxicity and habitat disturbance).

Effects from decommissioning the Causeway-Fionn facilities, which are considered to have potential to act in an incremental, cumulative or synergistic manner are summarised below.

Physical disturbance	**Incremental**: disturbance will be incremental with that resulting from other well plug and abandonment, pipeline decommissioning activities; there are other decommissioning projects in the wider northern North Sea area. However, the majority of the spatial extent of disturbance for decommissioning Causeway-Fionn is limited and widely separated from other decommissioning projects, with the only footprint overlap being the tie-in locations at the TAQA operated NCP, this also under assessment for future decommissioning. The total area affected is a small proportion of benthic habitat area. **Cumulative**: fishing probably represents the principal sources of seabed disturbance in and around the wider Causeway-Fionn area. **Synergistic**: none
Emissions	**Incremental**: no significant incremental effects, in view of scale of inputs (relatively few vessels on site, for relatively short durations at a time, limited vessel overlap) and very high available dispersion. **Cumulative**: greenhouse and acid gas emissions will be cumulative in a regional and global context, although the contribution associated with the decommissioning activities is minor. **Synergistic**: none

5.4 Transboundary Impacts

The UK has ratified the Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) and thus an assessment is required of the potential for the decommissioning activities to result in significant transboundary effects.

At its closest point, the Causeway-Fionn facilities are only *ca*. 20km from the UK/Norway median line, however the activities associated with the decommissioning of the fields (well P&A, disconnect of pipelines/umbilicals, removal of spools/jumpers, protective material and the *ca*. 1.5km umbilical) are considered to offer a remote risk of transboundary effects. As part of the permitting and consenting process for the decommissioning activities, accidental events and a major environmental incident assessment will be carried out, which will take into consideration the potential for transboundary impacts.

6 ISSUE MANAGEMENT AND OVERALL CONCLUSION

6.1 Introduction

Through a systematic evaluation of the Causeway-Fionn decommissioning activities and their interactions with the environment, a number of potential sources of effect were identified; the majority of these were of limited extent and duration and deemed minor and not assessed further (Section 4.2, Table 4.2). Those activities which were identified as being of potentially greater concern were assessed further in Section 5.

Predicted environmental effects from decommissioning activities are comparable with those from the decommissioning of other tie-back (i.e. well and pipeline) field facilities, with no topside and jacket facilities, on the UKCS. During the assessment process, no potential issues of concern were identified and there were no gaps or limitations in the environmental information available (e.g. pre-decommissioning survey of the Causeway-Fionn area, Fugro 2020a,b).

The risk of spills has been considered and there will be preventative measures and procedures in place to minimise the likelihood of their occurrence and potential environmental damage.

6.2 Environmental Management Commitments

The decommissioning activities will be conducted in accordance with Ithaca Energy's Operational Excellence policy. A number of contractors will be involved in the detailed planning and execution of the decommissioning activities and Ithaca Energy has established contractor selection and management procedures which include evaluation of HS&E aspects and environmental management and compliance.

Table 6.1 below presents a summary of commitments identified through the assessment process and actions for the decommissioning activities, matched with their responsible team; the table below does not include legal requirements, e.g. obtaining and complying with approved permits and consents, and the conditions contained therein (including, but not limited to, notice to mariners for rig and vessel movements and required rig/vessel lighting and markings), including the pipeline works authorisation (PWA) and those required under PETS, the required oil spill response documents (i.e. OPEPs) and the compliance with all relevant waste regulations applicable to material being returned to shore.

The commitments described in Table 6.1 are over and above those required by relevant legislation and conditions contained within permit/consent approvals.

Table 6 1 – Summary of Commitments and Actions for the decommissioning of the Causeway-Fionn subsea facilities

Item	Issue	Actions	Responsibility
Overall Project			
1	Environmental objectives	Ensure indicators and targets for the decommissioning project are consistent with Ithaca Energy policy and the environmental goals are established for each of the main activities (well plug and abandonment, subsea infrastructure decommissioning/removal). Monitor and review performance against indicators and targets, ensuring remedial action is instigated where necessary.	Projects/HSE Department
2	Contractor management	Ensure contractor management assurance processes in place and include environmental aspects for all contracted elements of the offshore activities; including new	Projects/HSE Departments

