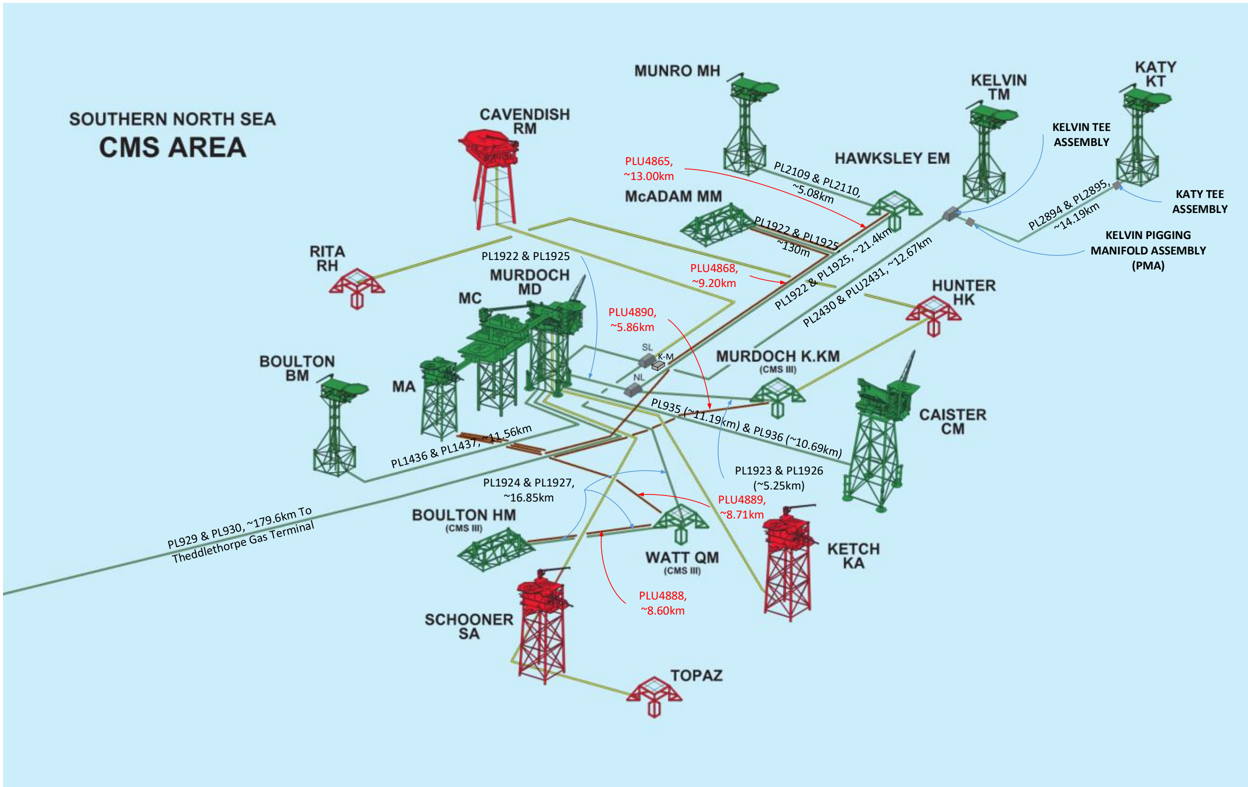
CHRYSAOR



Environmental Appraisal for the Caister-Murdoch System

This Environmental Appraisal accompanies the Decommissioning Programmes for CDP1b, CDP2 and CDP3

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Abbreviation	Explanation
~	Approximately
3PLE	3 Layer Polyethylene
AIS	Automatic identification system
Approaches	Refer to pipelines as they come nearer to the risers on the installations
APE	Alkylphenol ethoxylates
As	Arsenic
AWV	Accommodation work vessel
BAP	Biodiversity Action Plan
BCs	Background Concentrations
BEIS	Department for Business, Energy and Industrial Strategy
Boulton BM	Surface installation located in UKCS block 44/21a; uses PL1436 & PL1437
Boulton HM	Subsea Installation located in UKCS block 44/22b and uses the same pipelines as Watt QM; PL1924 & PL1927
CA	Comparative Assessment (Report)
CCS	Carbon Capture & Storage
Caister CM	Surface installation located in UKCS block 44/23a; uses PL935 & PL936
Cd	Cadmium
CDP1b	Caister Decommissioning Programmes 1: Caister Pipelines
CDP2	Caister Decommissioning Programmes 2: CMS (excluding Murdoch and Caister)
CDP3	Caister Decommissioning Programmes 3: Murdoch
Chrysaor	Chrysaor Production (UK) Limited
CMS	Caister Murdoch System
CoP	Cessation of Production
Cr	Chromium
Crossing	Pipeline crossing. A pipeline with a higher identification number crosses over the top of a pipeline with a lower identification number. Typically pipeline crossings might be protected with concrete mattresses and overlain with deposited rock.
CSPS	Cavendish Subsea Pigging Skid (also known as Pigging Skid Southern Lobe, PSSL)
Cu	Copper
Cut and lift	The ‘cut and lift’ method of removing trenched and buried pipelines would involve excavating the pipelines from within the seabed and thereafter cutting the pipeline into recoverable and transportable lengths. The method is usually only viable for short pipelines.
dB	Decibels
DoB	Depth of Burial
DOC	The blue line on the burial profiles shows the profile of cover. The area between the blue line and maroon line (DOL) shows the depth of sediment above the top of the pipeline.
DOL	Pipeline trench profile; depth of lowering to top of pipe.
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DNV	Det Norske Veritas
DP	Decommissioning Programme(s)
DP	Direct Positioning
EA	Environmental Appraisal
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ENVID	Environmental Impact Identification
EPS	European Protected Species
ERL	Effects Range Low
ESDV	Emergency Shutdown Valve
EUNIS	European Nature Information System
Exposure	An exposure occurs when the ‘crown’ of a pipeline or umbilical can be seen. This does not generally mean it is a hazard
FBE	Fusion Bonded Epoxy

Abbreviation	Explanation
FCS	Favourable Conservation Status
FishSafe	The FishSafe database contains a host of oil & gas structures, pipelines, and potential fishing hazards. This includes information and changes as the data are reported for pipelines and cables, suspended wellheads pipeline spans, surface & subsurface structures, safety zones and pipeline gates (www.FishSafe.eu)
GMG	Global Marine Group
Hawksley EM	Subsea Installation located in UKCS block 44/17a; uses PL1922 & PL1925
Hg	Mercury
HLV	Heavy Lift Vessel
HRA	Habitats Regulations Assessment
HSE	Health, Safety, Environment
HSE	Health and Safety Executive
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Seas
ID	Identity (as in tabulated feature)
", in	Inch; 25.4 millimetres
Katy KT	Surface installation located in UKCS block 44/19b; uses PL2894 & PL2895
Kelvin TM	Surface installation located in UKCS block 44/18 & 44/23b; uses PL2430 & PLU2431
km	kilometre
KP	Kilometre Point, usually measured from point of origin, the start of the pipeline at the pipeline flange. A negative KP means that the feature lies between the riser flange and the start of the pipeline
KPI	Key Performance Indicators
LAT	Lowest Astronomical Tide
LDP1-LDP5	LOGGS Decommissioning Programmes 1-5
Leave *in situ*	Leave *in situ* for pipelines would involve leaving trenched and buried pipelines *in situ* and risk assessing any exposures and spans
Li	Lithium
LOD	Limit of Detection
LOGGS	Lincolnshire Offshore Gas Gathering System
m	metres
MAIB	Marine Accident Investigation Branch
mm	millimetre
MMO	Marine Management Organisation
McAdam MM	Subsea Installation located in UKCS block 44/17c and uses the same pipelines as Hawksley EM; PL1922 & PL1925
MCZ	Marine Conservation Zone
MeOH	Methanol
MFE	Mass Flow Excavator provides a method of clearing material from pipeline trenches
MLWM	Mean Low Water Mark
MoD	Ministry of Defence
MPA	Marine Protected Area
MPE	Ministry of Petroleum and Energy
Murdoch Installation	Comprises Murdoch MA, Murdoch MC and Murdoch MD that are all bridge linked, located in UKCS Block 44/22a
Murdoch MA	Murdoch Accommodation installation; comprises temporary refuges and helideck
Murdoch MC	Murdoch Compression installation; comprises process facilities for separation and compression as well as accommodation
Murdoch MD	Murdoch Drilling Installation containing risers and wellheads; source and destination for PL929 and PL930 respectively
Murdoch K.KM	Subsea Installation located in UKCS block 44/22a and uses PL1923 & PL1926
n/a	Not Applicable
N,S,E,W	North, South East & West
NFFO	National Federation of Fishermen's Organisations
Ni	Nickel
NIFPO	Northern Ireland Fish Producers Organisation
NORM	Naturally Occurring Radioactive Material

Abbreviation	Explanation
NRA	Navigational Risk Assessment
NUI	Normally Unattended Installation
OGA	Oil and Gas Authority
OGUK	Oil and Gas United Kingdom
OMR 17	Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2017
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic Aromatic Hydrocarbon
Partial removal	The partial removal decommissioning option for pipelines would involve excavating trenched and buried pipelines local to the exposed ends of the pipeline and thereafter effecting removal of the section of pipeline using the ‘cut and lift’ method. Typically, the excavated locations and cut pipeline ends in the seabed may need to be remediated in some way, either by back-filling the excavated material or by depositing rock
Pa	Pascal
Pb	Lead
PCB	Polychlorinated biphenyl
Piggybacked	Clamped or connected to another pipeline along part or all of its length
Pipeline	Pipeline or umbilical pipeline
Pipeline end	Pipeline to pipe spool connection; either a flanged or welded joint
PL	Pipeline identification numbers
Platform	Installation, typically comprising topsides and jacket
PMA	Pigging Manifold Assembly
PSNL	Pigging Skid Northern Lobe; used by PL1922 & PL1925, PL1923 & PL1926
PSSL	Pigging Skid Southern Lobe, also known as the Cavendish Subsea Pigging Skid. Used by PL1924 & PL1927, PL2430 & PLU2431
PTS	Permanent threshold shift
Q1, Q2, Q3, Q4	Quarter 1, Quarter 2, Quarter 3, or Quarter 4 of any given year
Remediation	For the purposes of this document remediation can mean one of, or a combination of the following: post-trenching, removal of exposures and spans, deposition of additional rock
Reportable span	A reportable span is a significant span which meets set criteria (FishSafe criteria) of height above the seabed and span length (10 m long x 0.8 m high)
Riser	Pipe that connects the pipeline to the topsides’ pipework
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCANS-III	Small Cetaceans in European Atlantic Waters and the North Sea III
Scour	Natural degradation of seabed in one area and its aggradation in another caused by local flow of seawater
SEI	Significant Environmental Impact
SFF	Scottish Fishermen’s Federation
SNS	Southern North Sea
SOSI	Seabird Oil Sensitivity Index
SPA	Special Protection Area
Span	Sometimes referred to as a ‘free-span’. Similar to an exposure except that the whole of the section of pipeline is visible above the seabed rather than just part of it. Once the height and length dimensions meet or exceed certain criteria the span becomes a reportable span
SSS	Side-Scan Sonar
STA	Subsea Tee Assembly
Te	Tonne(s)
Tee	Pipeline junction, usually includes a valve assembly as well as a protection structure
Template	Protection structure that typically contains wellheads, pipe manifolds, valves, and pipework
TGT	Theddlethorpe Gas Terminal (WGS84 Degrees: 53.362438° N .237783° E)
THC	Total Hydrocarbon Concentration
TFSW	Trans-Frontier Shipment of Waste

Abbreviation	Explanation
TOC	Total Organic Carbon
TOM	Total Organic Matter
µg	Microgram
UHB	Upheaval buckling
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	UK Hydrographic Office
UKOOA	UK Offshore Operators Association
Umbilical	Flexible pipeline manufactured of various materials including steel and plastics typically used to send electrical power, communication signals, chemicals and hydraulic fluid to a manifold or wellhead. An umbilical pipeline will include cables and tubes that are covered with an outer sheath to protect them from damage
V	Vanadium
VDP1	Viking Decommissioning Programme 1
VDP2	Viking Decommissioning Programme 2
VDP3	Viking Decommissioning Programme 3
WGS84	World Geodetic System 84 is the reference coordinate system used by the Global Positioning System
WHPS	Wellhead Protection Structure
Zn	Zinc

1 Executive Summary

1.1 Introduction and background

Chrysaor Production (U.K.) Limited (Chrysaor) operates three main gas areas in the Southern North Sea (SNS); Viking, the Lincolnshire Offshore Gas Gathering System (LOGGS) and the Caister Murdoch System (CMS; Figure 1.1.1).

Chrysaor Production (U.K.) Limited is a wholly owned subsidiary of Chrysaor Exploration and Production Limited, the parent company of which is Harbour Energy Plc. Chrysaor Production (U.K) Limited for simplicity is referred to as Chrysaor in this document.

The CMS area is made up of the following eight platforms: Caister CM; Murdoch MC, MD and MA; Boulton BM; Munro MH; Kelvin TM, and Katy KT and associated seabed infrastructure. The Murdoch Hub is located in United Kingdom Continental Shelf (UKCS) block 44/22a and comprises three bridge-linked platforms MA, MC, and MD.

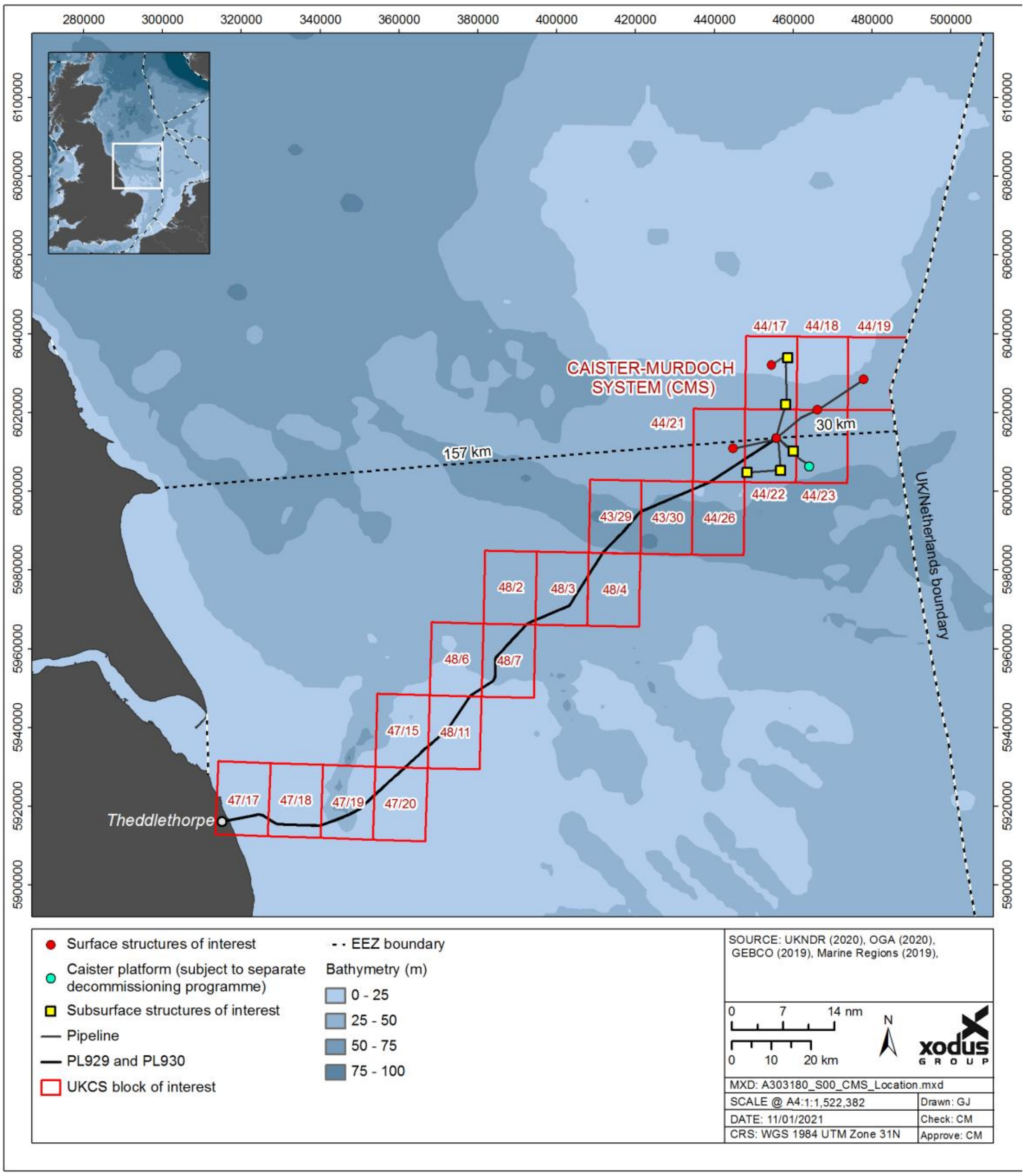


Figure 1.1.1: Location of the CMS

The Caister CM platform is part of a separate Decommissioning Programme (DP) (CDP1a) which has already been accepted by the regulator, along with its own EA; therefore, Caister CM is not within scope of this EA. Boulton BM, Munro MH, Kelvin TM and Katy KT are normally unmanned installations (NUIs). The subsea wells that are tied back to Murdoch include Murdoch K (KM) (44/22a), McAdam (MM) (44/17c), Hawksley (EM) (44/17a), Boulton H (HM) (44/22b) and Watt (QM) (44/22b).

This executive summary outlines the findings of the Environmental Appraisal (EA) conducted by Chrysaor in support of the proposed CMS decommissioning programme for the latter phases of the CMS decommissioning which will be supported by three decommissioning programmes, termed CDP1b, CDP2, and CDP3. A summary of the CMS infrastructure to be decommissioned within the context of this EA is given in Table 1.2.1.

1.2 Regulatory context

The Petroleum Act 1998 (as amended by the Energy Act 2008) governs the decommissioning of offshore oil and gas infrastructure, including pipelines, on the UKCS. The responsibility for ensuring compliance with the Petroleum Act 1998 rests with Department of Business, Energy and Industrial Strategy (BEIS), formerly the Department for Energy and Climate Change (DECC) and is managed through its regulatory body the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). OPRED is also the Competent Authority on decommissioning in the UK for OSPAR purposes and relevant legislation. The Petroleum Act requires the operator of an offshore installation or pipeline to submit a draft Decommissioning Programme for statutory and public consultation, and to obtain approval of the DP from the OPRED, part of BEIS, before initiating decommissioning work. The DP outlines in detail the infrastructure being decommissioned and the method by which the decommissioning will take place. Well decommissioning is determined under a different process to the DP, called the Well Operations Notification System.

Formal Environmental Impact Assessment (EIA) to support the DP is not explicitly required under existing UK legislation. However, the primary guidance for offshore decommissioning that was updated and published by OPRED in 2018 [2], detailed the need for an EA to be submitted in support of the DP. The guidance recognised that environmental deliverables to support DPs were overly lengthy and did not focus in on the key issues, and now describes a more proportionate EA process that culminates in a streamlined Environmental Appraisal Report which focuses on screening out of non-significant impacts and presents a detailed assessment of potentially significant impacts.

In terms of activities in the SNS, The East Inshore and East Offshore Marine Plans have been developed by the Department for Environment, Food and Rural Affairs (Defra) to help ensure sustainable development of the marine area. Although the Plans do not specifically address decommissioning of oil and gas, they do note the challenges that such activities can introduce. Chrysaor present this EA in alignment with the broader aims of the Plans.

Table 1.2.1: CMS infrastructure to be decommissioned

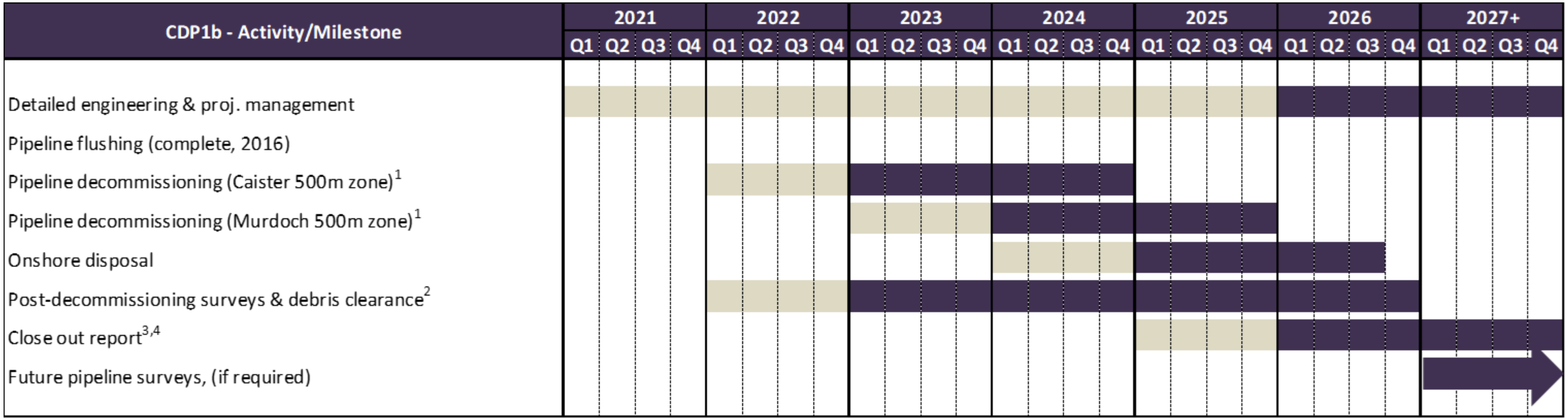
Surface installations			
Boulton BM, Katy KT, Kelvin TM, Munro MH, Murdoch MA, Murdoch MC, Murdoch MD			
Subsea installations			
Boulton HM, Hawksley EM, McAdam MM, Murdoch K.KM, Watt QM			
Subsea structures			
Katy Tee Protection Structure, Kelvin/Murdoch Pigging Skid, Kelvin PMA, Kelvin STA, McAdam Tee, Pigging Skid Northern Lobe (PSNL), Pigging Skid Southern Lobe (PSSL)			
Pipelines and umbilicals			
Pipeline ID	**Description**	**Diameter**	**Length (km)**
PL935	Gas Export Pipeline	16 in	11.188
PL936	MeOH import pipeline	3 in	10.692
PL1311[1]	Riser for PL1436 at Murdoch MD	10 in	0.075
PL1312[2]	Riser for PL1437 at Murdoch MD	3 in	0.072
PL1436	Gas pipeline	10 in	11.56
PL1437	MeOH pipeline	3 in	11.56
PL1922	Gas pipeline	10/12 in	21.62
PL1925	MeOH pipeline	3 in	21.53
PL1923	Gas pipeline	10 in	5.25
PL1926	MeOH pipeline	3 in	5.25
PL1924	Gas pipeline	10 in	16.76
PL1927	MeOH pipeline	3 in	16.85
PL2109	Gas pipeline	10 in	5.08
PL2110	MeOH pipeline	3 in	5.08
PL2430	Gas pipeline	12 in	12.67
PLU2431	MeOH pipeline	3 in	12.67
PL2894	Gas pipeline	10 in	14.19
PL2895	MeOH pipeline	2 in	14.19
PLU4685	Umbilical	108.5 mm	13.00
PLU4686	Umbilical	108.5 mm	9.20
PLU4888	Umbilical	82 mm	8.60
PLU4889	Umbilical	96 mm	8.71
PLU4890	Umbilical	82 mm	5.86
Pipeline ID	**Description**	**Diameter (inches)**	**Length (km)**
PL929	Gas Export Pipeline	26 in	179.64
PL930	Methanol Import Pipeline	4 in	179.58
Stabilisation and protection features			
A total of 749 mattresses to be removed (from an estimated 917) within the CMS (various types and sizes)			

[1] The PL1311 is the riser end section of the PL1436 at the Murdoch MD platform. While this riser has been itemised here and in CDP2, it has been assessed as part of the overall jacket removal therefore is not considered independently.
[2] The PL1312 is the riser end section of the PL1437 at the Murdoch MD platform. While this riser has been itemised here and in CDP2, it has been assessed as part of the overall jacket removal therefore is not considered independently.