Item	Issue	Actions	Responsibility
		technologies available for rig equipment to reduce emissions. Monitor environmental performance during decommissioning activities	
3	Compliance assurance	Ensure a process is in place to manage the applications for and monitoring of compliance with the requirements of environmental permits and consents.	HSE Department
4	Decommissioning debris	Ensure any items of equipment or materials lost overboard are reported to Ithaca Energy representative. Recover all significant items of debris located.	Projects/HSE Departments
5	Survey	Post-decommissioning/debris/clearance survey carried out upon completion of decommissioning activities.	Projects/HSE Departments
Well Plug and Abandonment			
6	Rig audit	Audit of rig to be carried out, if required[1], to confirm systems and procedures are as required	HSE Department
7	Environmental critical elements	Ensure rig has a register of environmentally critical equipment, that scheduled maintenance checks are undertaken and that items are appropriately prioritised.	HSE Department
8	Bunkering	Bunkering to be conducted in favourable sea states, according to the rig operator's procedures and during daylight hours so far as practicable	Projects/HSE Departments
9	Waste procedures	Waste management and procedures to be raised at pre-operations meeting Raise expectations of waste recycling Monitoring of waste management practices and ensure appropriate documentation and record keeping	Projects/HSE Department
Subsea infrastructure			
10	Waste procedures	Waste management and procedures to be raised at pre-operations meeting. Monitoring of waste management practices and ensure appropriate documentation and record keeping	Projects/HSE Departments

Notes. [1]If a recent audit has been carried out on the rig prior to Ithaca Energy taking contract of the unit, Ithaca Energy will obtain a copy of this, rather than repeat the audit

6.3 Overall Conclusion

Overall conclusions of the environmental appraisal of the decommissioning of the Causeway-Fionn facilities are:

- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant impacts on conservation interests are predicted
- No specific, additional controls were considered necessary on activities beyond application of regulatory requirements, established Ithaca Energy management system processes, operational controls and following industry guidelines where applicable
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

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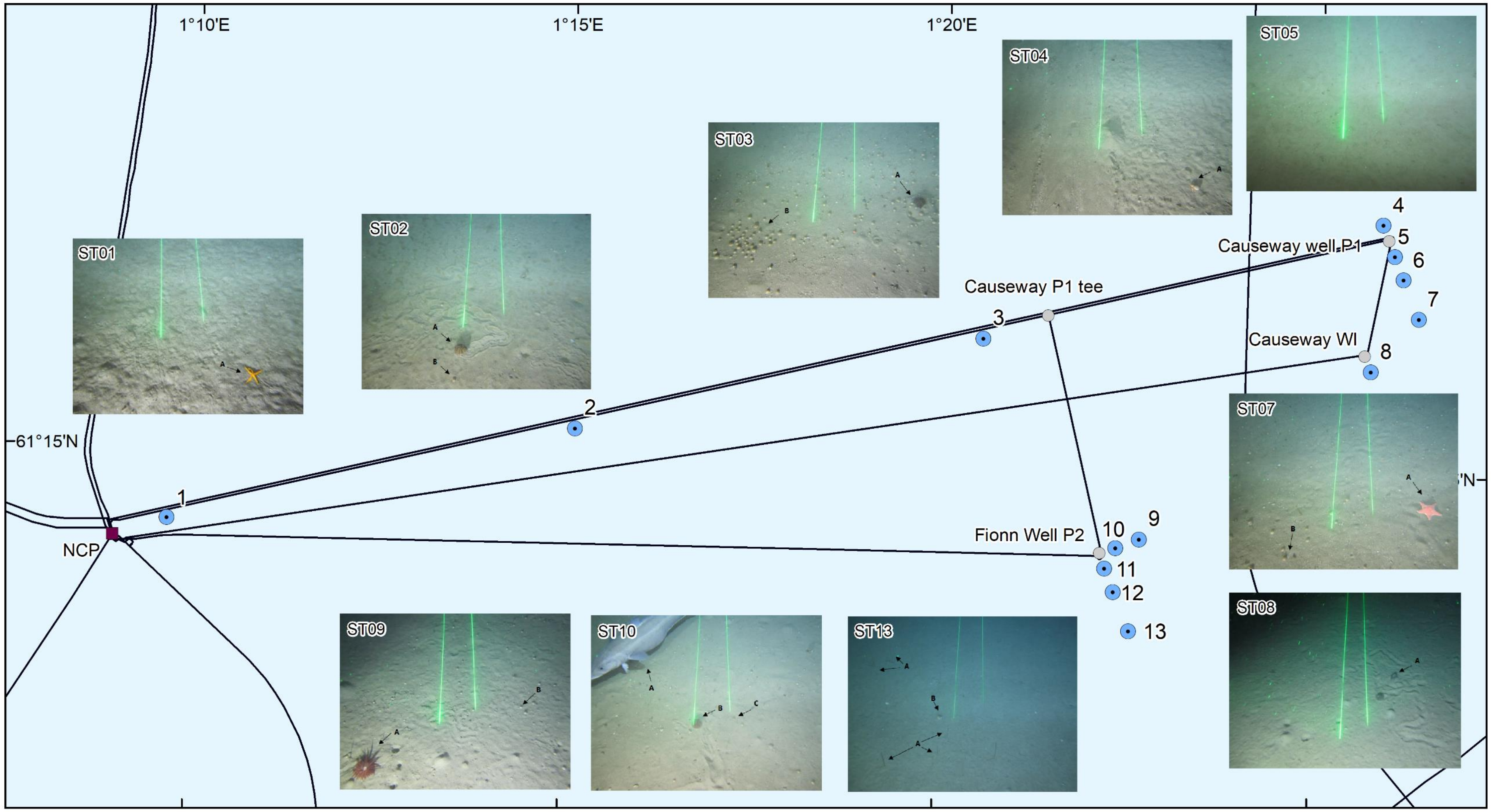
APPENDIX A - SEABED FEATURES AND HABITAT – CAUSEWAY-FIONN