1.3 Schedule

The precise timing of the decommissioning activities is not yet confirmed and will be subject to market availability of cost-effective removal services and contractual agreements. The high-level Gantt charts featured in Figure 1.3.1, Figure 1.3.2 and Figure 1.3.3 provides the overall schedule for the programme of decommissioning activities for the CMS according to each DP (CDP1b, CDP2 and CDP3).

Figure 1.3.1: Schedule of the CMS decommissioning (CDP1b)



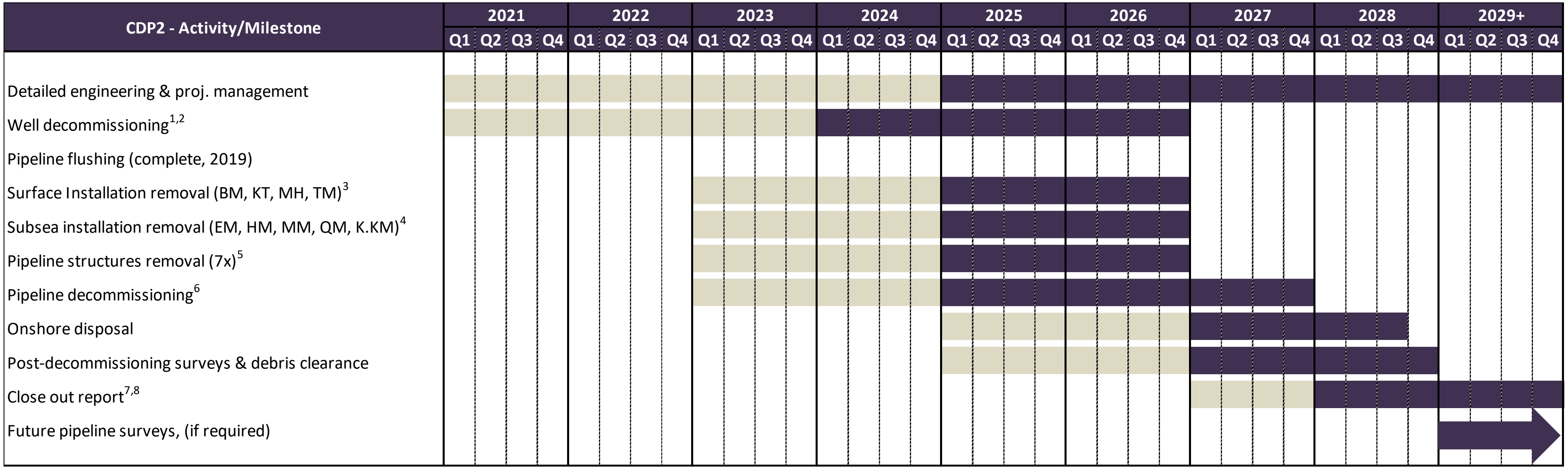
Notes / Key

Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

1. The pipelines were disconnected at Caister CM before the platform and its template were removed in May-June 2020; The pipelines are to be disconnected from Murdoch MD in 2021;
2. Post decommissioning survey at Murdoch will likely be completed as part of a wider campaign with CDP3 scope;
3. The close out report will be prepared on completion of offshore activities. It will contain results of environmental suveys, debris survey (identification/removal) and clear seabed verification survey;
4. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

Figure 1.3.2: Schedule of the CMS decommissioning (CDP2)



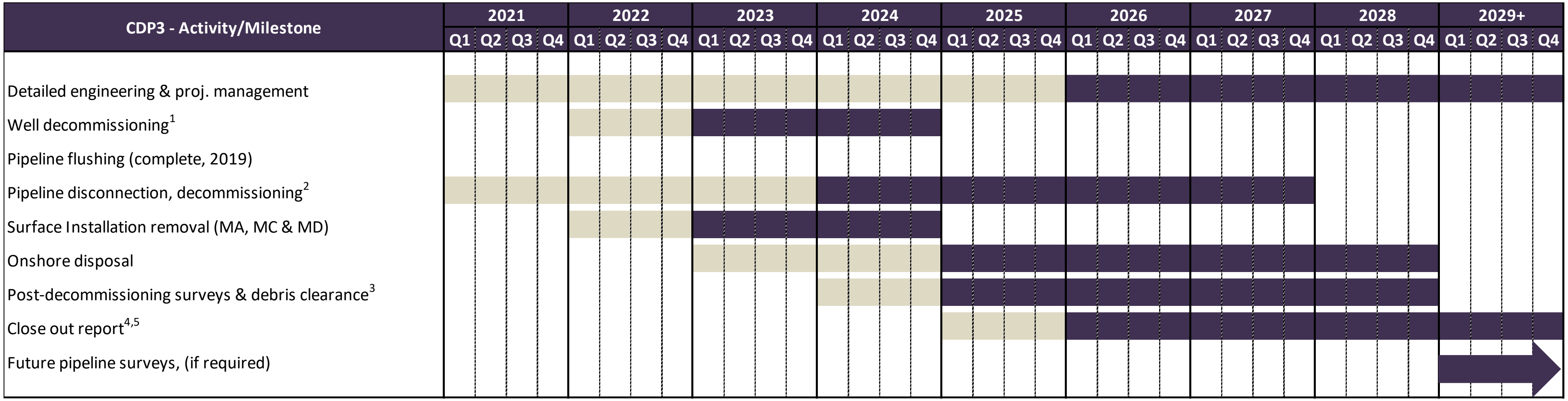
Notes / Key

Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

1. Well decommissioning. Hawksley EM & Watt QM complete. McAdam MM wells partly decommissioned (AB2) in 2019; Boulton HM wells to be partly decommissioned (AB2) in 2021; Murdoch K.KM wells to be partially decommissioned (AB2) in 2022. The decommissioning of the MM, HM and K.KM wells will be completed when the well conductors are removed during the same campaign as removal of the respective subsea installations. The dates quoted here are the earliest dates
2. Decommissioning of the surface installation wells is schedules for 2022-2023; the conductors may need to be removed along as part of the removal campaign for the installations;
3. The surface installations include Boulton BM, Katy KT, Munro MH, Kelvin TM;
4. The subsea installations include Bouton HM, Hawksley EM, McAdam MM, Murdoch K.KM, Watt QM;
5. The pipeline structures include Katy Tee, Kelvin-Murdoch Subsea Pigging Skid, Kelvin Pigging Manifold Assembly, Kelvin Subsea Tee Assembly, McAdam Tee, Pigging Skid Northern Lobe, Pigging Skid Southern Lobe;
6. The pipelines are already disconnected from the surface satellite installations;
7. The close out report will be prepared on completion of offshore activities. It will contain results of environmental surveys, debris survey (identification/removal) and clear seabed verification survey;
8. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

Figure 1.3.3: Schedule of the CMS decommissioning (CDP3)



<u>Notes / Key</u>

Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

1. The wells have already been partially decommissioned (AB2). The intention is that the conductors are removed in the same campaign as removal of the MD installation;
2. The pipelines will be disconnected from Murdoch MA and Murdoch MD earliest in 2021 but prior to removal of the installations; pipeline decommissioning may be carried out as part of a wider subsea decommissioning campaign associated with CDP2;
3. Post decommissioning debris clearance within Murdoch 500m zone will be timed to coincide with execution of the scope of work associated with CDP2;
4. The close out report will be prepared on completion of offshore activities. It will contain results of environmental suveys, debris survey (identification/removal) and clear seabed verification survey;
5. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

1.4 Selected decommissioning options

Options to re-use the CMS installations *in situ* for future hydrocarbon developments have been considered, but to date none have yielded a viable commercial opportunity. This has primarily been due to limited remaining hydrocarbon reserves and design life of the infrastructure. However, the PL929 export pipeline has been preserved should an opportunity for re-use present itself in the future.

As per the guidance, all surface and subsea structures will be fully removed.

The decommissioning methods for the associated flushed and cleaned pipeline infrastructure were assessed against each other in a Comparative Assessment (CA) which looked at a number of full removal, partial removal and decommission *in situ* options. The mattresses within the CMS were also taken through a CA process. To facilitate the CA, the pipeline portfolio was split into groups of lines with similar characteristics. The emerging recommendation for each group was as follows:

Group 1: PL929, PL930, PL935 and PL936

The recommendation from the CA is to decommission the Group 1 pipelines *in situ*, without remediation along the length. Surface laid and end sections of pipeline, pipeline spools and the associated overlying mattresses will be removed, and the cut ends will be remediated as appropriate. The CA evaluates the fate of the trunkline should re-use of the infrastructure be deemed unviable.

Group 2: PL1436 & PL1437, PL1922 & PL1925, PL1923 & PL1926, PL1924 & PL1927, PL2109 & PL2110, PL2430 & PLU2431, and PL2894 & PL2895

The recommendation from the CA is to decommission most of the Group 2 pipelines *in situ*, without remediation along the length. Surface laid and end sections of pipeline, pipeline spools and the associated overlying mattresses will be removed, and the cut ends will be remediated as appropriate. The PL2109 and PL2110 are the exception, having been selected for partial removal. As the first 1.5 km of these pipelines have been prone to exposures, these initial sections will be removed.

Group 3: PLU4686 & PLU4685, PLU4889 & PLU4888 and PLU4890

The recommendation from the CA is to decommission most of the Group 3 pipelines *in situ*, without remediation along the length. Surface laid and end sections of pipeline, pipeline spools and the associated overlying mattresses will be removed, and the cut ends will be remediated as appropriate. The single PLU4685 will be partially removed through cut and lift to remove a short exposed length.

The CA also addressed the mattresses within the CMS. The recommendation of the CA was to recover 749 of the mattresses within the CMS, out of a total 917 as a number are associated with third-party infrastructure/crossings. There are an estimated 3,500 grout bags within the CMS area; the intention is for all visible grout bags to be fully removed.

1.5 Environmental and societal sensitivities

The key environmental and societal sensitivities in the project area are summarised in Table 1.5.1.

Table 1.5.1: Environmental and Societal Sensitivities

Conservation Interests and Sites
Only two ocean quahog *Arctica islandica* individuals were observed across two separate survey areas and years. At one single survey location, faunal burrows were observed at a density which could be indicative of the OSPAR listed habitat 'seapens and burrowing megafauna community'; however, the burrows cannot be confidently attributed to any of the 'megafauna' species associated with the habitat. 21 individuals of *Sabellaria spinulosa*, the Ross worm and reef building polychaete, were identified in one sample taken at the Murdoch Hub. A 968 m stretch of *S. spinulosa* reef was identified in 2006 along the PL929/PL930 close to shore, and three smaller patches (≤2 m long) were observed along the PL935/PL936 within the main CMS area. Cod *Gadus morhua* are an OSPAR listed species and use the project area as a nursery and for spawning. The CMS is partly located within the Dogger Bank Special Area of Conservation (SAC) and the Southern North Sea SAC, which are protected for sandbank features and harbour porpoise respectively. The associated PL929 and PL930 to shore intersect a further three protected sites: Inner Dowsing and Race

Bank SAC (protected for sandbanks and reefs); Greater Wash Special Protection Area (SPA) and Humber Estuary SPA (both of which are designated for a number of bird species).

Conservation Species

Harbour porpoise, minke whale, white-beaked dolphin, and long-finned pilot whale have all been observed within the vicinity of the project. For all species but harbour porpoise, they are found in relatively low numbers in the CMS or have low abundance estimates. Harbour porpoise are common in the SNS and frequent the area throughout much of the year. They are thought to be found in the area at a density of 0.888 animals/km^2 which is relatively high compared to other areas of the North Sea. All of the cetacean species are both European Protected Species (EPS) and are covered by the UK Biodiversity Action Plan (UK BAP).

Both grey and harbour seal densities are relatively low offshore in the CMS area. However, where the PL929 and PL930 arrive at the shore seal density is much higher, particularly for grey seals. Grey seals use the Humber Estuary SAC in autumn to form large breeding colonies. Comparatively, harbour seals use the Wash and North Norfolk Coast SAC (~27 km south of the TGT) for breeding and hauling-out. Both pinniped species are Annex II listed.

Benthic Environment

The CMS is located in an area of sandy seabed consistent with the environment of the Dogger Bank. The seabed at the CMS is predominantly a mix of EUNIS A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand and A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand. The seabed sediments remain relatively consistent along the pipelines to shore.

Total Hydrocarbon (THC) concentrations were below the Significant Environmental Impact (SEI) threshold across the CMS, and there is no evidence of drilling related hydrocarbon contamination. Reported Polycyclic Aromatic Hydrocarbon (PAH) concentrations were in line with levels typical of the wider SNS. Polychlorinated biphenyl (PCB) levels were below Limit of Detection (LOD). All detectable concentrations of heavy metals were above their respective OSPAR (2005) Background Concentrations (BCs). However, this is to be expected due to the heavily industrialised nature of the SNS.

Spatangoida (juveniles; the order of heart urchins) and *Spipohanes bombyx*, a polychaete, featured across the CMS. Juvenile *Spatangoida* dominated the benthos by number at almost every location however, when assessing the adult-only populations, the dominant taxa were more variable. Generally, Annelida (Polychaeta) were the dominant group, with the exception of the species at Katy KT, where Mollusca were the dominant group.

Fish

The CMS is located within an area of high intensity spawning for plaice and sandeel. The following species are also known to use the area for spawning: cod, herring, mackerel, *Nephrops*, sole, sprat, and whiting. Additionally, the following species use the area as nursery grounds: anglerfish, blue whiting, cod, European hake, herring, ling, mackerel, *Nephrops*, sandeel, spurdog, sprat, and tope shark. Whiting use the area as a high intensity nursery.

The probability of juvenile fish aggregations occurring is the CMS is low for: plaice, sole, hake, anglerfish, blue whiting, Norway pout, mackerel, haddock, and cod. The probability of juvenile herring, horse mackerel, sprat, and whiting being present in the CMS area is low-moderate.

Seabirds

The following species are present in the CMS area across the majority of the year: northern fulmar, northern gannet, great black-backed gull, black-headed gull, common gull, herring gull, Atlantic puffin, black-legged kittiwake, common guillemot, razorbill, little auk, and lesser black-backed gull.

Seabird sensitivity to oil (according to the Seabird Oil Sensitivity Index) is low throughout the year and highest in July and between November and January (Blocks 44/21, 44/22, 44/23, 44/17, 44/18, 44/19). Sensitivity is variable along the pipelines to shore but on average, is higher than offshore at the CMS. Block 48/2, approximately half-way along the PL929 and PL930, is high, very high, or extremely high every month of the year. In the Blocks nearest to the coast (47/17, 47/18) sensitivity is highest between October and December, and in March.

Commercial Fishing

The CMS area is located in International Council for the Exploration of the Seas (ICES) statistical rectangle 37F2. The associated PL929 and PL930 pass through rectangles 37F1, 36F1, 36F0, and 35F0. Fisheries

landings vary throughout the project area. At the CMS area in 2019, catch was mostly demersal and was relatively low compared to other rectangles. Closer to shore shellfish make up the majority of landings the value of which was very high; in rectangles 36F1, 36F0 and 35F0 closest to shore the value of catch was >£1,000,000 every year from 2015 onwards. Commercial fishing effort was also highest in rectangle 36F0 (2,344 days in 2019). This effort is consistently high across all months excluding January, February, November and December when effort is moderate. Effort is much lower around the CMS (rectangle 37F2). Fishing effort in other rectangles is comparatively low (<100 days per month).
Other Users
The CMS is located in a mature area of the SNS with extensive oil and gas development. There are ten oil and gas surface structures within 50 km of the project, the closest being 20.1 km away. Shipping in the project area is variable; closest to shore Blocks 47/18, 47/19, 47/20, 47/15, experience very high shipping activity, due to their proximity to the Humber Estuary. In the CMS area shipping is moderate (in Blocks 44/22 and 44/23) to high (Blocks 44/17, 44/18 and 44/19). Two telecom cables come within 1 km of the Murdoch platform (TAMPNET Norsea Com 1 and MCCS). The PL929 and PL930 do not cross any third-party telecom cables. However, as there is much renewable energy activity in the area, the pipelines to shore do cross the Hornsea 1 active export cable. Furthermore, the PL929 and PL930 pass through the Hornsea 2 area for ~25 km, and through the Triton Knoll windfarm area which is currently under construction. The Race Bank windfarm (and proposed extension), and the Lincs windfarm are also both located within 15 km of the PL929/PL930. Blocks 47/18, 47/19, 47/20, 47/15, 43/29, 43/30, and 44/26 are of concern to the Ministry of Defence (MoD) as they lie within training ranges. Additionally, Block 47/17, in which the PL929 and PL930 terminate at the shore, has been excluded from consideration of granting development licenses at the request of the MoD. There are seven non-dangerous wrecks within 20 km of Murdoch. There is a single dangerous wreck 18 km from Murdoch. There are no designated historical wrecks recorded in the area.

1.6 Impact assessment

This EA Report has been prepared in line with the OPRED Decommissioning Guidelines and with Decom North Sea's EA Guidelines for Offshore Oil and Gas Decommissioning. The OPRED Decommissioning Guidance states that an EA in support of a DP should be focused on the key issues related to the specific activities proposed; and that the impact assessment write-up should be proportionate to the scale of the project and to the environmental sensitivities of the project area.

The EA has been informed by several different processes, including the identification of potential environmental issues through project engineer and marine environmental specialist review in an Environmental Identification (ENVID) screening workshop and consultation with key stakeholders.

The impact assessment screening identified ten potential impact areas based on the proposed CMS decommissioning activities:

- Atmospheric emissions;
- Seabed disturbance;
- Physical presence of infrastructure decommissioned *in situ*;
- Physical presence of vessels in relation to other sea users;
- Underwater noise;
- Discharges to sea;
- Resource use;
- Waste;
- Disturbance to nesting seabird; and,
- Accidental events

Of these, the following three were screened in and taken forward for assessment based on the potential severity and/or likelihood of their respective environmental impact: seabed disturbance; physical presence of infrastructure decommissioned *in situ*; disturbance to nesting seabirds; and underwater noise.

Disturbance to seabed was investigated further for potential impacts due to the nature of the proposed activities and the location of the CMS within the Dogger Bank SAC, designated for seabed features.

The removal of structures associated with the CMS and the disturbance these processes generate is expected to temporarily impact an area of 0.0926 km^2. Permanent disturbance due to rock placement will affect approximately 0.0026 km^2. Overall, these areas are small in the context of the wider SNS and compared to the area of the Dogger Bank SAC; 0.0006% of the Dogger Bank SAC is expected to be affected due to the decommissioning. Taxa known to inhabit the CMS area are likely to be able to tolerate secondary disturbance and the community will be able to recover and recolonise any areas disturbed, or any newly added substrate. Overall, when considering the spatial and temporal scale of the disturbance, and accounting for the following mitigation measures, the impact of the decommissioning on the seabed was considered **not significant**.

- Cutting and lifting operations will be controlled by a remotely operated vehicle (ROV) to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment;
- The requirements for further excavation will be assessed on a case-by-case basis and will be minimised to provide access only where necessary. Internal cutting will be used preferentially where access is available;
- Heavy lift vessels are most likely to be equipped with dynamic positioning (DP) rather than relying on anchors to remain in position which interact with the seabed.
- The rock mass will be carefully placed over the designated areas of the pipelines and seabed by the use of an ROV. This will control the profile of the rock covering and accurate placement of rock over the pipeline and on the seabed to ensure rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance;
- The *in situ* decommissioning of the existing rock stabilisation will prevent the need for additional rock placement as support on pipelines to be decommissioned *in situ*;
- The profile of the rock-placement over the pipeline ends will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear;
- Survey data collected in the area will be reviewed for potential sensitive seabed habitats prior to the commencement of operations; and
- Post decommissioning debris clearance, surveys and monitoring shall be carried out using non-intrusive methodologies such as side scan sonar, using ROVs etc.

Physical presence of infrastructure decommissioned *in situ* was investigated as a potential impact on commercial fisheries. Of key importance was understanding the utilisation of the CMS areas for commercial fisheries purposes and the risk that infrastructure decommissioned *in situ* may pose as a gear snagging risk. Also addressed was the potential for seabed depressions (either existing or which may be generated through the decommissioning) to present a snag risk.

The presence of trawling within the vicinity of the CMS pipelines is mostly concentrated to a few pipelines within the CMS and does not coincide with any known areas of exposure. The CA outcome has determined certain pipelines should be partially removed in order to minimise the snag risk their exposures present. There are only two reportable spans associated with the PL929/PL930 trunkline. These areas do not coincide with areas of high intensity trawling activity. Furthermore, due to the nature of the highly mobile sediments of the SNS, it is likely that seabed depressions will be naturally back-filled over time. Owing to the improbability of a snagging event occurring, and in consideration with the following mitigation measures, it has been concluded that the impact of the physical presence of infrastructure decommissioned *in situ* on commercial fisheries is **not significant**.

- The CMS subsea infrastructure is currently shown on Admiralty Charts and the FishSafe system. Once decommissioning activities are complete, updated information on the CMS subsea area (i.e. which infrastructure remains *in situ* and which has been removed) will be made available to allow the Admiralty Charts and the FishSafe system to be updated;
- The pipelines will be decommissioned *in situ*;

- Any exposed/cut pipeline/umbilical ends will undergo remediation, as appropriate, to ensure they are overtrawlable to fishing gear. Remediation may entail rock placement or burial of ends using sediment;
- Evaluation of post-decommissioning surveys will identify the requirement for remediation of depressions generated through dredging around piles, although metocean conditions are likely to be sufficient to naturally backfill any such depressions;
- Any objects dropped during decommissioning activities or any existing debris identified will be removed from the seabed where appropriate;
- An appropriate vessel will be engaged to carry out survey work within the 500 m safety exclusion zones to evaluate any potential snagging risks. Decommissioning activities will be considered to be complete subject to certification of seabed clearance and acceptance of the Decommissioning Close-out Report by OPRED. The existing 500 m safety exclusion zones will then be removed; and
- Chrysaor recognises its commitment to monitor any infrastructure decommissioned *in situ* and therefore intends to set up arrangements to undertake post-decommissioning monitoring on behalf of the Licence Owners. The frequency of the monitoring will be agreed with OPRED and future monitoring will be determined through a risk-based approach based on the findings from each subsequent survey. A monitoring strategy will be proposed in the decommissioning close out report. During the period over which monitoring is required, the status of the infrastructure decommissioned *in situ* would be reviewed and any necessary remedial action undertaken to ensure it does not pose a risk to other sea users.

Underwater noise was assessed specifically owing to the presence of much of the CMS within the Southern North Sea SAC, designated for harbour porpoise. Of particular interest was the potential for noise generation due to cutting activities and vessel presence within the SAC, and any consequent injury or disturbance to marine mammals in the area.

Noise emissions generated by the decommissioning are expected to be sufficiently low that injury will not occur from any of the activities. With regards to disturbance, potential zones of avoidance around vessels or cutting activities are not predicted to extend beyond approximately 100 m. On this basis that the impact will be transitory, highly localised and largely undetectable against natural variation, the impact of underwater noise on marine mammals is considered **not significant**.

On the basis of the expected noise emissions, there is no requirement to adopt additional mitigation to limited potential for impact. However, there are control measures built into the project that will ensure noise emissions are not greater than would be required to execute the decommissioning activities. For example, machinery and equipment will be well-maintained and the number of vessels will be minimised as far as possible.

Disturbance to nesting seabirds was scoped in owing to the presence of seabird nests on two of the CMS platforms. Legislative expectations and requirements determine the protection of wild birds, their eggs and nests in the offshore marine area, including offshore marine installations. Future surveys are proposed by Chrysaor and will be conducted prior to the commencement of decommissioning activities early in the breeding season (during Q2), the results of which will indicate bird presence/absence thereby informing subsequent mitigations and discussions with OPRED. Chrysaor will, in their bird management strategy, outline any proposed methods of deterrence. Disturbance of nesting seabirds is only anticipated if the aforementioned deterrence methods should fail. The overall impact of decommissioning activities on nesting seabirds is currently considered **not significant** and should this outcome change in the wake of future survey effort, this will be communicated to OPRED.

1.7 Conclusion

This EA has considered the relevant Marine Plans, adopted by the UK Government to help ensure sustainable development of the marine area. Chrysaor consider that the proposed decommissioning activities are in alignment with its objectives and policies.

Having reviewed the project activities within the wider regional context and taking into consideration the mitigation measures to limit any potential impacts, the findings of this EA conclude that the activities do not pose any significant threat to environmental or societal receptors within the UKCS.

2 Introduction

2.1 Background

Chrysaor Production (U.K.) Limited operates three main gas areas in the Southern North Sea (SNS); Viking, the Lincolnshire Offshore Gas Gathering System (LOGGS) and the Caister Murdoch System (CMS). Chrysaor is making progress through a ten-year decommissioning project covering these facilities, an ongoing project which began with well decommissioning activities in 2014.

Chrysaor Production (U.K.) Limited is a wholly owned subsidiary of Chrysaor Exploration and Production Limited, the parent company of which is Harbour Energy Plc. Chrysaor Production (U.K) Limited for simplicity is referred to as Chrysaor in this document.

2.2 Overview of the Caister Murdoch System

The Caister Murdoch System is located in the SNS in Quadrant 44 of the United Kingdom Continental Shelf (UKCS). The CMS area is made up of the following eight platforms: Caister CM; Murdoch MC, MD and MA; Boulton BM; Munro MH; Kelvin TM, and Katy KT. The Murdoch Hub is located in UKCS block 44/22a and comprises three bridge-linked platforms MA, MC, and MD. MA accommodated personnel during operations, with MA and MD providing electrohydraulic power for the umbilicals. Murdoch MD received gas and exported it to Theddlethorpe Gas Terminal (TGT) via the 26” trunk gas pipeline PL929. Methanol was exported to the CMS via PL930, the 4” methanol pipeline originating from TGT which ties into Murdoch MD and was distributed to the various satellites. MD was built and installed in 1993, MC was built and installed in 1996 and MA was built and installed in 2002. Initial production was achieved 1993 with fields being added up until 2013. Production ceased in 2018. The location of the CMS infrastructure is shown in Figure 2.3.1.

The Caister CM platform is part of a separate DP [1] which has already been accepted by the regulator, along with its own EA; therefore, Caister CM is not within the scope of this EA. However, the pipelines associated with this installation are covered herein. Boulton BM, Munro MH, Kelvin TM and Katy KT are normally unmanned installations (NUIs). The subsea wells that are tied back to Murdoch include Murdoch K (KM) (44/22a), McAdam (MM) (44/17c), Hawksley (EM) (44/17a), Boulton H (HM) (44/22b) and Watt (QM) (44/22b). Collectively this is known as the Caister Murdoch System.

Pipelines from other installations (e.g. Cavendish RM, Hunter HK, Rita RH, Ketch KA, and Schooner SA) are also tied into Murdoch, but these are subject to other Decommissioning Programmes (DPs) and are therefore out of scope.

Figure 2.3.2 is a schematic overview of the CMS area. Items in green are under operatorship of Chrysaor, those in red are third party infrastructure. As of July 2021, the four NUIs (Boulton BM, Munro MH, Kelvin TM and Katy KT) are in warm suspension awaiting well and topside decommissioning. The three platforms forming the Murdoch Hub achieved cold suspension in 2020. The term 'cold suspension' indicates that the facilities are hydrocarbon free (topsides depressurised, freed of residual hydrocarbons and pipelines flooded) and the wells have been permanently isolated from hydrocarbon bearing reservoir/s. 'Warm suspension' indicates that the platform has suspended production operations but is still exposed to hydrocarbons either from topsides facilities or from both the topsides facilities and unplugged wells.

2.3 Learning from previous Southern North Sea decommissioning

The CMS decommissioning activities are the third major set of decommissioning works within Chrysaor’s wider decommissioning plans for the SNS. The activities proposed herein, and the assessment that has been undertaken, have incorporated learnings from Chrysaor’s other SNS decommissioning activities and from wider decommissioning activities in the North Sea. Following initial decommissioning activities approved under VDP1, VDP2, VDP3 and LDP1-LDP5, Chrysaor has conducted further design work, including efficient management of rock remediation and placement of the accommodation work vessel (AWV) on the basis of review of the site-specific survey data, which minimises the need for additional stabilisation material at these locations. This has significantly reduced the quantity of rock required for stabilisation of the AWV, and therefore the potential environmental impact. A number of SNS decommissioning campaigns are currently under way and, once they conclude, Chrysaor will endeavour to incorporate any lessons learned into future activities. Chrysaor will continue to investigate the possibility of streamlining operations to further reduce potential environmental impact as planning for the decommissioning activities progresses.

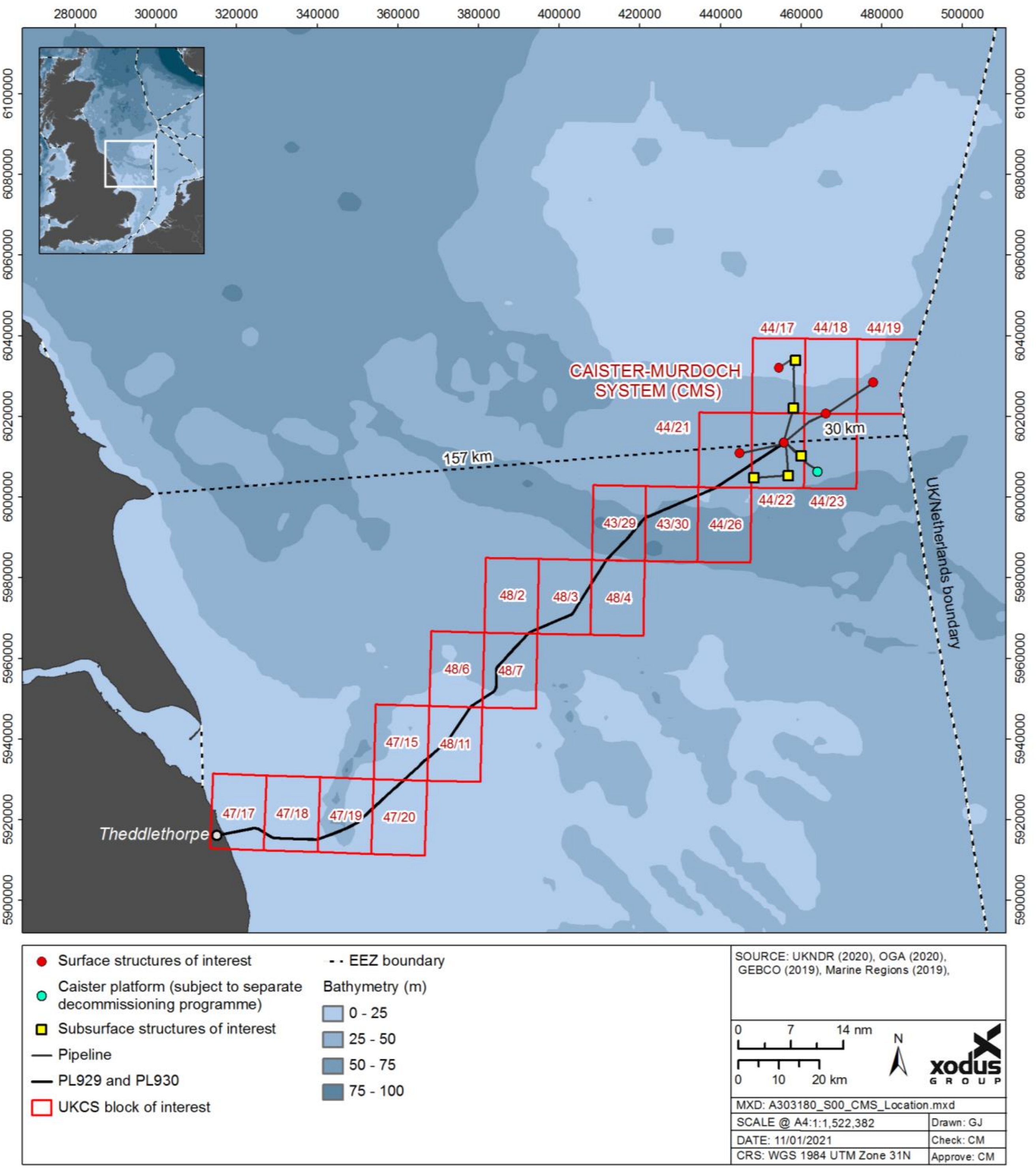


Figure 2.3.1: Location of the CMS infrastructure in the SNS

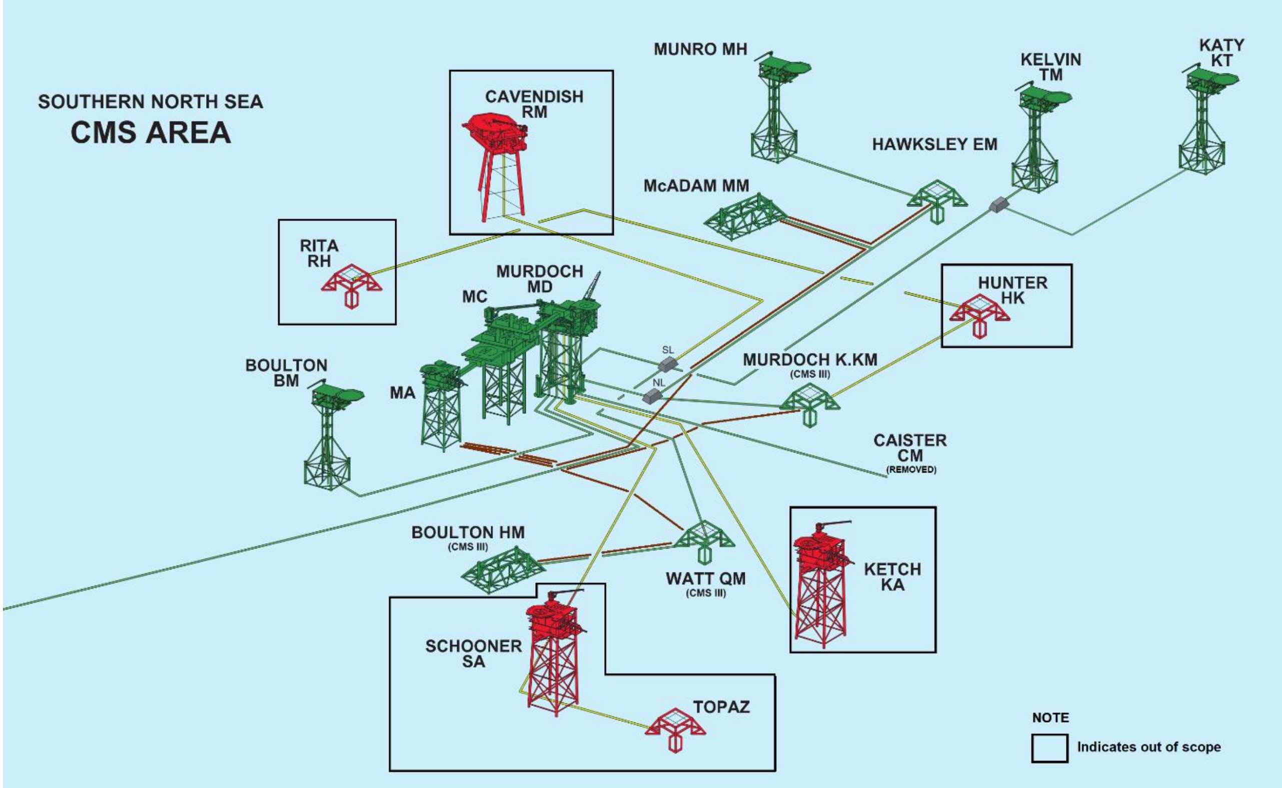


Figure 2.3.2: Schematic of the CMS area

2.4 Regulatory context

The Petroleum Act 1998 (as amended by the Energy Act 2008) governs the decommissioning of offshore oil and gas infrastructure, including pipelines, on the United Kingdom Continental Shelf (UKCS). The responsibility for ensuring compliance with the Petroleum Act 1998 rests with Department of Business, Energy and Industrial Strategy (BEIS), formerly the Department for Energy and Climate Change (DECC) and is managed through its regulatory body the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). OPRED is also the Competent Authority on decommissioning in the UK for OSPAR purposes and relevant legislation. The Petroleum Act requires the operator of an offshore installation or pipeline to submit a draft Decommissioning Programme for statutory and public consultation, and to obtain approval of the Decommissioning Programme from the Secretary of State, deferring to OPRED, part of BEIS, before initiating decommissioning work. The Decommissioning Programme outlines in detail the infrastructure being decommissioned and the method by which the decommissioning will take place. Well decommissioning is determined under a different process to the Decommissioning Programme, called the Well Operations Notification System.

Formal Environmental Impact Assessment (EIA) to support the Decommissioning Programme is not explicitly required under existing UK legislation. However, the primary guidance for offshore decommissioning that was updated and published by BEIS in 2018 [2], detailed the need for an EA to be submitted in support of the DP. The guidance recognised that environmental deliverables to support DP were overly lengthy and did not focus in on the key issues, and now describes a more proportionate EA process that culminates in a streamlined Environmental Appraisal Report which focuses on screening out of non-significant impacts and presents a detailed assessment of potentially significant impacts. The EA has been written in light of the BEIS 2018 [2] guidance and the 2018 Decom North Sea EA guidance [3].

In terms of activities in the SNS, The East Inshore and East Offshore Marine Plans have been developed by the Department for Environment, Food and Rural Affairs (Defra) to help ensure sustainable development of the marine area. Although the Plans do not specifically address decommissioning of oil and gas, they do note the challenges that such activities can introduce. As part of the conclusions to this assessment (Section 6), Chrysaor has considered the broader aims of the Plans and made a statement on alignment with the aims.

2.5 Scope of the Environmental Appraisal

The CMS area has been assessed within this EA as a single package because decommissioning timings coincide and the decommissioning recommendations are applicable to the full scope because all CMS assets are in the same environmental setting. However, for the purposes of planning the decommissioning activities, the CMS area has been divided into three DPs at the request of OPRED to simplify decommissioning programme submissions for the regulator and align with the progression of decommissioning works.

The decommissioning of Caister is close to completion with the platform having been removed in 2020 and the Murdoch platforms are currently unmanned and awaiting removal. The rest of the platforms require further works to achieve cold suspension ahead of removal. The three DPs cover the following:

- CDP1b: Caister pipelines [4]
- CDP2: CMS (excluding the Murdoch Hub and Caister CM) [5]
- CDP3: Murdoch Hub [6]

This EA supports the decommissioning activities associated with the above CMS DPs, for which further information is given in the following sections.

2.6 Environmental Appraisal approach

2.6.1 Stakeholder engagement

Engagement with stakeholders is an important part of the decommissioning process as it enables the issues and concerns of stakeholders to be incorporated into the EA and presented within the DPs, where applicable, and acted upon during the subsequent planning and implementation stages of the project.

Informal responses received to date from stakeholders have been incorporated into the DPs. Formal stakeholder consultation will begin with the submission of the draft DPs, supported by this EA report, to OPRED.

2.6.2 Environmental Appraisal process

In order to evaluate the potential environmental impact of the proposed DP on the environment an EA process is conducted in accordance with the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020. This EA documents the results of the EA process and is used to communicate the process. An overview of the EA process is provided in Figure 2.6.1. A full description of the process is available in Appendix 1.

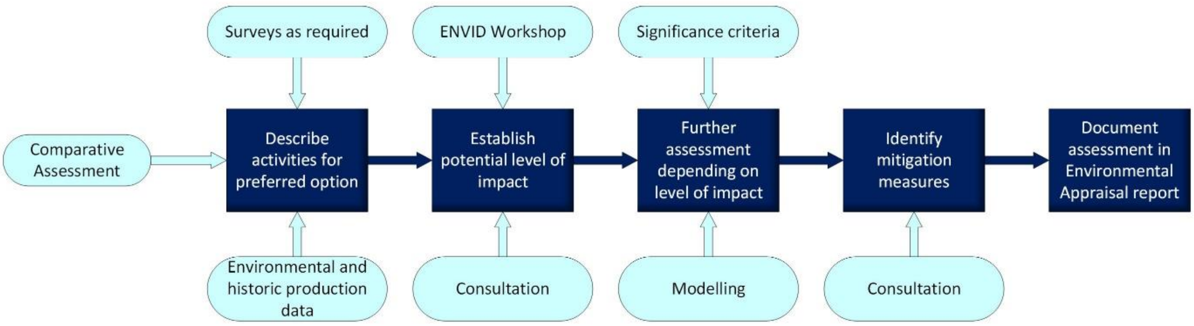


Figure 2.6.1: EA process

3 Project Description

This section outlines the infrastructure being decommissioned as part of the CMS project (covered by this EA), and described the manner in which the assets will be removed (surface and subsea installations, pipeline stabilisation and protection features and pipeline structures) and decommissioned *in situ* (pipelines).

3.1 Description of facilities

The infrastructure associated with the CMS has been grouped into four DPs (CDP1a, CDP1b, CDP2 and CDP3). This EA covers the following DPs: CDP1b, CDP2 and CDP3 [4][5][6]. CDP1a has already been accepted by the regulator and therefore is not covered by this EA. The subsequent sections outline the infrastructure that is to be decommissioned as part of each DP. A more detailed layout of the CMS infrastructure is in Figure 3.1.1. All third party infrastructure is shown in red.

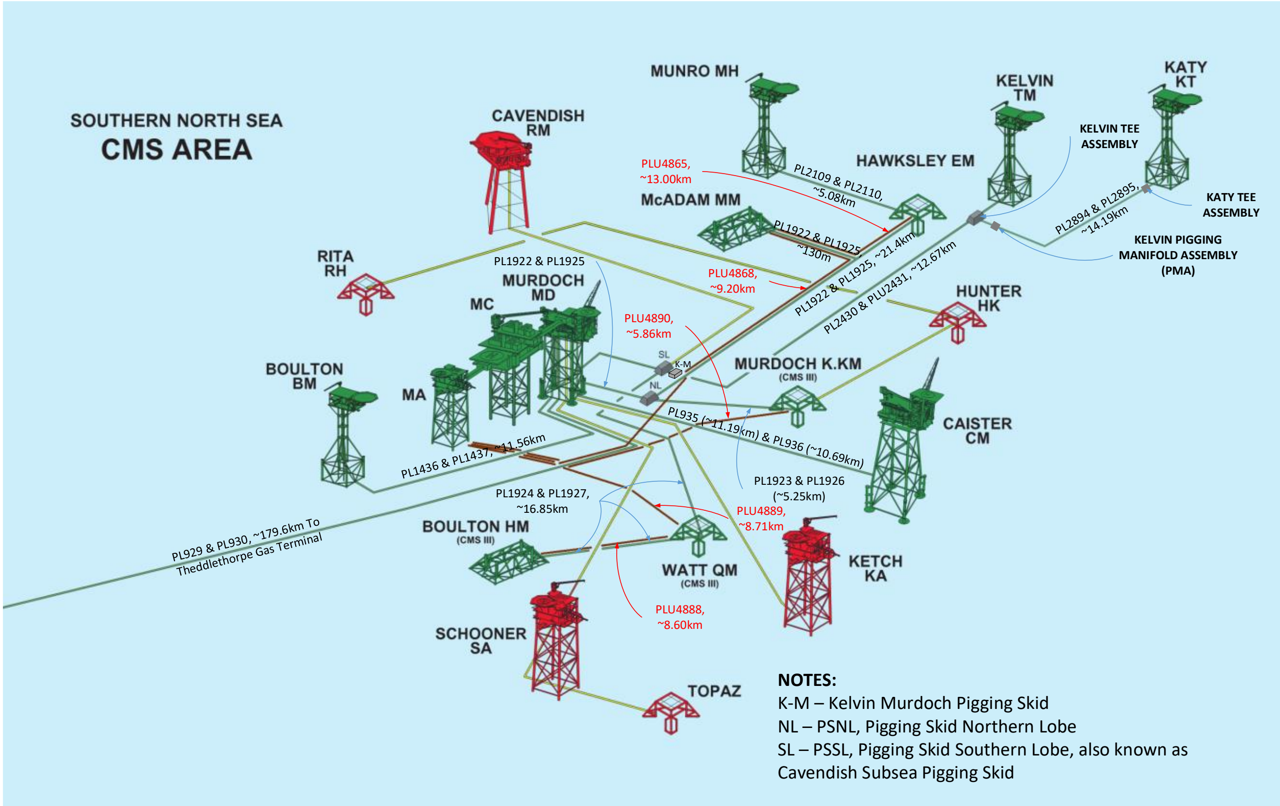


Figure 3.1.1: Detailed overview of CMS infrastructure[3]

3.1.1 Surface installations

The Murdoch Hub consists of three adjacent jacket facilities for accommodation, compression, and wellheads, creating three independent platforms designated MA, MC, and MD. The MC platform is linked to the MD platform by a 37 m bridge at main deck level. MA platform is linked to the MC platform by a 45 m bridge, connecting the mezzanine deck on MC to Level 1 of MA. The Murdoch Hub is based on three separate four leg vertical structures with horizontal bracing systems. The jackets are fixed to the seabed using piles. Above the jackets, vertical structural members support the topside modules and decking. The major decking on MD and MC consists of an under-deck, Cellar Deck, Main Deck and Helideck, some areas have mezzanine or intermediate deck levels. There are four levels and a helideck on MA. Images of all the surface installations within the CMS are available in Appendix 1.