Legend

- ■ Surface infrastructure
- ● Subsurface infrastructure
- ● Seabed photos, Fugro (2020)
- —— Pipeline

ST01	Starfish (Asteroidea)
ST02	Urchin (Spatangus sp.), Urchins (Gracilechinus acutus), Faunal tracks
ST03	Urchin (Spatangus sp.), Urchins (Echinidae including Gracilechinus acutus)
ST04	Hermit crab (Paguridae), Faunal tracks
ST05	No fauna observed
ST07	Cushion star (Hippasteria phrygiana), Urchins (Echinidae, including Gracilechinus acutus)
ST08	Urchin (Spatangus sp.), Faunal tracks and burrows
ST09	Anemone (Bolocera tuediae), Urchins (Echinidae, including Gracilechinus acutus), Faunal tracks and mounds
ST10	Ling (Molva molva), Urchin (Spatangus sp.), Urchins (Echinidae, including Gracilechinus acutus), Faunal tracks
ST13	Sea pens (Virgularia sp.), Hermit crab (Paguridae), Faunal tracks

Data Sources: OGA, Fugro.

0 1 2 Km

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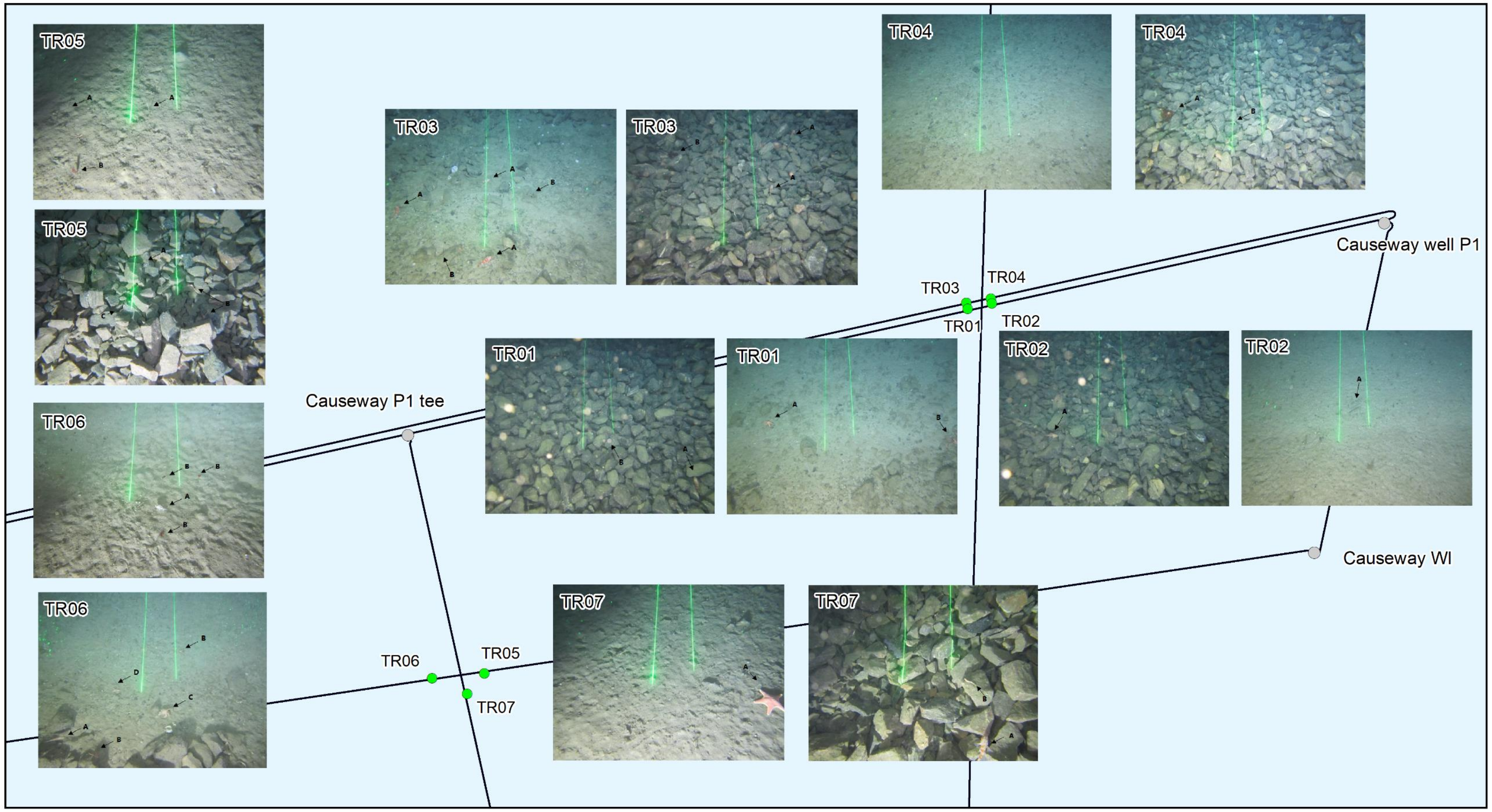
ED50 UTM Zone 31N

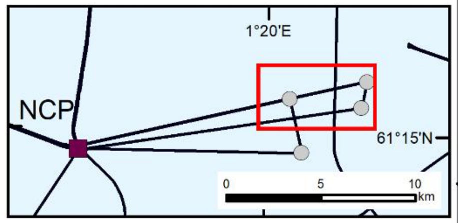
HAL_ITH29_G19_VER01



Legend

- Surface infrastructure
- Subsurface infrastructure
- Transect photos, Fugro (2020)
- Pipeline

TR01	Redfish (Sebastidae), Urchin (Echinidae), Starfish (Asteroidea), Crab (Pleocyemata)
TR02	Fish (Pisces), Faunal turf (Hydozoa/Bryozoa), Faunal tracks, Redfish (Sebastidae)
TR03	Redfish (Sebastidae), Squat lobsters (Galatheoidea), Anemone (Actiniaria, possible Bolocera tuediae*)*
TR04	Anemone (Actiniaria, possible Bolocera tuediae), Starfish (Asteroidea)
TR05	Sea pen (Vigularia sp.), Sea pen (Pennatula phosphorea), Faunal turf (Hydozoa/Bryozoa), Redfish (Sebastidae), Squat lobsters (Galatheoidea), Calcareous worm tubes (Serpulidae)
TR06	Redfish (Sebastidae), Sea pen (Pennatula phosphorea), Faunal turf (Hydozoa/Bryozoa), Squat lobsters (Galatheoidea), Hermit crab (Paguridae), Starfish (Asteroidea)
TR07	Cushion star (Hippasteria phrygiana), Redfish (Sebastidae), Calcareous worm tubes (Serpulidae)



Data Sources: OGA, Fugro.