[3] Please note, as in Figure 2.3.2, the Caister CM installation (as covered by CDP1) has already been removed and is not within scope of this EA.

The surface installations that are tied back to Murdoch MD include Boulton BM, Caister CM, Katy KT, Kelvin TM, and Munro MH. Of these, Boulton BM, Katy KT, Kelvin TM and Munro MH are summarised in Table 3.1.1. Caister CM was subject to a separate DP (CDP1a) [1] and is not within the scope of this EA. A full inventory, including additional details and location coordinates of the items is available in Appendix 3.

Table 3.1.1: Surface installations

Name	DP	Facility Type	Topsides / Facilities		Jacket		
			Mass (Te)	No of modules	Mass (Te)[4]	No of Legs, Piles	Mass of piles (Te)
Boulton BM	CDP2	Wellhead platform	351.0	1	605.1	4, 4	202.7
Katy KT	CDP2	Wellhead platform	353.5	1	580.6	3, 3	251.7
Kelvin TM	CDP2	Wellhead platform	288.6	1	483.6	3, 3	213.1
Munro MH	CDP2	Wellhead platform	210.9	1	384.9	3, 3	165.3
Murdoch MA	CDP3	Fixed Steel Jacket	835.3	1	672.9	4, 4	340.0
Murdoch MC	CDP3	Fixed Steel Jacket	4,393.3	1	1,217.6	4, 4	474.4
Murdoch MD	CDP3	Fixed Steel Jacket	2,256.5	1	2,089.6	4, 4	817.7

3.1.2 Subsea installations

The CMS subsea installations comprise either single or dual slot wellhead protection structures that are all controlled using an umbilical that is tied back to Murdoch MA and they include Boulton HM, Hawksley EM, McAdam MM, Murdoch K.KM and Watt QM, a summary of the subsea installations and stabilisation features can be seen in Table 3.1.2. Additional details are available in Appendix 3.

Table 3.1.2: Subsea installations

Subsea Installations / Stabilisation Features	DP	Number	Size (m) / Mass (Te)
Boulton HM	CDP2	1	16.0 x 10.2 x 5.0
			118.4
Hawksley EM	CDP2	1	7.9 x 6.2 x 5.0
			70.0
McAdam MM	CDP2	1	16.0 x 10.2 x 5.0
			118.4
Murdoch K.KM	CDP2	1	10.2 x 10.2 x 5.0
			93.4
Watt QM	CDP2	1	10.2 x 10.2 x 5.0
			93.4

[4] Jacket weight excluding piles.

3.1.3 Pipelines and umbilicals

All the pipelines / flowlines and umbilicals that are within the scope of this EA are listed below in Table 3.1.3 according to DP. Further details on the CMS pipelines, including dimensions and flow direction, are provided in Appendix 3.

Table 3.1.3: Pipelines and umbilicals

DP	Pipeline ID
CDP1b	PL935, PL936
CDP2	PL1436, PL1437, PL1922, PL1925, PL1923, PL1926, PL1924, PL1927, PL2109, PL2110, PL2430, PLU2431, PL2894, PL2895, PLU4685, PLU4686, PLU4888, PLU4889, PLU4890
CDP3	PL929, PL930

3.1.4 Subsea structures

A summary of the subsea structures and associated stabilisation features is presented in Table 3.1.4. All the subsea structures are covered by CDP2. Additional details are available in Appendix 3.

Table 3.1.4: Subsea structures

Subsea Installations	DP	Number	Size (m) / Mass (Te)
Katy Tee Protection Structure	CDP2	1	8.4 x 4.5 x 3.4 39.0
Kelvin/Murdoch Subsea Pigging Skid	CDP2	1	10.5 x 5.1 x 4.0 97.6
Kelvin Pigging Manifold Assembly (PMA)	CDP2	1	9.5 x 6 x 3.4 51.4
Kelvin Subsea Tee Assembly (STA)	CDP2	1	10.5 x 4.8 x 2.7 77.8
McAdam Tee	CDP2	1	3.1 x 1.6 x 1.4 40.0
Pigging Skid Northern Lobe (PSNL)	CDP2	1	5.5 x 5.5 x 3.5 153.1
Pigging Skid Southern Lobe (PSSL)	CDP2	1	6.3 x 4.3 x 1.8 55.5

3.1.5 Stabilisation and protection features

This section presents all protection and stabilisation features that are being decommissioned as part of CDP1b, CDP2 and CDP3, other than those sections 3.1.2 and 3.1.4. A summary of all the mattresses that are within in the scope of CDP1b, CDP2, and CDP3 can be seen in Appendix 3. It should be noted that the not all 917 mattresses present will be removed as some relate to third-party infrastructure/crossings. An estimated 739 mattresses will be removed as part of the proposed decommissioning. An additional 79 contingency mattresses may be removed. They are associated with the cross-over or divergence points for PL929 and PL930 (CDP3 – 66 mattresses), and PL935 and PL936 (CDP1b – 13 mattresses).

There are an estimated 3,500 grout bags within the CMS area of assumed standard size (0.3 x 0.6 m). The intention is for all visible grout bags to be fully removed. While the material of the grout bags currently in situ is not known, as a worst case it is assumed that the bags are assumed to be non-biodegradable (containing polypropylene).

3.2 Consideration of alternatives and selected approach

3.2.1 Decision-making approach

Platforms

As a Contracting Party of the Convention for the Protection of the Marine Environment of the North-East Atlantic ('OSPAR'), the UK has agreed to implement OSPAR Decision 98/3, which prohibits leaving offshore installations wholly or partly in place. The legal requirement for Operators to comply with the OSPAR Convention is affected through the Petroleum Act 1998 (as amended by the Energy Act 2008), the Guidance Notes for which outline the expectations of the UK regulator in terms of complying with the relevant OSPAR decisions. OSPAR Decision 98/3 states that the topsides of all installations should be returned to shore and that all jackets with a weight of less than 10,000 tonnes are completely removed for reuse, recycling or final disposal on land. In the CMS, all the jackets weigh less than 10,000 Te, therefore in compliance with OSPAR Decision 98/3, the topsides and jackets of all installations (Murdoch MA, Murdoch MC, Murdoch MD, Boulton BM, Munro MH, Kelvin TM and Katy TKT) will be fully removed and disposed of appropriately onshore.

Subsea infrastructure

The latest BEIS Guidance (2018) states that subsea installations (e.g. drilling templates, wellheads and their protective structures, production manifolds and risers) must, where practicable, be completely removed for reuse or recycling or final disposal on land [2]. Any piles used to secure such structures in place should be cut below natural seabed level at such a depth to ensure that any remains are unlikely to become uncovered. Should an Operator wish to make an application to leave in place a subsea installation because of the difficulty of removing it, justification in terms of the environmental, technical or safety reasons would be required. With regards to pipelines (including flowlines and umbilicals), these should be considered on a case-by-case basis. The guidance does provide general advice regarding removal for two categories of pipelines:

- For small diameter pipelines (including flexible flowlines and umbilicals) which are neither trenched nor buried, the guidance states that they should normally be entirely removed; and
- For pipelines covered with rock protection, the guidance states that these are expected to remain in place unless there are special circumstances warranting removal.

The guidance also highlights instances where pipelines could be decommissioned *in situ*. For example, pipelines that are adequately buried or trenched or which are expected to self-bury. Where an Operator is considering decommissioning pipelines *in situ*, the decision-making process must be informed by 'Comparative Assessment' of the feasible decommissioning options. This CA takes account of safety, environmental, technical, societal and economic factors to arrive at a preferred decommissioning solution.

Finally, the guidance states that mattresses and grout bags installed to protect pipelines should be removed for disposal onshore, if their condition allows. If the condition of the mattresses or grout bags is such that they cannot be removed safely or efficiently, any proposal to leave them in place must be supported by an appropriate CA of the options.

3.2.2 Alternatives to decommissioning

Options to re-use the CMS infrastructure *in situ* for future hydrocarbon or alternative developments have been considered, but to date none have yielded a viable commercial opportunity. The PL929 has currently been identified for potential use as part of an Energy Transition project. The pipeline has been cleaned and filled with inhibited seawater and has since been disconnected at the Murdoch end. The decommissioning operations and activities that have been carried out on PL929 and which resulted in the cutting and disconnection of the pipeline will not impact any future opportunities for reuse.

Given the uncertainty over the feasibility of re-use of the CMS infrastructure, there is no reason to delay decommissioning of the infrastructure in a way that is safe and environmentally and socio-economically acceptable (and the 'do nothing' approach to the infrastructure is thus rejected).

3.2.3 Comparative Assessment

3.2.3.1 Pipelines and umbilicals

In line with the guidance summarised above, Chrysaor has committed to fully removing all subsea structures and all surface infrastructure within the CMS area. The pipelines within and associated with the CMS have been considered within a CA in order to arrive at an optimal decommissioning method. The CA methodology is described fully within the CA for pipelines in the Caister-Murdoch System submitted along with this EA [7].

A summary of the infrastructure for which a CA of options was made and the selected option (based on consideration of safety, environmental, technical, societal and economic factors) is given in Table 3.2.1. The CA used a non-weighted process to eliminate any subjectivity. Actual environmental data was considered when comparing options including seabed disturbance, habitat loss and underwater noise in line with the conservation objectives and sensitivities of protected sites in the vicinity.

Table 3.2.1: Preferred decommissioning options for CA Groups

DP	CA Group no.	Pipeline no.	Pipeline infrastructure description	Options preferred for subsea decommissioning
CDP1b	**1**	PL935	16" Gas Export Pipeline from Cut point B at Caister CM to ESDV at Murdoch MD, Trenched and Buried	Decommission *in situ*, without remediation
		PL936	3" Methanol Import Pipeline from ESDV at Murdoch MD topsides to Flexible Spool End Fitting at Caister CM, Trenched and Buried	
CDP2	**2**	PL1436	10" Gas Pipeline from ESDV at Boulton BM to Riser Tie-in Flange at Murdoch MD, Trenched and Buried	Decommission *in situ*, without remediation
		PL1437	3" Methanol Pipeline from Subsea Tie-in Flange at Murdoch MD to ESDV at Boulton BM, piggybacked on PL1346, Trenched and Buried	
		PL2894	10" Gas Pipeline from ESDV at Katy KT to Kelvin TM Subsea Tee, Trenched and Buried	
		PL2895	2" Methanol Pipeline from Kelvin TM Subsea Tee to ESDV at Katy KT, piggybacked on PL2894, Trenched and Buried	
		PL2430	12" Gas Pipeline from ESDV at Kelvin TM to PSSL, Trenched and Buried	
		PLU2431	3" Methanol Pipeline from PSSL to ESDV at Kelvin TM, piggybacked on PL2430, Trenched and Buried	
		PL2109	10" Gas Pipeline from Cut Point A at Munro MH to Hawksley EM, Trenched and Buried	
		PL2110	3" Methanol Pipeline from Hawksley EM to Cut Point C at Munro MH, piggybacked on PL2109, Trenched and Buried	
		PL1924	10" Gas Pipeline from ESDV at Murdoch MD to Hawksley Subsea Well Head, Trenched and Buried	Partial removal
		PL1927	3" Methanol Pipeline from ESDV at Murdoch MD to Boulton HM Subsea Well Head, Trenched and Buried	

DP	CA Group no.	Pipeline no.	Pipeline infrastructure description	Options preferred for subsea decommissioning
		PL1923	10” Gas Pipeline from Murdoch K.KM Subsea Manifold to PSNL, Trenched and Buried	Decommission *in situ*, without remediation
		PL1926	3” Methanol Pipeline from PSNL to Murdoch K.KM Subsea Well Head, piggybacked on PL1923, Trenched and Buried	
		PL1922	10/12” Gas Pipeline Hawksley Subsea Well Head to ESDV Valve at Murdoch MD, Trenched and Buried	
		PL1925	3” Methane Pipeline ESDV Valve at Murdoch MD to Hawksley Subsea Well Head, piggybacked on PL1922 between McAdam MM and Murdoch MD, Trenched and Buried	
	3	PLU4686	108.5 mm ø Electrohydraulic Umbilical from Murdoch MA TUTU to McAdam MM WHPS SUTU, Trenched and Buried	Decommission *in situ*, without remediation
		PLU4685	108.5 mm ø Electrohydraulic Umbilical from McAdam MM WHPS SUTU to Hawksley EM WHPS SUTU, Trenched and Buried	Partial removal
		PLU4888	82 mm ø Electrohydraulic Umbilical from Watt QM SUTU to Boulton HM SUTU, Trenched and Buried	Decommission *in situ*, without remediation
		PLU4889	96 mm ø Electrohydraulic Umbilical, Murdoch MA TUTU to Watt QM SUTU, Trenched and Buried	
		PLU4890	82 mm ø Electrohydraulic Umbilical, Murdoch MA TUTU Murdoch KM SUTU, Trenched and Buried	
CDP3	1	PL929	26” Gas Export Pipeline from ESDV Murdoch MD to MLWM, Trenched and Buried	Decommission *in situ*, without remediation
		PL930	4” Methanol Import Pipeline from MLWM to ESDV at Murdoch MD, Trenched and Buried	

3.2.3.2 Stabilisation and protection features

Mattresses and grout bags associated with CMS were also included within the CA. The results of this are outlined below.

Several hundred fronded and concrete mattresses were installed to protect the pipelines and umbilicals on the approaches and to protect the installations, pipeline tee and pigging manifold assembly protection structures from scour. In recognition that most lie within the Dogger Bank Special Area of Conservation (SAC), these were also subject to a CA, except for a small number of concrete mattresses (13) that are buried under rock. It is assumed that these would remain *in situ*.

Mattress decommissioning options

Two decommissioning options are considered for the removal of fronded and concrete mattresses. These are:

- Complete removal – This would involve the complete removal of the mattresses by whatever means would be most practicable and acceptable from a technical perspective;
- Leave *in situ* – This would involve leaving the mattresses *in situ* with no remedial works but possibly verifying their status via future surveys.

Most of the mattresses are associated with the approaches, and if removed it is assumed that any pipelines or umbilicals underneath them would also be removed. Mattresses associated with any third-party installations or pipeline crossings will remain undisturbed. A small number may be buried under deposited rock and an implicit assumption of this assessment is that mattresses buried under rock will be left *in situ*.

Grout bags

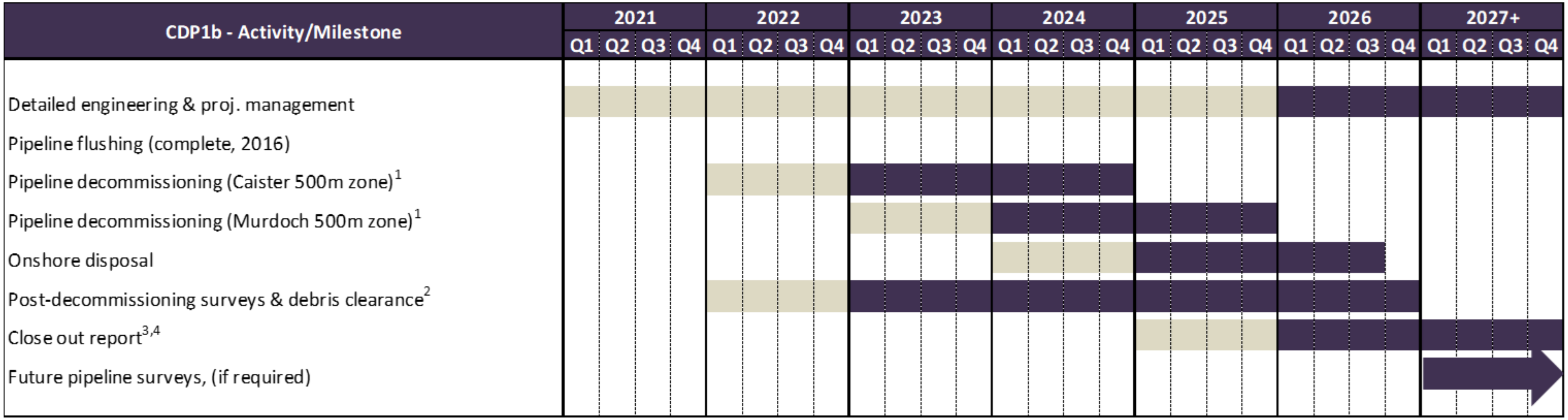
Ordinarily, the intention would be to leave all fully buried grout bags *in situ* when decommissioning the pipelines, but should they be disturbed as part of decommissioning operations they will be removed. Although several different methods could theoretically be used to remove the grout bags, from a practical perspective it is not known whether the bag material has remained intact.

3.3 Proposed schedule

The proposed schedule of activities is shown according to each DP in Figure 3.3.1, Figure 3.3.2 and Figure 3.3.4, CDP1b, CDP2 and CDP3 respectively. The activities are subject to the acceptance of the DPs associated with in this document and any unavoidable constraints (e.g. vessel availability) that may be encountered while executing the decommissioning activities. Therefore, activity schedule windows have been included to account for this uncertainty.

The commencement of offshore decommissioning activities will depend on commercial agreements and commitments.

Figure 3.3.1: Schedule of the CMS decommissioning (CDP1b)



Notes / Key

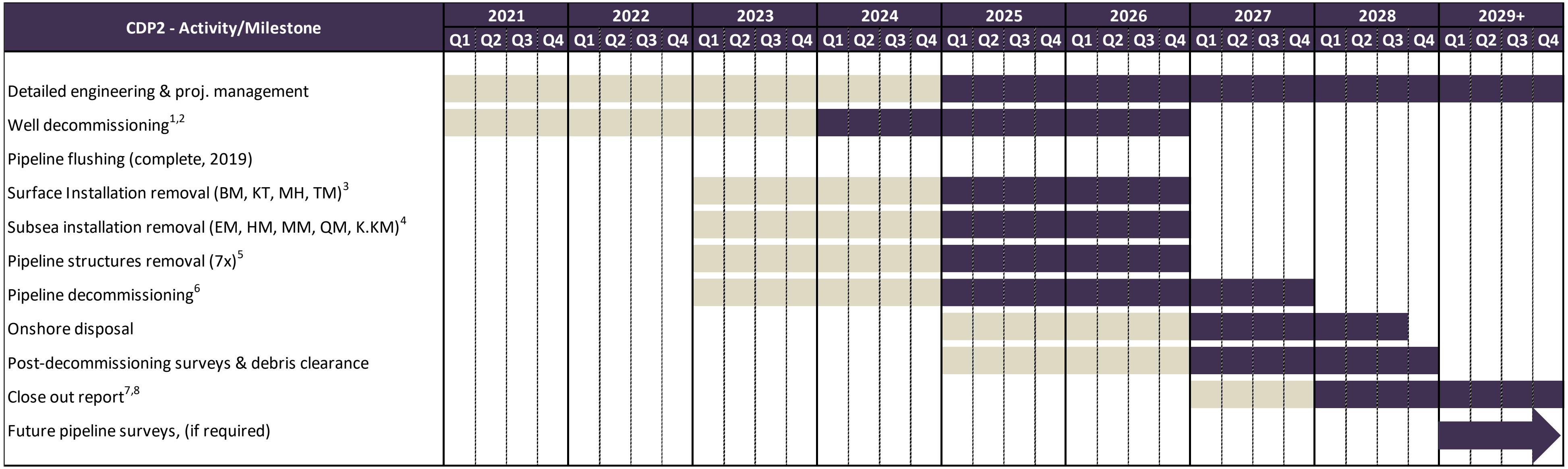
Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

1. The pipelines were disconnected at Caister CM before the platform and its template were removed in May-June 2020; The pipelines are to be disconnected from Murdoch MD in 2021;
2. Post decommissioning survey at Murdoch will likely be completed as part of a wider campaign with CDP3 scope;
3. The close out report will be prepared on completion of offshore activities. It will contain results of environmental suveys, debris survey (identification/removal) and clear seabed verification survey;
4. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

Figure 3.3.2:Schedule of the CMS decommissioning (CDP2)

Figure 3.3.4: Schedule of the CMS decommissioning (CDP2)



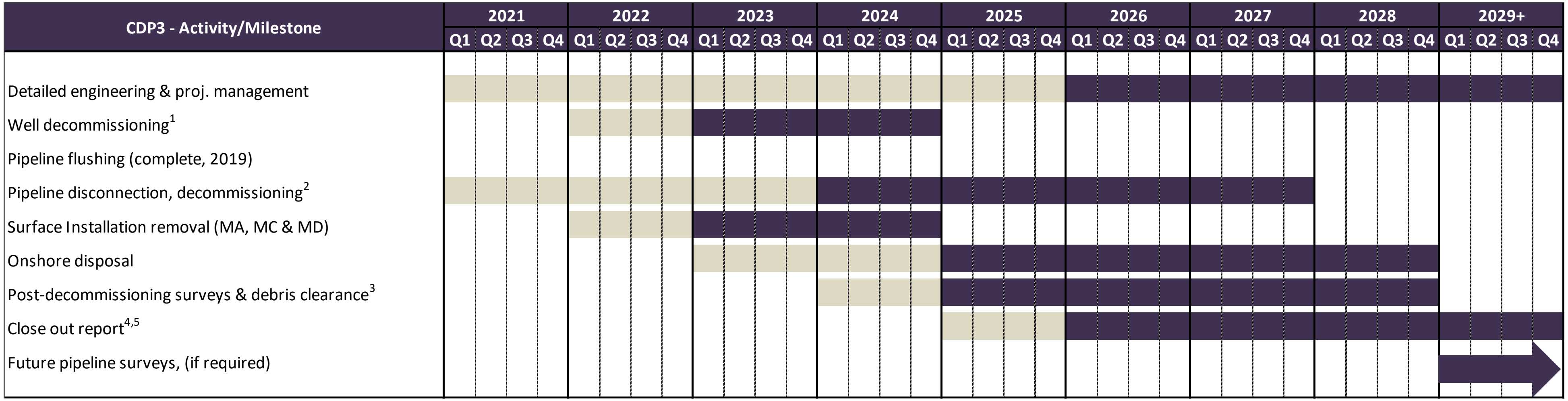
Notes / Key

Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

9. Well decommissioning. Hawksley EM & Watt QM complete. McAdam MM wells partly decommissioned (AB2) in 2019; Boulton HM wells to be partly decommissioned (AB2) in 2021; Murdoch K.KM wells to be partially decommissioned (AB2) in 2022. The decommissioning of the MM, HM and K.KM wells will be completed when the well conductors are removed during the same campaign as removal of the respective subsea installations. The dates quoted here are the earliest dates
10. Decommissioning of the surface installation wells is schedules for 2022-2023; the conductors may need to be removed along as part of the removal campaign for the installations;
11. The surface installations include Boulton BM, Katy KT, Munro MH, Kelvin TM;
12. The subsea installations include Bouton HM, Hawksley EM, McAdam MM, Murdoch K.KM, Watt QM;
13. The pipeline structures include Katy Tee, Kelvin-Murdoch Subsea Pigging Skid, Kelvin Pigging Manifold Assembly, Kelvin Subsea Tee Assembly, McAdam Tee, Pigging Skid Northern Lobe, Pigging Skid Southern Lobe;
14. The pipelines are already disconnected from the surface satellite installations;
15. The close out report will be prepared on completion of offshore activities. It will contain results of environmental surveys, debris survey (identification/removal) and clear seabed verification survey;
16. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

Figure 3.3.4: Schedule of the CMS decommissioning (CDP3)



Notes / Key

Earliest potential activity

Activity window to allow commercial flexibility associated with decommissioning activities

1. The wells have already been partially decommissioned (AB2). The intention is that the conductors are removed in the same campaign as removal of the MD installation;
2. The pipelines will be disconnected from Murdoch MA and Murdoch MD earliest in 2021 but prior to removal of the installations; pipeline decommissioning may be carried out as part of a wider subsea decommissioning campaign associated with CDP2;
3. Post decommissioning debris clearance within Murdoch 500m zone will be timed to coincide with execution of the scope of work associated with CDP2;
4. The close out report will be prepared on completion of offshore activities. It will contain results of environmental suveys, debris survey (identification/removal) and clear seabed verification survey;
5. The close out report will explain the strategy based on risk assessments and results of post decommissioning surveys.

3.4 Decommissioning activities

This section outlines the section the proposed decommissioning activities for CDP1b, CDP2, and CDP3. The activities described within include activities that are outwith the scope of this EA, however they are included within this section to provide an overview of all decommissioning activities.

3.4.1 Preparation for decommissioning

Well decommissioning

Well decommissioning is not within the scope of this environmental appraisal, and it has been or will be assessed as part of well intervention and marine licence applications. A description is included here to describe the activities leading up to the point that the decommissioning activities that are assessed here begin.

All wells will be decommissioned to current industry standard, this means that each well will be systematically and permanently closed in accordance with well decommissioning best practice; these activities will be carried out using a jack up rig.

Flushing and cleaning operations

These flushing and cleaning operations are not within the scope of this EA, and they have been assessed as part of ongoing operations of the facilities. A description is included here to describe the activities which have occurred leading up to the point that the decommissioning activities that are being assessed here begin.

Pipelines

Chrysaor has flushed all the infield production pipelines with seawater, followed by plugs of gel or foam called ‘pigs’ propelled through the lines. This activity was designed to remove mobile hydrocarbons and achieve a cleanliness of less than 30 mg/l oil in pipeline flush fluids. Chemical pipelines were subjected to a turbulent seawater flush to displace all contents.

Platforms

Following isolation from the wells, gas (nitrogen) is passed through the platform processing systems to ensure that minimal hydrocarbons remained in the system prior to the final cleaning and disconnect. During the final cleaning and disconnect activities, all the processing systems on the platform are progressively depressurised, purged with gas (nitrogen) and rendered safe for removal operations. All bulk chemicals surplus to requirement were backloaded onshore for disposal. The pipework and tanks will be visually inspected where possible and may be further treated should any sources of potential spills of oils and other fluids be identified.

Platform decommissioning

Cold suspension

There are seven platforms within the CMS area (as covered by CDP1b, CDP2, and CDP3). Specialist engineering contractors will prepare the infrastructure for removal. For the four satellite platforms (Boulton BM, Katy KT, Kelvin TM and Munro MH), topsides may or may not require removal prior to the jackets being removed, whilst for the three remaining manned platforms (Murdoch MA, MC and MD) the topsides will require removal separately from the removal of the jacket.

Once hydrocarbon free, isolated from hydrocarbon sources and without a routine power source (all diesel fuel will have been drained and backloaded to shore), the platforms will enter a phase called ‘cold suspension’. During this time, the platforms will be equipped with solar powered aids to navigation and an automatic identification system (AIS) to mark the structures until such time they are fully removed. During cold suspension, it is assumed that:

- The assets will be marked accordingly in line with the Consent to Locate. Dispensation from the Standard Marking Schedule is to be requested owing to the solar powered aids to navigation consisting of primary lights and foghorn, without subsidiary lighting. A contingency plan has been prepared in the event of a failure with the executive action being dependent on the remaining duration of the period of cold suspension; and
- No further activities are to be undertaken at the assets during cold suspension ahead of the removals phase apart from subsea surveys; and

- There is the potential for flights to land on some NUIs pre-cold suspension. However, once the installations are light-housed, no personnel will re-board the topsides. The platform removal techniques planned will be similar for all platform types.

Each jacket is secured to the seabed by piles. All piles securing the jackets will be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents. Chrysaor is estimating this to be at least 3 m below the natural seabed level.

Topside removal

Chrysaor will remove the topsides using the single lift method. A heavy lift vessel capable of lifting the entire topsides in one lift will be used. The topsides will be prepared for this by a combination of making sure modules are secured for transport and structural strengthening of the topsides. For the four unmanned satellite platforms the topsides may or may not require removal prior to the jackets being removed. The three bridge linked manned Murdoch platforms will require the removal of the topsides separately to the jackets.

Jacket removal

The removal process for of each of the seven jackets is expected to be:

- Cutting of the lines that connect the platform to the subsea infrastructure (called risers);
- Cutting of the piles that secure the jacket to the seabed; and
- Removal of each platform jacket by heavy lift vessel (including risers).

Jacket piles will be internally cut (where possible), if this is not possible the area around the piles will be excavated and the piles will be cut externally. Should excavation be required, a suitable method (MFE or suction dredging) will be used. As a worst-case/conservative approach, it has currently been assumed that one in three installations are expected to require excavation to -4 m to allow for cutting equipment to reach the piles at -3 m.

3.4.2 Subsea infrastructure decommissioning

Overview

A subsea contractor will sequentially mobilise a fleet comprising vessels with a range of crane capabilities for lifting objects of different sizes and weights off the seabed, vessels that can support underwater operations including remotely operated vehicle (ROV) deployment, diving, cutting, trench ploughing and backfilling, excavation and rock placement, survey vessels and guard vessels. The vessels will deploy ROVs (or divers when necessary) to disconnect the subsea installations and tie-in spools and to cut the spools and ends of flowlines. The vessels' cranes will lift the subsea structures to the vessel.

Pipelines and umbilicals

Pipelines and umbilicals will be physically disconnected subsea from all subsea and surface structures and any mattresses and grout bags that cover the disconnection points will be recovered back to the vessel. Following this, the lines will be prepared for decommissioning as below:

- Group 1 (decommission *in situ*): PL935, PL936, PL929, PL930

The recommendation from the CA is to decommission the Group 1 pipelines *in situ*, without remediation along the length. Ends will be cut and remediated. Proposed remediation is listed in Table 3.4.1.

- Group 2 (decommission *in situ*): PL1436, PL1437, PL2894, PL2895, PL2430, PLU2431, PL2109, PL2110, PL1923, PL1926, PL1922, PL1925
- Group 2 (partial removal): PL2109, PL2110

The recommendation from the CA is to decommission most of the Group 2 pipelines *in situ*, without remediation along the length. Ends will be cut and remediated using cut and lift methodology. Proposed remediation is listed in Table 3.4.1. The PL2109 and PL2110 are the exception, having been selected for partial removal along the first section of the pipeline, as the first 1.5 km of the pipelines have been prone to exposures.

- Group 3 (decommission *in situ*): PLU4686, PLU4888, PLU4889, PLU4890
- Group 3 (partial removal): PLU4685

The recommendation from the CA is to decommission most of the Group 3 pipelines *in situ*, without remediation along the length. Ends will be cut and remediated. Proposed remediation is listed in Table 3.4.1. The single PLU4685 will be partially removed through cut and lift to remove a short exposure.

A suitable vessel will be used to undertake the subsea intervention scopes associated with pipeline disconnection and remediation, removal of infrastructure and stabilisation materials and clearance activities. The cut pipeline ends will be remediated by placing rock over the pipeline ends. Table 3.4.1 lists the length of each pipeline/umbilical end being removed, including the type of remediation taking place at the pipeline/umbilical ends. It should be noted that duplications of pipeline ID within the table below indicate multiple pipeline ends as would arise when flowlines are routed through subsea installations.

Table 3.4.1: Length of cut ends and anticipated type of remediation

Pipeline ID	From (A)	Remediation at end A	Length removed at cut end A (m)	To (B)	Remediation at end B	Length removed at cut end B (m)
PL929	Murdoch MD	Rock	147	MLWM TGT	N/A	0
PL930	MLWM TGT	N/A	0	Murdoch MD	Rock	147
PL935	Caister CM	Rock	85	Murdoch MD	Rock	100
PL936	Murdoch MD	Rock	100	Caister CM	Rock	85
PL1311[5]	Riser Tie Flange Murdoch MD	N/A	0	ESDV Murdoch MD	N/A	0
PL1312[6]	ESDV Murdoch MD	N/A	0	Subsea Tie-in Murdoch MD	N/A	0
PL1436	Boulton BM	Rock	113	Murdoch MD	Rock	77
PL1437	Murdoch MD	Rock	113	Boulton BM	Rock	77
PL1922	Hawksley EM	Rock	106	McAdam MM	Rock	0
PL1922	McAdam MM	Rock	58	Murdoch MD	Rock	248
PL1923	Murdoch K.KM	Rock	66	PSNL	Rock	45
PL1924	Boulton HM	Rock	82	Watt QM	Rock	89
PL1924	Watt QM	Rock	66	Murdoch MD	Rock	157

[5] The PL1311 is the riser end section of the PL1436 at the Murdoch MD platform. While this riser has been itemised here and in CDP2, it has been assessed as part of the overall jacket removal therefore is not considered independently nor has any associated remediation at its ends.

[6] The PL1312 is the riser end section of the PL1437 at the Murdoch MD platform. While this riser has been itemised here and in CDP2, it has been assessed as part of the overall jacket removal therefore is not considered independently nor has any associated remediation at its ends.

PL1925	Murdoch MD	Rock	232	McAdam MM	Rock	45
PL1925	McAdam MM	Rock	74	Hawksley EM	Rock	92
Pipeline ID	**From (A)**	**Remediation at end A**	**Length removed at cut end A (m)**	**To (B)**	**Remediation at end B**	**Length removed at cut end B (m)**
PL1926	PSNL	Rock	45	Murdoch K.KM	Rock	45
PL1927	Murdoch MD	Rock	194	Watt QM	Rock	64
PL1927	Watt QM	Rock	89	Boulton HM	Rock	68
PL2109	Munro MH	Rock	21	Hawksley EM	Rock	207
PL2110	Hawksley EM	Rock	244	Munro MH	Rock	1,582
PL2430	Kelvin TM	Rock	63	Cavendish Subsea Pigging Skid	Rock	141
PLU2431	Cavendish Subsea Pigging Skid	Rock	141	Kelvin TM	Rock	51
PL2894	Katy KT	Rock	57	Kelvin TM Subsea Tee	Rock	87
PL2895	Kelvin TM Subsea Tee	Rock	90	Katy KT	Rock	60
PLU4685	McAdam MM	Rock	220	Hawksley EM	Rock	72
PLU4686	Murdoch MA	Rock	362	McAdam MM	Rock	70
PLU4888	Watt QM	Rock	121	Boulton HM	Rock	75
PLU4889	Murdoch MA	Rock	200	Watt QM	Rock	115
PLU4890	Murdoch MD	Rock	200	Murdoch K.KM	Rock	115

Table 3.4.2 below shows possible mid-line sections that may be removed should the mattresses be exposed. They have been assessed as a contingency but are included in the worst case scenario, hence are shown separate from Table 3.4.1.

Table 3.4.2 : Possible mid-line remediation

Pipeline ID	Location	KP	Remediation	Length Recovered (m)
PL930	PL930 Separation from PL929	KP 4.8	Seabed sediment	40
PL930	PL930 crossing over PL929	KP 20	Seabed sediment	80
PL930	PL930 separating from PL929	KP 180.409	Seabed sediment	40
PL936	PL935 separating from PL935	KP 0.493	Seabed sediment	65
PL936	PL935 separating from PL935	KP 10.485	Seabed sediment	40

Subsea infrastructure

Subsea infrastructure, including wellhead protection structures, manifolds and tees will be disconnected by either ROV or divers, fully removed and recovered to a vessel for transfer onshore for recycling or disposal. All piled subsea infrastructure will have their piles cut internally (where possible) and will be fully recovered. Should internal cutting not prove possible, excavation and external cutting at -3 m will be the alternative method of removal. For the purposes of this assessment, it has been assumed that one in three piles would be externally excavated to achieve a sufficient cut depth.

Protection and support materials

As per the OPRED guidance, the base case for mattresses is full removal, with the exception of any protection structures associated with crossing points and any third-party infrastructure. If any mattresses are found to have insufficient integrity to be removed, then Chrysaor will engage with the regulator regarding decommissioning these mattresses *in situ*.

3.4.3 Post-decommissioning activity

Following decommissioning activities, a seabed clearance survey will identify any debris on the seabed within a 500 m radius of each platform and within the corridor of any pipelines and umbilicals decommissioned *in situ* which will be recovered for onshore disposal. Owing to the environmental sensitivities, non-intrusive means will be employed to demonstrate that no snagging risks remain on the seabed. Subject to acceptance of the close-out report by OPRED, the existing safety zones will be lifted.

The survey methods will be discussed and finalised with OPRED prior to survey commencement to ensure the survey meets the requirements for clear seabed verification. Non-intrusive verification techniques will be considered in the first instance. These may include techniques which do not make contact with the seabed, such as Side Scan Sonar (SSS) and Remotely Operated Vehicle (ROV) surveys.

A post-decommissioning monitoring programme covering the pipelines and associated stabilisation features remaining *in situ* is to be agreed with OPRED. The proposed approach includes the following:

- An initial baseline survey covering the full length of each pipeline;
- Followed by a risk assessment for each pipeline (and associated stabilisation materials) which will inform the minimum agreed extent and frequency of future surveying. This will take account of pipeline burial, exposure and spanning derived from the initial baseline survey, historical survey information and fisheries impact assessment;
- A report of each required survey will be prepared which will include analysis of the findings, the impact of the risk-based assessment and identification of the proposed timing of the next survey. This is for discussion and agreement with OPRED;
- Provision will be included for remediation where such a requirement is identified. Appropriate remediation will be discussed and agreed with OPRED;
- Where remediation has been undertaken, a follow up survey of the remediated area will be required;
- In the event of a reported snagging incident on any section of pipeline, the requirement of any additional survey and/or remediation will be discussed and agreed with OPRED;
- Monitoring will become reactive following completion of the agreed survey programme and OPRED agreement; and
- Pipeline information will be recorded on navigation charts and FishSafe.

3.5 Waste management

The onshore treatment of waste from the CMS decommissioning activities will be undertaken according to the principles of the waste hierarchy, a conceptual framework which ranks the options for dealing with waste in terms of sustainability (Figure 3.5.1). The waste hierarchy is a key element in OSPAR Decision 98/3 and DECC 2018 Guidance Notes [2].

Non-hazardous waste material, such as scrap metal, concrete and plastic not contaminated with hazardous waste, will, where possible, be reused or recycled. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Hazardous waste resulting from the dismantling of the CMS facilities will be pre-treated to reduce hazardous properties or render it non-hazardous prior to recycling or disposing of it to a suitable landfill site. Under the Landfill Directive, pre-treatment is necessary for most hazardous wastes destined to be disposed of to a landfill site.

The management of waste generated from operations and drilling activities has been addressed by Chrysaor through an ISO14001 certified Environmental Management System (EMS). The EMS initially comprised a procedure for waste management designed to ensure that all waste generated during the Chrysaor offshore production and drilling operations are managed according to Harbour Energy's Health, Safety and Environment policy (Appendix 4) and relevant legislation. Procedures and processes for waste management are now embedded in the EMS. Furthermore, Chrysaor has prepared a waste management plan in support of the CMS DPs. The Waste Management Plan will record how handling, storage, transfer and treatment of waste will be conducted by contractors/sub-contractors on behalf of Chrysaor using their own waste management system. The Waste Management Plan will also detail how the reporting of waste for internal and external recording and reporting will be managed.

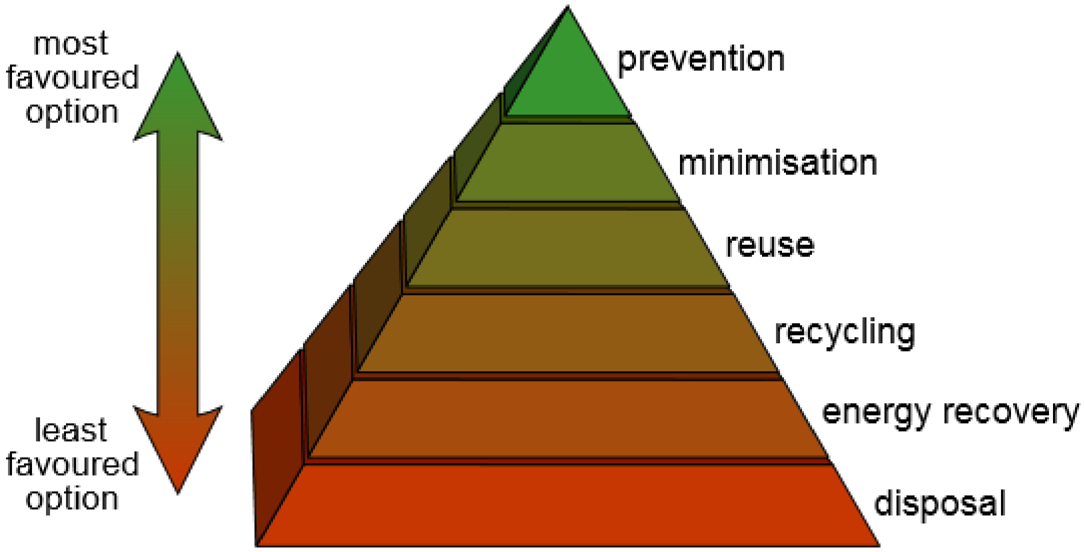


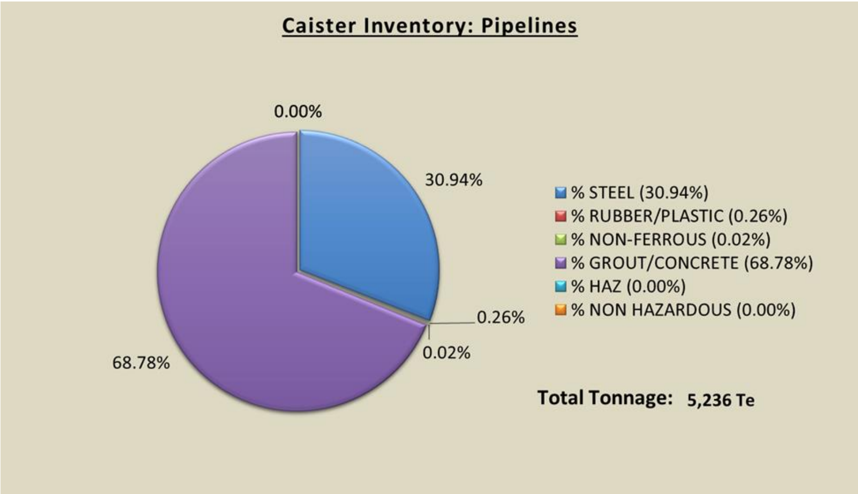
Figure 3.5.1: Waste management hierarchy