0 0.25 0.5 Km
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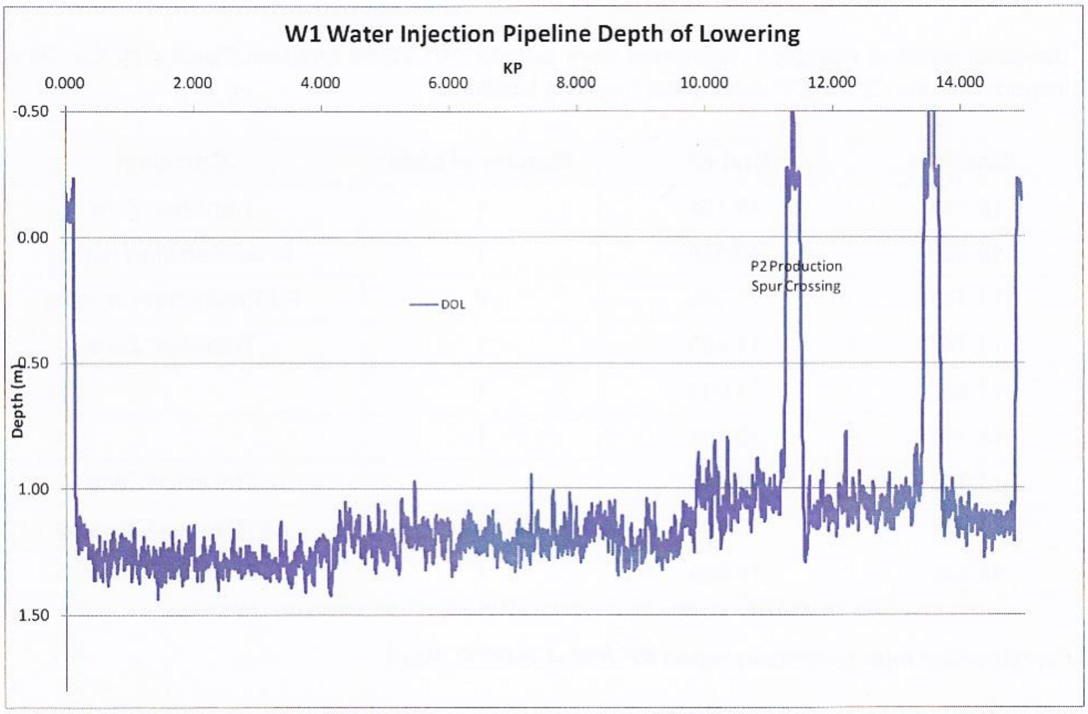
ED50 UTM Zone 31N

HAL_ITH29_G20_VER01

APPENDIX B – DEPTH OF LOWERING FOR PL2890, PLU2891, PLU2892 AND PLU2893

Figure B1 – WI pipeline PL2890 Depth of Lowering (DOL)



Note: KP = Kilometre Post

Figure B2 – Umbilical PLU2891 Depth of Lowering (DOL)