Table 3.5.1: Material Inventory of CMS

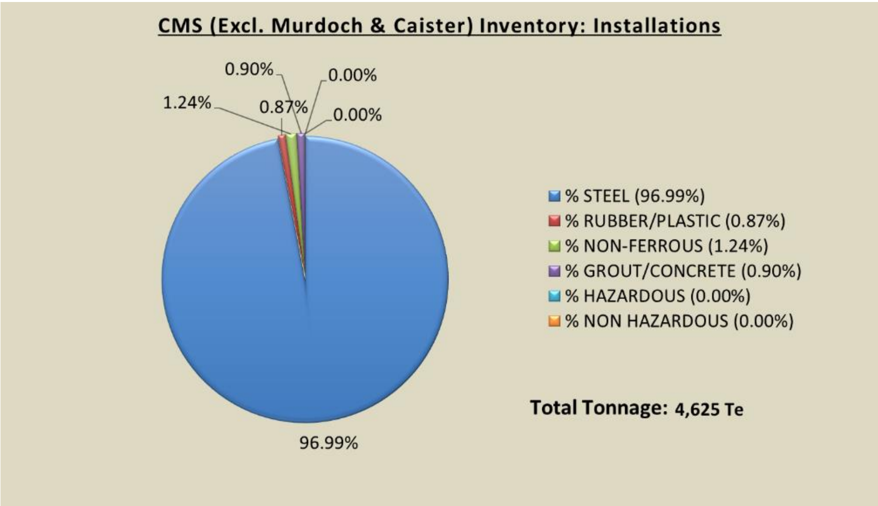
DP		Total inventory (Te)	Removed to shore (Te)	Remaining (Te)	Steel (Te)	Plastic/rubber (Te)	Non-ferrous (Te)	Grout/concrete (Te)	Hazardous (Te)	Other non-hazardous (Te)
CDP1b	**Structures**	-	-	-	-	-	-	-	-	-
	Pipelines	5,236	197	5,093	1,619.83	13.63	1.19	3,601.39	0.09	0.00
	Deposited rock	9,063	-	9,063	-	-	-	-	-	-
CDP2	**Structures**	4,625	3,791.83	832.80	5,078.54	45.80	64.81	46.97	0.00	0.00
	Pipelines	23,742	6,560.12	17,181.62	3,447.53	217.48	5.28	1,565.83	0.00	0.00
	Deposited rock	190,784	0.00	190,784.25	-	-	-	-	-	-
CDP3	**Structures**	13,097	11,465.15	1,632.10	5,031.44	81.34	90.72	32.62	0.00	0.00
	Pipelines	146,543	208.74	146,334.74	2,203.42	2.30	1.05	3,029.29	0.07	0.00
	Deposited rock	50,350	0.00	50,350.00	-	-	-	-	-	-
Total		**443,440.46**	**22,222.83**	**412,116.00**	**17,380.75**	**360.54**	**163.05**	**8,276.10**	**0.16**	**0.00**

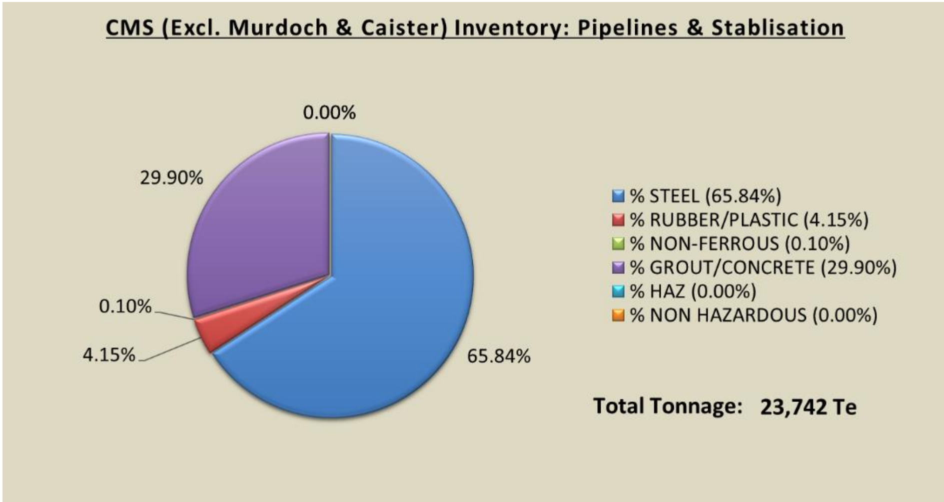
Table 3.5.2: Pie charts of estimated inventory associated with each CMS DP

CDP1b:

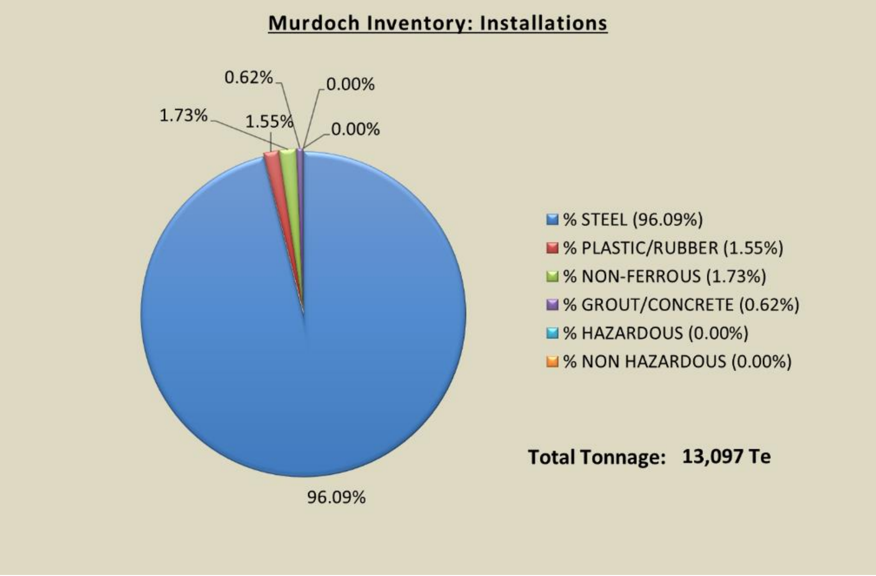


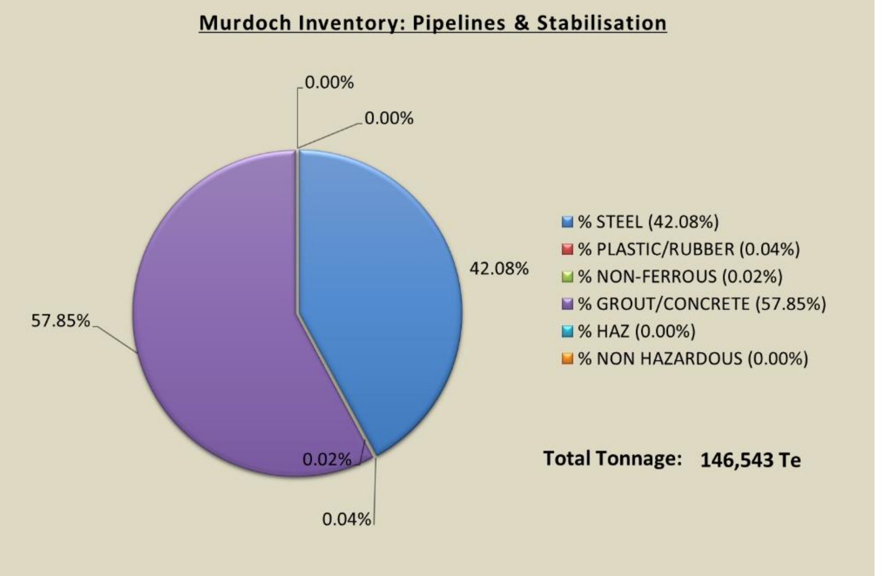
CDP2:





CDP3:


Murdoch Inventory: Installations
0.62%
0.00%
1.73%
1.55%
0.00%
96.09%
% STEEL (96.09%)
% PLASTIC/RUBBER (1.55%)
% NON-FERROUS (1.73%)
% GROUT/CONCRETE (0.62%)
% HAZARDOUS (0.00%)
% NON HAZARDOUS (0.00%)
Total Tonnage: 13,097 Te


Murdoch Inventory: Pipelines & Stabilisation
0.00%
0.00%
42.08%
57.85%
0.02%
0.04%
% STEEL (42.08%)
% PLASTIC/RUBBER (0.04%)
% NON-FERROUS (0.02%)
% GROUT/CONCRETE (57.85%)
% HAZ (0.00%)
% NON HAZARDOUS (0.00%)
Total Tonnage: 146,543 Te

4 Environmental Baseline

4.1 Summary of Receptors

The baseline environment of the project area is summarised in Table 4.1.1. For most receptors, the summarised information provided is considered sufficient to inform the environmental assessment of potential impacts within this EA. The following receptors identified during the ENVID and during consultation as of interest to stakeholders are assessed in more detail in the following Sections:

- Seabed environment (Section 4.2)
- Commercial fisheries (Section 4.3)
- Marine mammals (Section 4.4)
- Seabirds (Section 4.5)
- Conservation sites (Section 4.5)

Table 4.1.1: Environmental Baseline Summary

Environmental Receptor	Description
Conservation Interests and Sites	
OSPAR threatened and/or declining species and habitats	Owing to much of the CMS infrastructure being located within the Dogger Bank, the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' will be present across much of the CMS. One ocean quahog *Arctica islandica* individual was identified during a seabed survey of the Murdoch Hub in 2015 [14]. A further juvenile individual was identified at the Katy KT platform in 2020. Bivalve siphons were observed in the 2020 survey throughout the CMS area however it is not possible to identify the species from the siphon alone therefore this cannot confirm the presence of more *A. islandica* [15]. Faunal burrows were observed throughout the area surveyed in 2020. Only one site at Kelvin TM displayed burrows at a density sufficient to register on the Marine Nature Conservation Review SACFOR scale as showing a level of similarity to the OSPAR habitat 'seapens and burrowing megafauna community'. Despite this, the burrows observed cannot be confidently attributed to any of the 'megafauna' species associated with the 'seapen and burrowing megafauna community' habitat. Instead, the burrows observed at Kelvin TM and within the CMS area more likely relate to a number of species characteristic of the Dogger Bank community, including sand eels. Therefore, this habitat is not thought to be present within the CMS area [16]. 21 individuals of *Sabellaria spinulosa*, the Ross worm and reef building polychaete, were identified from samples taken at the Murdoch Hub, however none were observed in seabed imagery [14]. A 968 m stretch of *S. spinulosa* was observed during a 2006 survey of the PL929/PL930 between KP 31.390 and KP 32.358, this was determined to be an area of established reef. Three small patches (≤2 m long) of *S. spinulosa* were observed along the PL935/PL936, close to the Murdoch Hub [17]. Cod *Gadus morhua* are an OSPAR listed species and use the project area as a nursery and for spawning, which will be discussed later on in the table. Three fish belonging to the family Gadidae were identified during the 2020 survey, but the species was not determined [15].

Special Areas of Conservation (SACs)	The CMS is partly located within the **Dogger Bank SAC** and **Southern North Sea SAC**. The Dogger Bank is the largest sandbank within UK waters and the SAC is designated for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' [18]. The Southern North Sea SAC is designated for the protection of harbour porpoise, an Annex II species [19]. The PL929 and PL930 also intersect the Southern North Sea SAC and, additionally, the **Inner Dowsing, Race Bank and North Ridge SAC**. The Inner Dowsing, Race Bank and North Ridge SAC is designated for the following benthic features: 'Sandbanks which are slightly covered by sea water all the time' and 'Reefs' (specifically owing to the presence of *S. spinulosa*, which forms biogenic reefs. Both features are Annex I habitats [20]. The **Humber Estuary SAC** is located ~7 km north of the onshore terminus of the PL929 and PL930. The site is designated for a number of features. Of those, the features present which are a primary reason for site designation are 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide' [21]. The **North Norfolk Sandbanks and Saturn Reef SAC** is ~15 km south of the PL929 and PL930. The site is designated for 'Sandbanks which are slightly covered by sea water all the time' and biogenic *S. spinulosa* 'Reefs' [22]. The **Wash and North Norfolk Coast SAC** is located ~27 km southwest of the PL929 and PL930. It is designated for a number of features, the exclusively marine features being: 'Sandbanks which are slightly covered by sea water all the time', 'Mudflats and sandflats not covered by seawater at low tide', 'Large shallow inlets and bays', 'Reefs', and Annex II species harbour seal *Phoca vitulina* [23].
Special Protection Areas (SPAs)	The PL929 and PL930, close to shore, pass through the **Greater Wash SPA** which is designated for the following features: red-throated diver *Gavia stellata*, common scoter *Melanitta nigra*, and little gull *Hydrocoloeus minutus* during the non-breeding season, and for breeding sandwich tern *Sterna sandvicensis*, common tern *Sterna hirundo* and little tern *Sternula albifrons* [24]. The pipelines also intersect the **Humber Estuary SPA** by onshore terminus of the PL929 and PL930. The site is designated for a number of features, as follows: avocet *Recurvirostra avosetta* (both breeding and non-breeding populations); bar-tailed godwit *Limosa lapponica* (non-breeding population); bittern *Botaurus stellaris* (both breeding and non-breeding populations); black-tailed godwit *Limosa limosa islandica* (non-breeding population); dunlin *Calidris alpina alpina* (non-breeding population); golden plover *Pluvialis apricaria* (non-breeding population); hen harrier *Circus cyaneus* (non-breeding population); knot *Calidris canutus* (non-breeding population); little tern *Sterna albifrons* (breeding population); marsh harrier *Circus aeruginosus* (breeding population); redshank *Tringa totanus* (non-breeding population); ruff *Philomachus pugnax* (non-breeding population); shelduck *Tadorna tadorna* (non-breeding population); and waterbird assemblage [25]. **Gibraltar Point** SPA is located ~27 km south of the pipelines to shore. The site is protected for the following species: bar-tailed godwit (non-breeding); grey plover *Pluvialis squatarola* (non-breeding); little tern (breeding); and sanderling *Calidris alba* (non-breeding) [26]. **The Wash SPA** is located ~30 km south of the PL929 and PL930, and is designated for: bar-tailed godwit (non-breeding); Bewick's swan *Cygnus columbianus bewickii* (non-breeding); black-tailed godwit, (non-breeding); common scoter (non-breeding); common tern (breeding); curlew *Numenius arquata* (non-breeding); dark-bellied brent goose *Branta bernicla bernicla* (non-breeding); dunlin (non-breeding); gadwall *Mareca strepera* (non-breeding); goldeneye *Bucephala clangula* (non-breeding); grey plover (non-breeding); knot (non-breeding); little tern (breeding); oystercatcher *Haematopus ostralegus* (non-breeding); pink-footed goose *Anser brachyrhynchus* (non-breeding); pintail *Anas acuta* (non-breeding); redshank *Tringa totanus* (non-breeding); sanderling (non-breeding); shelduck (non-breeding); turnstone *Arenaria interpres* (non-breeding); wigeon *Mareca penelope* (non-breeding), and waterbird assemblage (non-breeding) [27].

Marine Conservation Zones (MCZs)	The **Holderness Offshore MCZ** is located ~15 km northwest of the PL929 and PL930 as it comes to shore. The site is protected for: 'Subtidal coarse sediment'; 'Subtidal mixed sediments'; 'Subtidal sand'; 'North Sea glacial tunnel valleys'; and ocean quahog *A. islandica* [28]. Nearshore is the **Holderness Inshore MCZ** which is protected for: 'High energy circalittoral rock'; 'Intertidal sand and muddy sand'; 'Moderate energy circalittoral rock'; Spurn Head (subtidal feature); 'Subtidal coarse sediment'; 'Subtidal mixed sediments'; 'Subtidal mud'; and 'Subtidal sand' [29]. This site is located ~25 km northwest of the PL929 and PL930. Further offshore, ~35 km southeast of the CMS, is the **Markham's Triangle MCZ**. The site is designated for the following features: 'Subtidal coarse sediment'; 'Subtidal mixed sediment'; 'Subtidal mud'; and 'Subtidal sand' [30].
Coastal and Offshore Annex II species most likely to be present in the project area:	
Harbour porpoise	Harbour porpoise *Phocoena phocoena* are frequently found throughout UK waters. They are common throughout the year within the vicinity of the CMS in moderate densities. They have been observed at high densities in the project area in November, though are not seen throughout the following winter months [31]. The density of harbour porpoise in the project area is estimated to be 0.888 animals/km^2 [32].
Minke whale	Minke whales *Balaenoptera acutorostrata* have been observed at a moderate density in the summer months of July and August near the CMS [31]. The density of minke whale is estimated to be 0.01 animals/km^2 [32].
White-beaked dolphin	White-beaked dolphin *Lagenorhynchus albirostris* are found at moderate densities in the CMS in the months of March, May and July [31]. The density of white-beaked dolphin in the CMS area is estimated to be 0.002 animals/km^2 [32].
Long-finned pilot whale	Pilot whales *Globicephala melas* have been observed in the vicinity of the CMS at a low density in August [31]. There is no density estimate for long-finned pilot whales in the project area owing to a lack of observational data.
Grey seal and harbour seal	Grey seals *Halichoerus grypus* and harbour seals *P. vitulina* are not expected to be present in the CMS area in significant numbers; their densities are 0-10 and 0-1 animals per 25 km^2 respectively [33]. This is due to the CMS being located 157 km offshore. However, higher numbers are expected around the PL929 and PL930 as they reach shore. Harbour seal density at TGT is 5-10 animals per 25km^2. For grey seals it is higher at 100-150 animals per 25 km^2 [33]. According to 2020 data, this equates to 0.001 % and 0.01% of the population in the offshore CMS area [34].
Benthic Environment	
Seabed sediments	The CMS is located in an area of seabed which can be considered a mix of EUNIS A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand and A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand [15][35]. Small patches of EUNIS biotope A5.14: Circalittoral coarse sediment were observed in surveys conducted around Boulton BM, Munro MH, Katy KT and Hawksley EM. Additionally, there was evidence of EUNIS A5.44: Circalittoral mixed sediments at Boulton BM [15]. The mean particle size across the CMS was consistent with the SNS UKOOA mean particle size of 243 µm [15]. Particle size was up to 2063 µm at some Murdoch Hub sites, this corresponded to observed areas of gravel [14]. Total Hydrocarbon (THC) concentrations were below the Significant Environmental Impact (SEI) threshold across the CMS, and there is no evidence of drilling related hydrocarbon contamination [14][15]. Reported Polycyclic Aromatic Hydrocarbon (PAH) concentrations were in line with levels typical of the wider SNS. Polychlorinated biphenyl (PCB) levels were below Limit of Detection (LOD). All detectable concentrations of heavy metals were above their respective OSPAR (2005) Background Concentrations (BCs). However, this is to be expected due to the heavily industrialised nature of the SNS [14][15]. Organotin concentrations were below LOD, except at a single station at the Murdoch Hub [14][15].

	The seabed sediments remain relatively consistent along the pipelines to shore. The PL929/PL930 travelling to shore pass through a band of A5.15: Deep circalittoral coarse sediment. This is followed by an area of A5.14, small outcrops of A5.25 or A5.26 may be encountered for a stretch. Finally, the pipelines pass through a thin section of A5.13 Infralittoral coarse sediment just prior to landfall [35].
Benthic fauna	*Spatangoida* (juveniles; the order of heart urchins) and *Spipohanes bombyx*, a polychaete, featured across all survey areas [14][15]. Juvenile *Spatangoida* dominated the benthos by number at almost every location however, when assessing the adult-only populations, the dominant taxa were more variable across the CMS [15]. Generally, Annelida (Polychaeta) were the dominant group, with the exception of the species at Katy KT. Mollusca were the dominant group at Katy KT, largely attributed to the species *Fabulina fabula*. Katy KT was the location of the single identified *A. islandica* juvenile [15]. Other polychaete species which were commonly observed were of the family Terebellidae and genus *Ophelia* [15]. Arthropoda were the second most prevalent group at Hawksley EM; mostly species of the *Bathyporeia* genus [15].
Fish – Spawning and Nursery Grounds	
Spawning grounds	The following species may use the project area for spawning: cod; herring *Clupea harengus*; lemon sole *Microstomus kitt*; mackerel *Scomber scombrus*; Norway lobster *Nephrops norvegicus*; plaice *Pleuronectes platessa*; sandeel *Ammodytidae spp.*; sole *Solea solea*; sprat *Sprattus sprattus*; whiting *Merlangius merlangus*. This information is presented by month in the table below [36][37].
Nursery grounds	The following species use the area as nursery grounds: anglerfish *Lophius piscatorius*; blue whiting *Micromesistius poutassou*; cod; European hake *Merluccinus merluccinus*; herring; lemon sole; ling *Molva molva*; mackerel; Norway lobster; plaice; sandeel; spurdog/spiny dogfish *Squalus acanthias*; sole; sprat; tope shark *Galeorhinus galeus*; whiting. This information is presented by month in the table below [36][37].
Probability of juvenile fish aggregations	Aires *et al.* (2014) provides a predicted spatial distribution of 0-year group (i.e. juvenile) fish. The model predicted low densities (<0.1) for the following species in the CMS area and along the PL929/PL930: plaice, sole, hake, anglerfish, blue whiting, Norway pout, mackerel, haddock, and cod. The probability of juvenile herring, horse mackerel, sprat, and whiting being present in the CMS area is low-moderate [38].

Spawning / Nursery Grounds

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	SN	S*N	S*N	SN	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	SN	SN	SN	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	S*N	S*N	S*N	SN	N	N	N	N
Nephrops	SN	SN	SN	S*N	S*N	S*N	SN	SN	SN	SN	SN	SN
Plaice	S*	S*	S									S
Sandeel	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Sole			S	S*	S							
Sprat	N	N	N	N	S*N	S*N	SN	SN	N	N	N	N
Tope shark	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	SN	SN	SN	SN	SN	N	N	N	N	N	N

S = Spawning, N = Nursery, SN = Spawning and Nursery; * = peak spawning; Species = High nursery intensity as per Ellis *et al.*, 2012; Species = High intensity spawning as per Ellis *et al.* (2012)

Seabirds

The CMS area is important for northern fulmar *Fulmarus glacialis*, northern gannet *Morus bassanus*, great black-backed gull *Larus marinus*, black-headed gull *Larus ridibundus*, common gull *Larus canus*, herring gull *Larus argentatus*, Atlantic puffin *Fratercula arctica*, black-legged kittiwake *Rissa tridactyla*, common guillemot *Uria aalge*, razorbill *Alca torda*, little auk *Alle alle* and lesser black-backed gull *Larus fuscus* for the majority of the year [39].

The sensitivity of seabirds to oil pollution is shown below by the Seabird Oil Sensitivity Index (see below for an abbreviated version of the SOSI, a full version is available in the Section 4.5) [40]. SOSI is shown by UKCS Block. The CMS area and associated PL929 and PL930 cover a number of Blocks.

Seabird sensitivity to oil within the offshore CMS area (Blocks 44/21, 44/22, 44/23, 44/17, 44/18, 44/19; see Figure 2.3.1) is low throughout the year and highest in July and the months of November to January. Along the PL929 and PL930 sensitivity is variable and generally higher throughout the year compared to the CMS area. SOSI is highest approximately halfway along the pipelines to shore; in Block 48/2 sensitivity is high, very high or extremely high every month of the year. In the Blocks nearest to the coast (47/17, 47/18) sensitivity is highest between October and December, and in March.

Seabed Oil Sensitivity Index (SOSI)

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43/29	2*	5*	5	5*	3*	3	1	4	2	2*	2*	2
43/30	2*	5*	5	5*	2*	2	1	4	3	3*	2*	2
44/17	3*	5*	5	5*	5*	5	3	4	5	5*	3*	3
44/18	3*	5*	5	5*	5*	5	4	5	5	5*	3*	3
44/19	1*	5*	5	5*	5*	5	4	5	5	5*	1*	1
44/21	2*	5*	5	5*	4*	4	1	3	5	5*	2*	2
44/22	3*	5*	5	5*	5*	5	2	3	5	5*	3*	3
44/23	3*	5*	5	5*	5*	5	3	5	5	5*	3*	3
44/26	2*	5*	5	5*	3*	3	1	4	5	5*	2*	2
47/15	3	3	2	5	5	5	5	3	5	3	1	2
47/17	4	4	3	5	5	5	5	5	5	2	2	2
47/18	4	4	2	5	5	5	5	4	4	1	2	2
47/19	3	3	2	5	5	5	5	4	4	3	1	2
47/20	3	4	2	5	5	5	5	4	4	3	1	2
48/2	1*	2	1	1*	2	2	2	3	1	1*	1*	1
48/3	1*	5*	5	5*	3*	3	1	4	1	1*	1*	1
48/4	1*	5*	5	5*	4*	4	1	4	1	1*	1*	1
48/6	2	2	2	2*	5	5	3	3	2	2	2	1
48/7	3	2	2	2*	5	3	3	3	2	2	2	1
48/11	3	3	2	2*	5	5	5	3	5	4	2	2

Key	1 = Extremely high	2 = Very high	3 = High	4 = Medium	5 = Low	N = No data
	* in light of coverage gaps, an indirect assessment of SOSI has been made					

Socio-economic Receptor	Description

Commercial Fishing

The CMS area is located in International Council for the Exploration of the Seas (ICES) statistical rectangle 37F2. The associated PL929 and PL930 pass through rectangles 37F1, 36F1, 36F0, and 35F0. Fisheries landings vary throughout the project area. At the CMS area, in 2019 catch was mostly demersal and was relatively low compared to other rectangles. Closer to shore shellfish make up the majority of landings the value of which was very high; in rectangles 36F1, 36F0 and 35F0 closest to shore the value of catch was >£1,000,000 every year from 2015 onwards. In 2019 the value of catch in rectangle 36F0 alone was £10,926,070 [41].

Commercial fishing effort was also highest in rectangle 36F0 (2,344 days in 2019). This effort is consistently high across all months excluding January, February, November and December when effort

<table>
<tr><td colspan="2">is moderate. Effort is much lower around the CMS (rectangle 37F2). Effort in 2019 was lower compared to historical data – a total of 167 days (attributed exclusively to the months of April, May, July and August). Fishing effort in other rectangles is comparatively low (<100 days per month). Data is not available or disclosive within rectangle 35F0, likely due to its proximity to the coast [42].</td></tr>
<tr><td colspan="2">Other Users</td></tr>
<tr><td>Shipping activity</td><td>Shipping activity is variable at the CMS and along the pipelines to shore. Blocks 47/18, 47/19, 47/20, 47/15 (closest to shore) experience very high shipping activity, due to proximity to the Humber Estuary.

Further offshore, Blocks 48/11, 48/6, 48/7, 48/2, 48/3, 48/4, 43/29, 43/30 experience high shipping activity. Shipping is moderate in Blocks 44/26, 44/21, 44/22, and 44/23. The Blocks containing the northern half of the CMS (44/17, 44/18, 44/19) experience high shipping [43]. The most common vessel type in the area is cargo vessels (75” of all traffic), followed by tankers (15%) and oil and gas associated craft (9%) [10].

For the assets covered by CDP2, the annual passing powered collision frequencies associated with the surface installations ranges from 1.9 x 10^{-4} (1 in 5,340 years) for Boulton BM and 1.4 x 10^{-5} (1 in 69,000 years) for Kelvin TM [10].</td></tr>
<tr><td>Oil and Gas</td><td>The following installations are located within 50 km of the CMS area (all assets are active unless otherwise stated):
<table>
<tr><th>Name</th><th>Operator</th><th>Distance / direction</th></tr>
<tr><td>Wingate platform</td><td>Wintershall</td><td>20.1 km ENE</td></tr>
<tr><td>Tyne platform</td><td>Perenco</td><td>22.7 km NNE</td></tr>
<tr><td>Ketch platform (not in use)</td><td>Faroe Petroleum</td><td>26.6 km SSE</td></tr>
<tr><td>Schooner A (not in use)</td><td>Faroe Petroleum</td><td>28.2 km SSW</td></tr>
<tr><td>Cygnus A platform</td><td>Neptune</td><td>33.6 km NNW</td></tr>
<tr><td>Cygnus B platform</td><td>Neptune</td><td>37.9 km NNW</td></tr>
<tr><td>D15-FA1 platform</td><td>Neptune</td><td>40.3 km ENE</td></tr>
<tr><td>Trent platform</td><td>Perenco</td><td>43.4 km WNW</td></tr>
<tr><td>Cavendish platform</td><td>INEOS UK SNS</td><td>44.6 km WNW</td></tr>
<tr><td>Chiswick platform</td><td>Spirit Energy</td><td>45.9 km SSE</td></tr>
</table></td></tr>
<tr><td>Telecommunications</td><td>The closest cable to the CMS is the TAMPNET Norsea Com 1 telecommunication cable (active) which passes through the area at the Murdoch platform (<1 km away). The MCCS telecommunication cable (active) also passes through the CMS area (<1 km from Murdoch) and joins the TAMPNET cable at Murdoch [44]. Finally, the BT UK-Germany 6 Seg 4 cable runs ~24 km northeast of the Katy platform [44]. The PL929 and PL930 do not cross any third-party telecom cables.</td></tr>
<tr><td>Military activities</td><td>Blocks 47/18, 47/19, 47/20, 47/15, 43/29, 43/30, and 44/26 are of concern to the Ministry of Defence (MoD) as they lie within training ranges. Additionally, Block 47/17, in which the PL929 and PL930 terminate at the shore, has been excluded from consideration of granting development licenses at the request of the MoD [45].

CMS area is located within a military exercise area. This exercise area is a Notifiable Danger Area used by the RAF. The area is currently active and could have military activity during the decommissioning operations. There is a MoD submarine exercise area to the south of the Caister CM facilities [10].</td></tr>
<tr><td>Renewables</td><td>The following windfarm areas are located close to the CMS area: Hornsea 1 (active, some areas under construction) ~35 km southwest from Murdoch; Hornsea 2 (under construction) 35 km southwest from Murdoch; Hornsea 3 (proposed) 31 km due south from Murdoch; Hornsea 4 (proposed) >50 km</td></tr>
</table>

	southwest from Murdoch (the Hornsea windfarm sites are all operated by Orsted); Dogger Bank Creyke Beck A (a joint venture between Equinor and SSE) 49 km from Murdoch [44]. The PL929 and PL930 pass through the Hornsea 2 area for ~30 km and cross the Hornsea 1 active export cable (at ~KP 83). The pipelines also pass through the Triton Knoll windfarm which is currently under construction (constructed and operated by RWE on behalf of a partnership) for ~8 km (between KP 42 and KP 50). The PL929 and PL930 pass 3 km north of the proposed Race Bank windfarm extension area (operated by Orsted) and are 7 km from the existing windfarm area. The active Lincs windfarm (operated by Orsted) is located 12 km south of the pipelines as they come to landfall [44].
Wrecks	There are seven non-dangerous wrecks within 20 km of Murdoch. There is a single dangerous wreck 18 km from Murdoch. There are no designated historical wrecks recorded in the area [46]. The 2020 baseline survey identified a possible wreck located 200 m NW of Boulton BM [15].

4.2 Seabed environment

4.2.1 Regional context

The North Sea is a large shallow sea with a surface area of around 750,000 km^2. The SNS is particularly shallow, with water depths of approximately 50 m or less [47]. Benthic sediments in the SNS consist largely of sand or muddy sand, with significant areas of coarse sediment, the latter mostly closer to shore [48]. Seabed features in the SNS include active sandbanks and sand waves which are maintained by the tidal and current regimes. An example is the North Norfolk sandbanks which is an active sandbank system thought to be progressively elongating in a north-easterly direction, maintained and developed by sediment transported offshore [18]. Another example is the less active Dogger Bank which is characterised by a large sublittoral sandbank formed by glacial processes before being submerged through sea level rise [48].

The Dogger Bank is home to a variety of species which live both on and within the sandy sediment. These species include segmented polychaete worms, shrimp-like amphipods, and small clams which burrow into the sand. Hermit crabs, flatfish and starfish also live on top of the sandbank. The location of Dogger Bank in the open sea means that it is exposed to waves, which in turn prevents the shallower parts of the bank from becoming vegetated [18]. Long thin silver sandeels can be found on the sides of the sandbank and are food for many seabirds, cetaceans, and fish [18].

The majority of sediments across the Dogger Bank are classified as sand to muddy sand. The underlying substrate is comprised mostly of clay material. Sands of variable thickness overlie the geological Dogger Bank Formation, reaching 20 m thickness in the southeast, while thinner layers (typically 0.1 – 0.2 m) cover the west and north of the site [49]. Similarly, a study of the evolution of the Dogger Bank identified the upper sand seabed layer to be between 5 m and 20 m in an area approximately 100 km north-northwest of the CMS [50]. Sand waves and mega ripples occur across the south-west and east central areas of the Dogger Bank.

Sand waves are generated by tidal currents in shallow tidal seas. Typical wavelengths range from 100 m to 800 m and they can be up to between 1 – 5 m high. The crests are almost orthogonal to the direction of tide propagation. Sand banks, particularly those in the North Norfolk area of the SNS, are large-scale mobile seabed forms in dynamic equilibrium with the environment. They can have a wavelength between 1 – 10 km, and they can achieve a height of several tens of metres [51]. Sand banks are found widely on shallow continental shelves where there is an abundance of sand and where currents exceed a certain speed [52]. The sand banks arise from an inherent instability of a seabed subject to tidal flow and mass transport. An example of some of the sandbanks associated with Dogger Bank region of the SNS can be seen on Figure 4.2.1. The waves can be seen in dark orange to the north and east of the Boulton BM platform.

4.2.2 CMS seabed environment

An overview map showing the locations of the most recent environmental surveys is provided in Figure 4.2.2. A survey conducted by Gardline Ltd in August 2015 sampled at the Murdoch Hub and Caister CM locations. The object of the pre-decommissioning survey, was to obtain baseline physico-chemical and faunal data, including the classification of the habitat types present according to EUNIS habitat classification. Geophysical data were acquired across the two areas utilising side scan sonar (SSS) and single and multi-beam echo sounder (SBES and MBES) to accurately confirm water depth, seabed material and to locate and identify any environmental habitats, seabed features or debris. The sample station locations from the Murdoch Hub are shown in Figure 4.2.3. The sample station locations taken at the Caister CM installation are shown in Figure 4.2.4.

A more recent survey was undertaken between 31st May 2020 and 16th June 2020 by Gardline Ltd. A pre-decommissioning survey and an environmental survey including a habitat assessment were completed of the offshore CMS area, comprising the Boulton BM, Munro MH, Kelvin TM, Katy KT platforms and the Hawksley EM subsea installation. The surveys gathered geophysical data to characterise the local physical environment around each platform. Still images and environmental samples were obtained at all of the surveyed locations to identify seabed features and classify the benthic communities. The locations of the environmental sampling are shown in Figure 4.2.5.

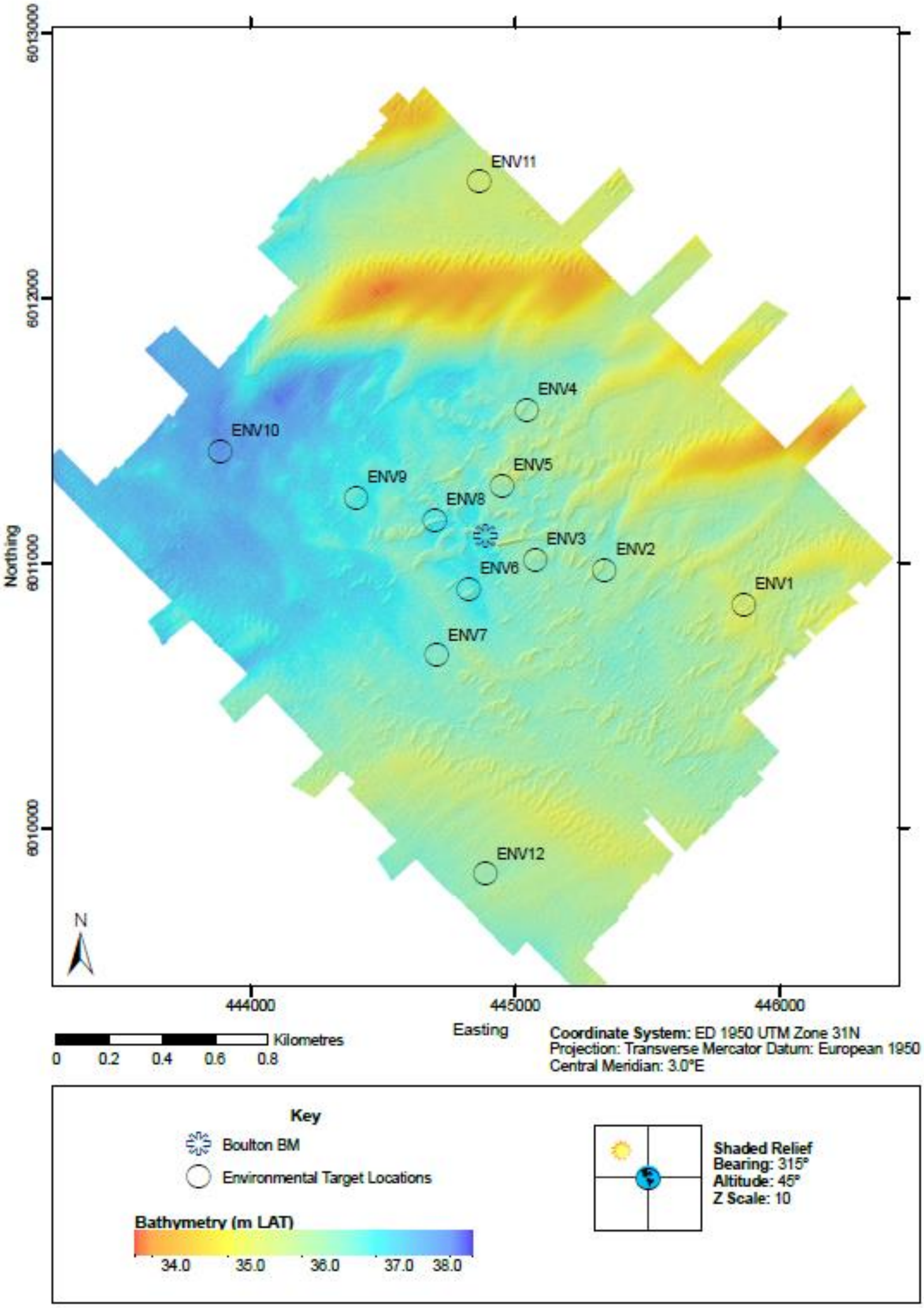


Figure 4.2.1: Bathymetry and sand waves around the Boulton BM platform [14]

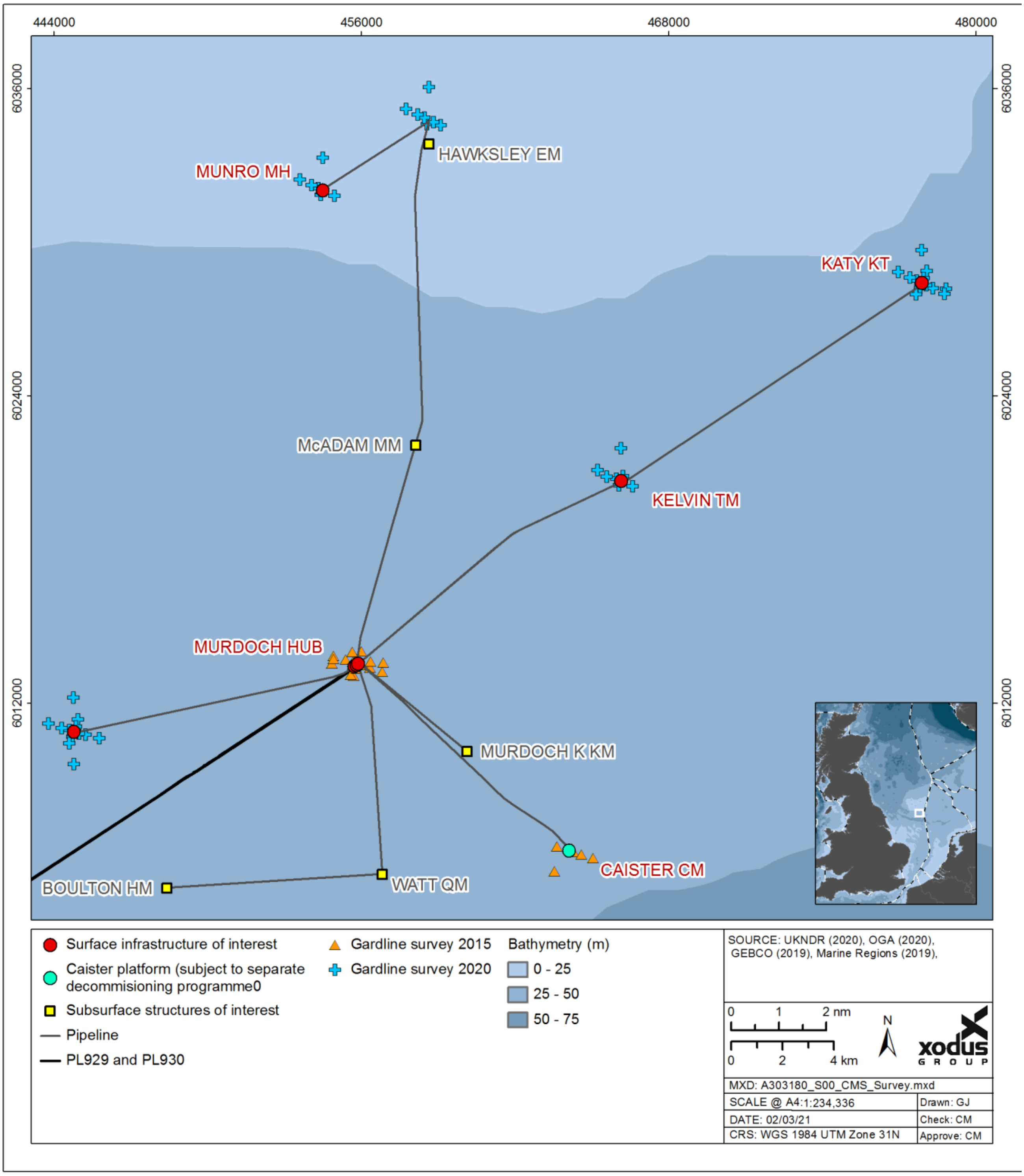


Figure 4.2.2: Locations of the most recent environmental surveys in the CMS area [14][15]

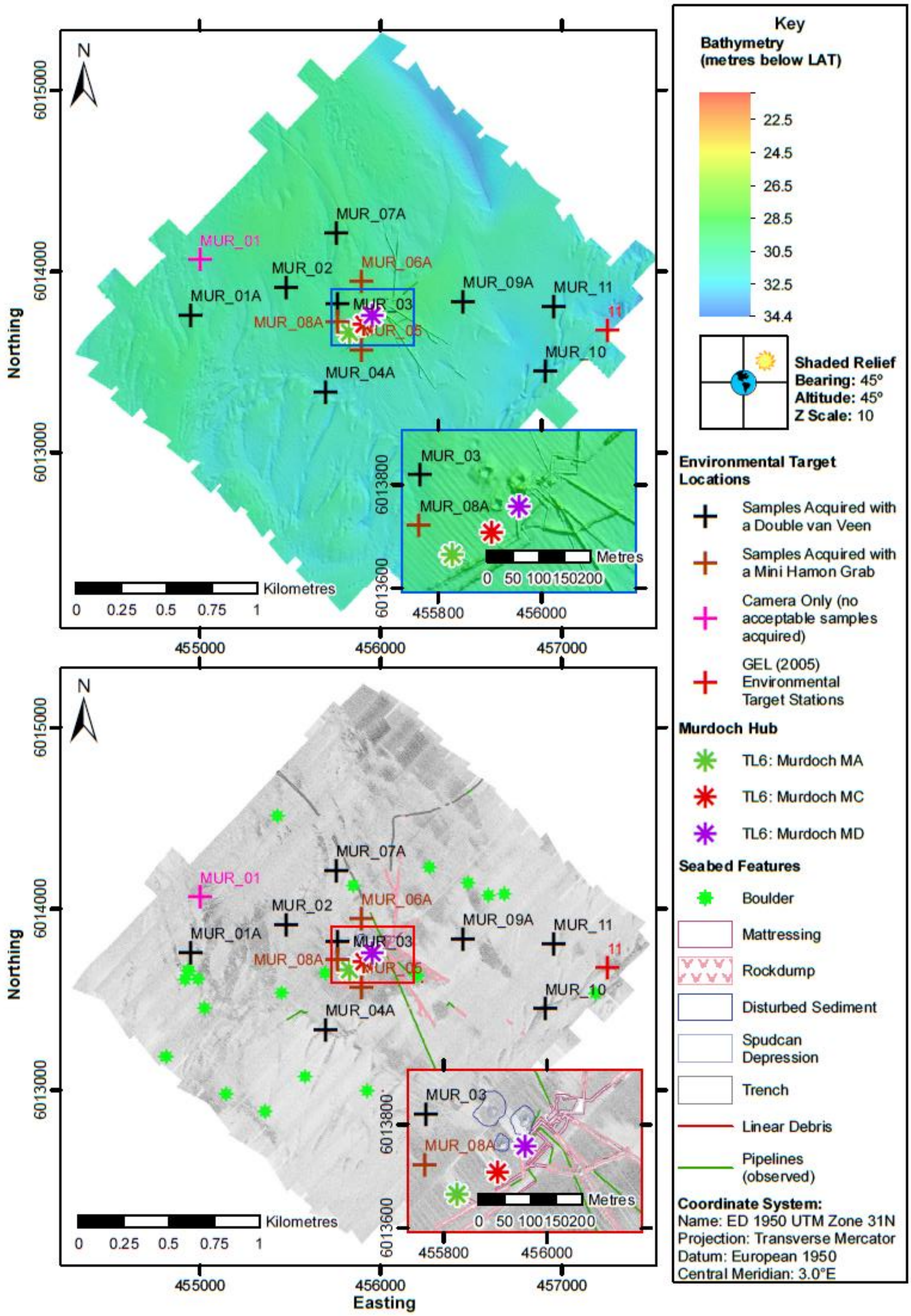


Figure 4.2.3: Sample station locations at the Murdoch Hub [14]