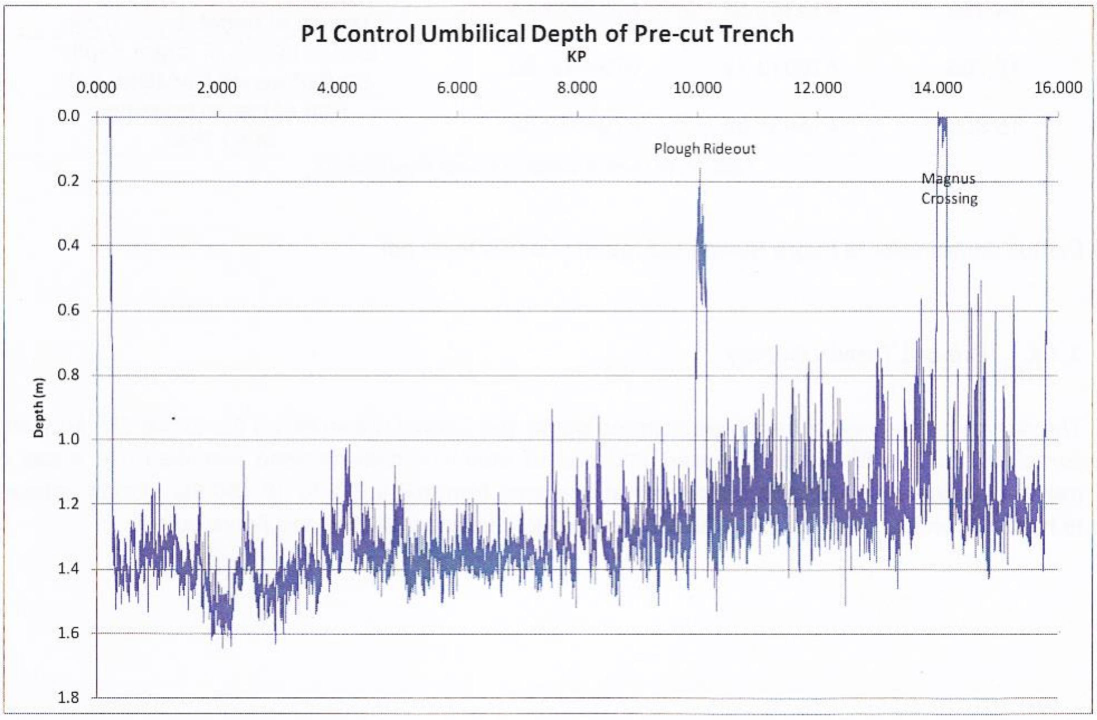


Figure B3 – Umbilical PLU2892 Depth of Lowering (DOL)

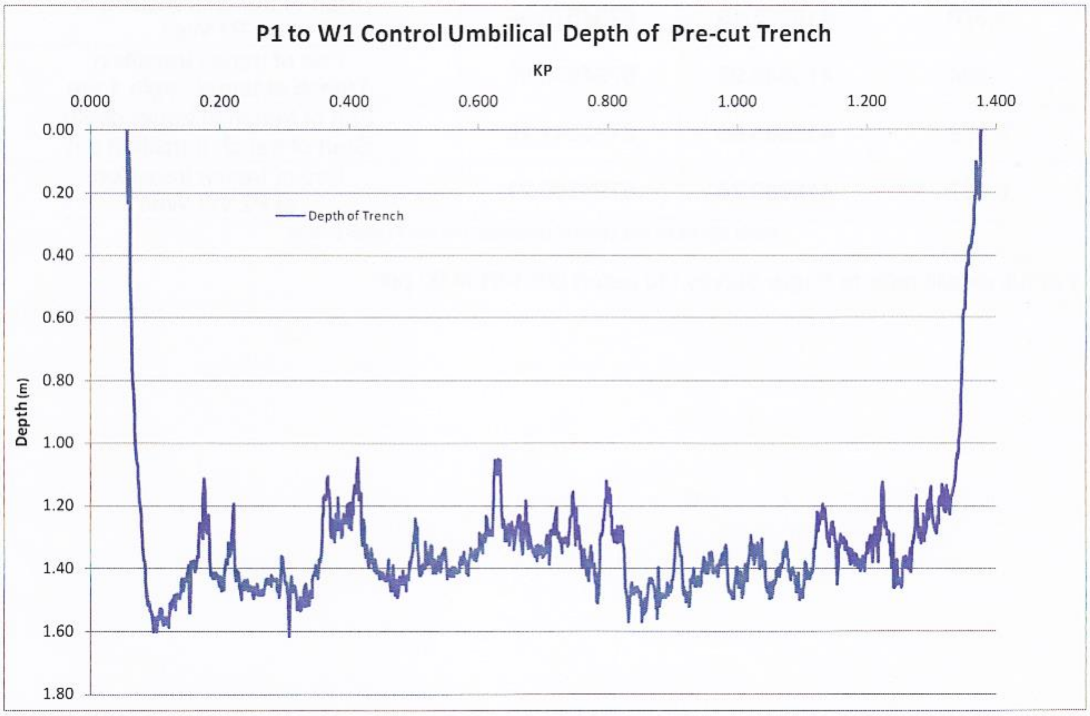


Figure B4 – Umbilical PLU2893 Depth of Lowering (DOL)