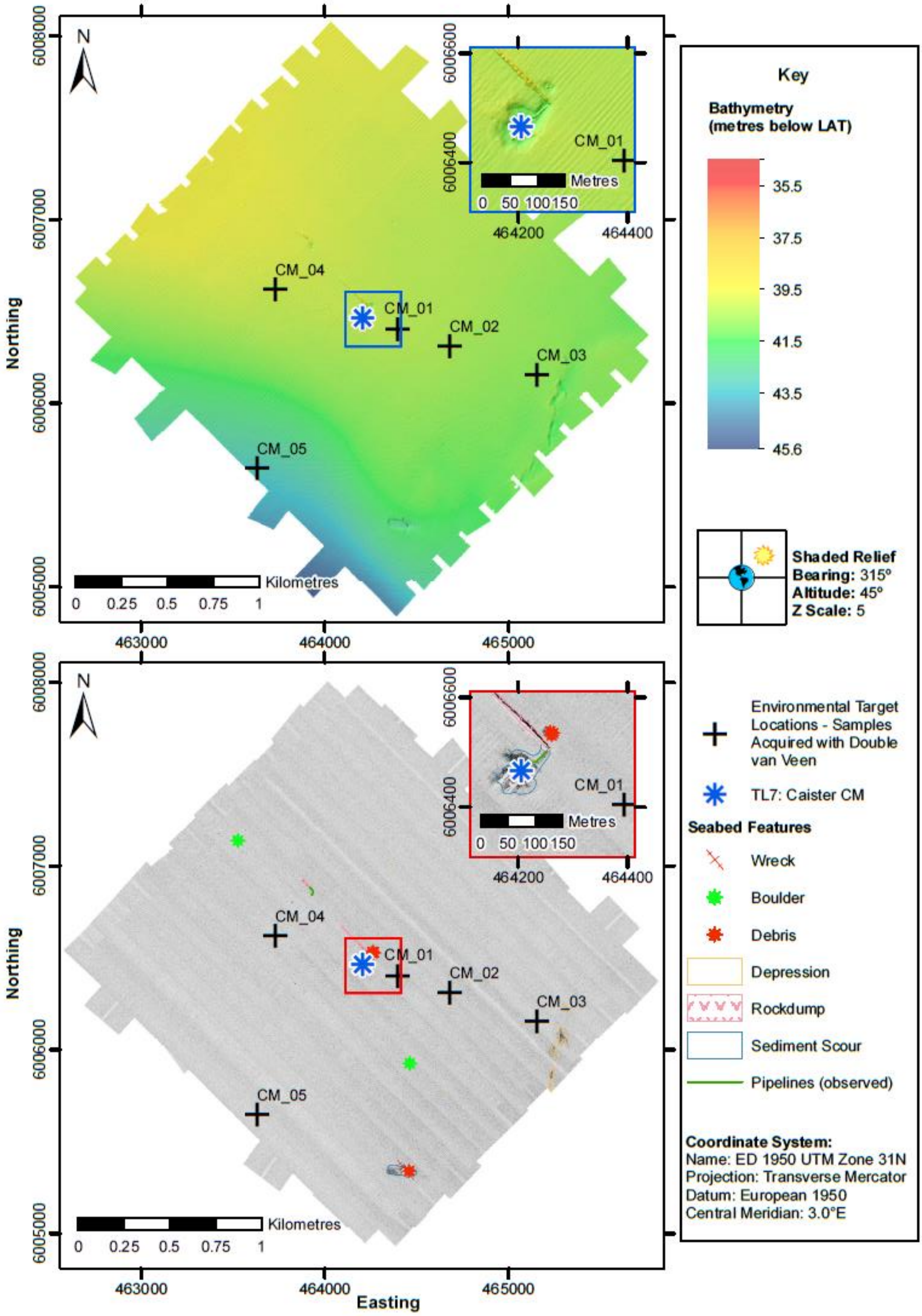


Figure 4.2.4: Sample station location at Caister CM [14]

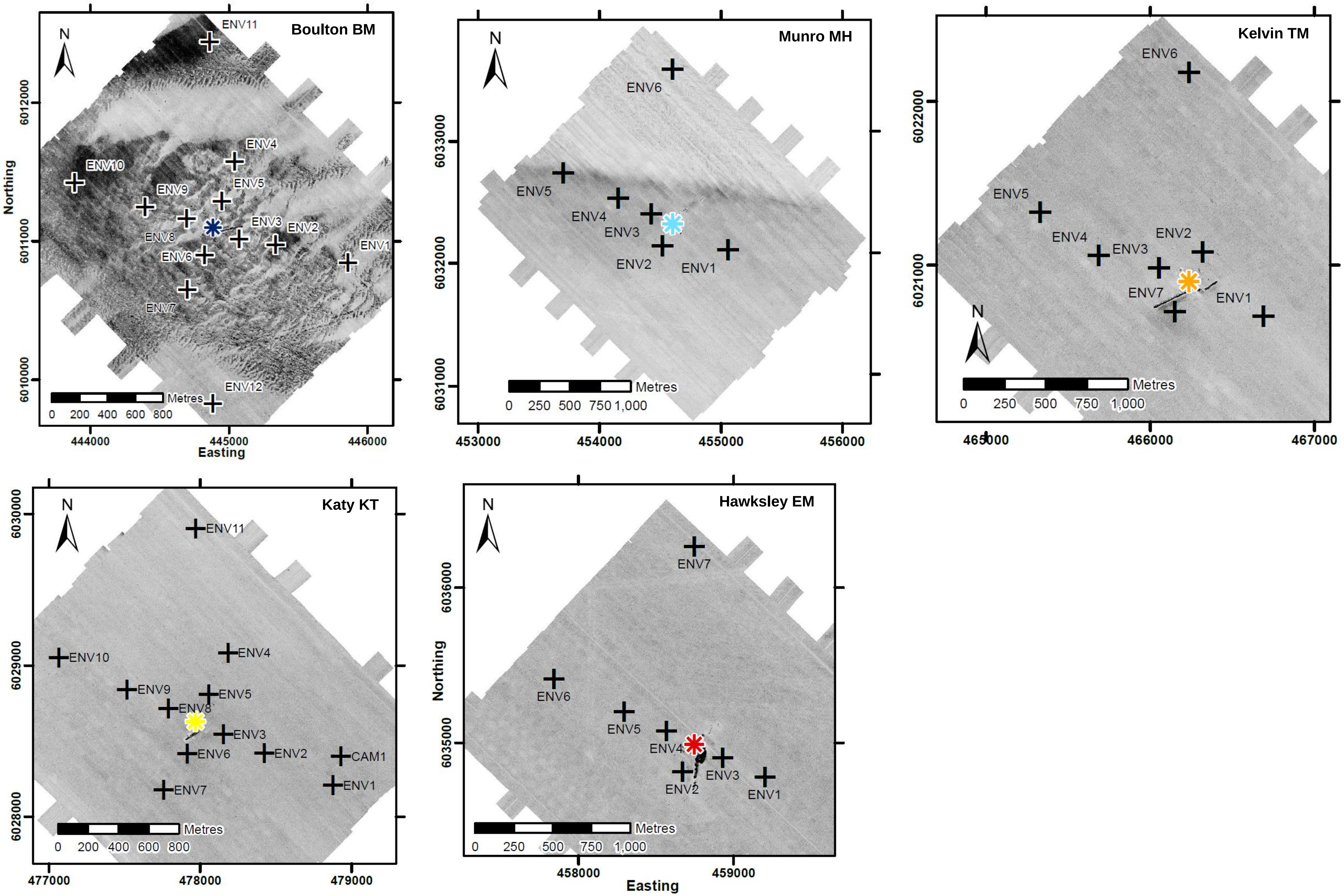


Figure 4.2.5: Sample station locations at CMS subsea infrastructure [15]

4.2.2.1 Physical composition

The seabed within the SNS is generally sandy. The CMS area is located in an area of seabed which can be considered a mix of EUNIS biotope complexes A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand and A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand, which are associated with the Dogger Bank feature [35]. The seabed sediments remain relatively consistent along the pipelines to shore. The PL929/PL930 travelling to shore pass through a band of A5.15: Deep circalittoral coarse sediment. This is followed by an area of A5.14, small outcrops of A5.25 or A5.26 may be encountered for a stretch. Finally, the pipelines pass through a thin section of A5.13 just prior to landfall [35].

Survey data from 2020 shows that the seabed at the Boulton BM, Munro MH, Kelvin TM, Katy KT platforms and the Hawksley EM subsea installation is best represented by EUNIS biotope A5.26 circalittoral muddy sand. EUNIS biotope A5.25: Circalittoral fine sand was also found, to a lesser extent, across the surveyed areas. EUNIS biotope A5.14: Circalittoral coarse sediment were also observed, albeit in small pockets, at all the areas surveyed, except at Kelvin TM. There was evidence of EUNIS A5.44: Circalittoral mixed sediments at Boulton BM [16]. One of the stations at Katy KT (pictured in Figure 4.2.6) identified a gravel mound (a concrete mattress dump) which was classified as EUNIS biotope complex A4.21: Echinoderms and crustose communities on circalittoral rock [16]. The sediment identified at the Murdoch Hub during the 2015 survey was classed similarly, all stations were either A5.25 or A5.14. The seabed at Caister was slightly different, considered A5.27: Deep circalittoral sand, owing to the slightly deeper water in the southeast of the CMS area [14]. While the Caister CM platform is not covered by this EA, having been addressed separately [1], Caister is ~5 km from the Watt QM and Murdoch K.KM subsea structures and therefore the environment is comparable.

The seabed at the Murdoch Hub was largely compromised of sand with shells, shell fragments and occasional gravel. Sand ripples and megaripples were observed at all stations throughout the area surveyed [14][15], though were most noticeable at Boulton BM where the seabed was characterised by outcrops of gravelly sand and low sand relief features (up to 1.5 m high with a maximum slope of 2.5°), including intermittent ripples (up to 0.3 m high with a maximum slope of 2°) [15]. Stations MUR_03 (pictured in Figure 4.2.6), MUR_04A, MUR_05 and MUR_08A stood out as regions where the sediment was more silty sand and gravel (including pebbles) with some cobbles [15]. The seabed across the Caister CM survey area was predominantly comprised of rippled sand with shells and shell fragments [14].

The mean particle size across the CMS varied but was generally consistent with the SNS UKOOA mean particle size of 243 µm [15]. The notable exception being some of the gravellier stations at the Murdoch Hub, where mean particle diameter reached 2063 µm at Station MUR_08A [14]. Mean particle diameter at Caister CM varied from 126.7µm to 176.7µm, equivalent to very coarse sand, and below the average for the SNS [14]. Mean particle diameter of sediments across the area surveyed at Boulton BM varied from 227µm to 417µm. The seabed at Munro MH was fine to medium grain sand [15].

There was evidence of bottom fishing in the north of the surveyed area, in depths of 16 m below LAT [15]. The remaining areas of seabed surveyed around the CMS installations was relatively flat and featureless; the concrete mattress dump area at Katy KT, described above, an area of 1 m deep scour immediately south of Hawksley EM, and areas of scour around Katy KT and Kelvin TM are notable exceptions to this [15].

4.2.2.2 Habitats and benthos

The full faunal community at the Murdoch Hub was dominated by Echinodermata in terms of individuals and by Annelida (Polychaetes) in terms of taxa. Only one adult Echinodermata species, *Echinocyamus pusillus*, was present, the other seven taxa (96%) were juveniles; dominated by Echinoidea and Spatangoida juveniles [14]. There was also an abundance of Annelida (Polychaeta), contributing between 9% and 70% of total individuals and 29% to 51% of total taxa at each station. When assessing the adult-only data, polychaetes overtook echinoderms as the most abundant species, largely due to the dominance of the following species: *Ophelia borealis*, *Pisione remota* and *S. bombyx* with 257 individuals, 182 individuals and 107 individuals respectively [14].

Notably, macrofaunal sample analysis identified 21 adult individuals of the reef building polychaete *S. spinulosa* at station MUR_05. However, the species was not observed during seabed imagery investigations [14]. Three small patches of *S. spinulosa* were observed during a pipeline survey of the PL935 and PL936 between Caister CM and the Murdoch Hub. Two of the patches were 2 m long, the other <1 m and all were within ~500 m of the Murdoch Hub [17]. This aligns with the findings of the species in the Murdoch benthic sample. The only other recorded incidence of *S. spinulosa* in the project area is evidence of an establish reef observed during a 2006 pipeline survey of the PL929/PL930 pipelines to shore. The reef spanned a distance of 968 m between KP 31.390 and KP 32.358 close to shore [17]. This section of pipeline is located within the Inner Dowsing, Race Bank and North Ridge SAC, and furthermore appears to coincide with an area of high confidence biogenic reef as recorded by the JNCC [53].

The same 2006 survey identified a 46 m long mussel bed growing on/in the seabed close to the PL929 and PL930. However, there was no record of mussel growth on the pipelines themselves. This feature occurred between KP 44.884 and KP 44.930, approximately 10 km beyond the observed *S. spinulosa* reef [17].

The dominant taxa varied in the seabed at the Boulton BM, Munro MH, Kelvin TM, Katy KT platforms and the Hawksley EM subsea installation; only Spatangoida (juveniles; the order of heart urchins) and *S. bombyx*, a polychaete, featured across all 2019 surveyed areas [15], and at the Murdoch Hub [14]. Notably, only juveniles of the Spatangodia order were so prevalent; when including juveniles in the macrofaunal analysis, they were the top ranked taxon by abundance across all the 2020 surveyed areas with the exception of Hawksley EM. Polychaetes from the family Terebellidae and the mollusc *Fabulina fabula* were also shared across the 2020 survey areas [15]. These findings align with those from the 2015 survey of the Caister and Murdoch assets [14][15]. Overall, given the consistency in results across the CMS area it is likely that the findings are representative of the wider SNS region.

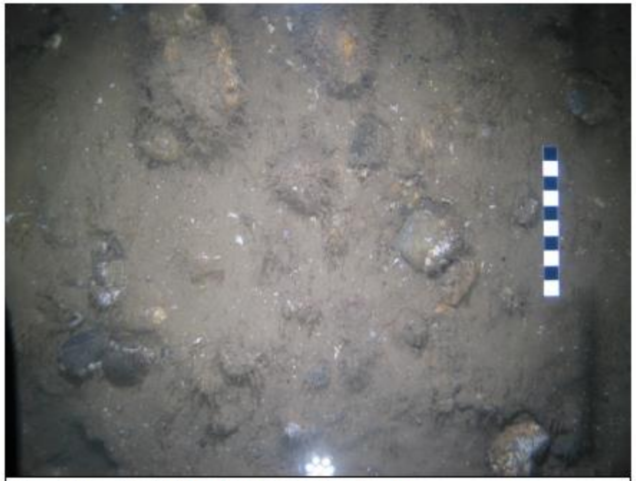
The faunal community at Boulton BM, during the 2020 survey, was found to be dominated in number by Echinodermata, which made up 62% of individuals but only 7% of taxa, compared to Annelida (polychaetes) which contributed 40% of the taxa. Of the Echinodermata, the pea urchin *Echinocyamus pusillus* dominated (n=125). Amongst the polychaetes, the species *S. bombyx* was the most common. Past research has identified *S. bombyx* as the most frequently distributed species in the entire North Sea, according to numerous collated data sets [15]. Other polychaete species at Boulton BM were *Nephtys cirrosa*, *Ophelia spp.* and *Scoloplos armiger* [15].

The adult fauna at Munro MH was dominated by Annelida (Polychaeta) which comprised 48% of the total individuals (n=1500) and 42% of the total taxa (n=47). This was due to the presence of polychaetes of the family Terebellidae which amounted to 35% of the total Annelida individual abundance [15]. After Annelida, molluscs belonging to the class Bivalvia were most common. In the area surveyed around Kelvin TM, the adult benthos was similarly dominated by Annelida (n=451 which contributed 46% of the total individuals), although there was no defining species contributing to the group's dominance, as at other surveyed locations within the CMS [15].

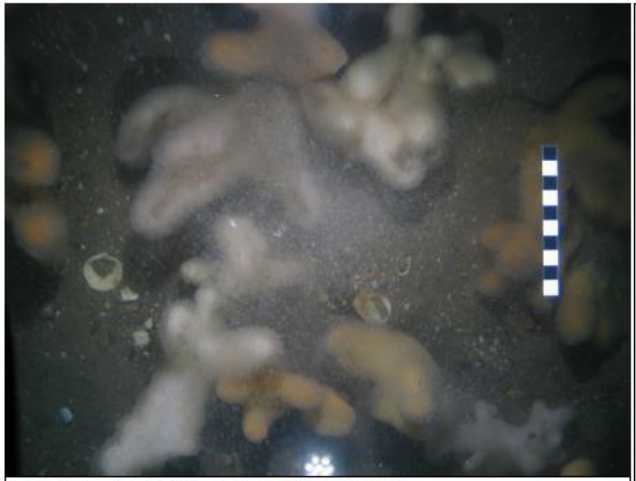
The 2020 survey found that Mollusca were the dominant group at Katy KT; they made up 37% of individuals and 34% of taxa identified. Katy KT was the only site found to be dominated by molluscs. In particular, the species *Fabulina fabula* (n=228) and the indeterminate individuals from the family Thracioidea contributed the most to the benthos here [15]. Notably, a single juvenile *A. islandica* was observed at Katy KT [15]. As mentioned above, the concrete mattress dump by Katy KT (pictured in Figure 4.2.6) was identified as the EUNIS biotope A4.21 echinoderms and crustose communities on circalittoral rock which is characterised by echinoderms, faunal crusts and anemones. The mattress dump covers an area of approximately 28 m^2 and was judged to exhibit a medium resemblance to rocky reef, according to the Irving (2009) definition [16].

The full community at Hawksley EM was heavily influenced by Echniodermata (n=979), this was not reflected in the adult-only analysis (n=7) indicating the disproportionate prevalence of juvenile echinoderms, which appears to be a general trend across the whole CMS area [15]. The adult benthos at Hawksley EM was instead dominated by Annelida (Polychaeta) which contributed 47% of individuals (largely attributed to individuals of the Terebellidae family) and 38% of taxa. Arthropoda were the second most prevalent group, mostly species of the *Bathyporeia* genus which accounted for 24% of the overall total abundance [15].

Murdoch Hub:



Fix: 105 E: 455773 N: 6013820 Depth: 31



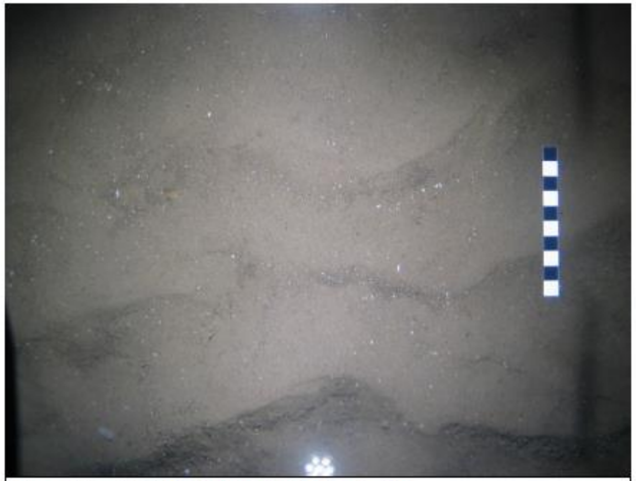
Fix: 124 E: 455763 N: 6013813 Depth: 31

Station: MUR_03
Sediment Description:
Fix105: Silty sand with cobbles and shell fragments

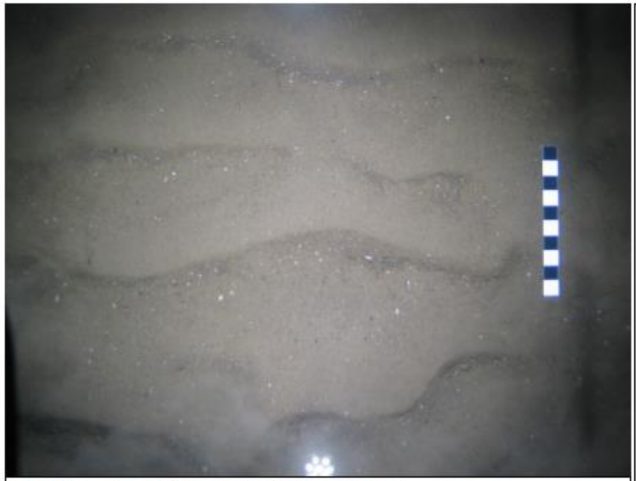
Fix124: Fine to coarse sand with shells, shell fragments and gravel

Fauna Description:
Fix105: Cnidaria (Hydrozoa) and other unidentified species

Fix124: Cnidaria (*Alcyonium digitatum*)



Fix: 197 E: 455749 N: 6014210 Depth: 29



Fix: 211 E: 455749 N: 6014219 Depth: 30

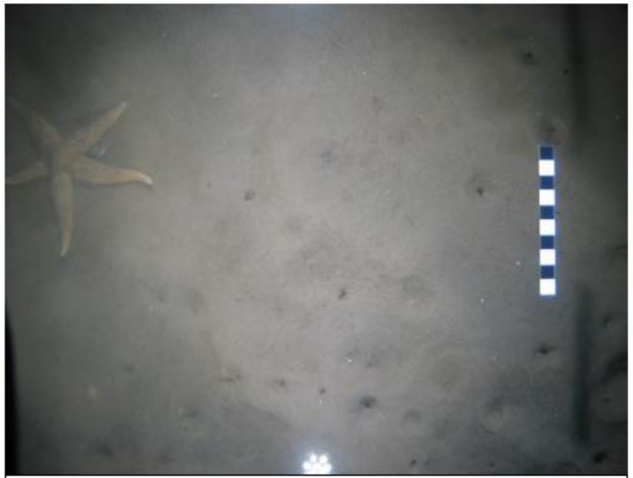
Station: MUR_07A
Sediment Description:
Fix197: Rippled fine to coarse sands with shell fragments

Fix211: Rippled fine to coarse sands with shell fragments

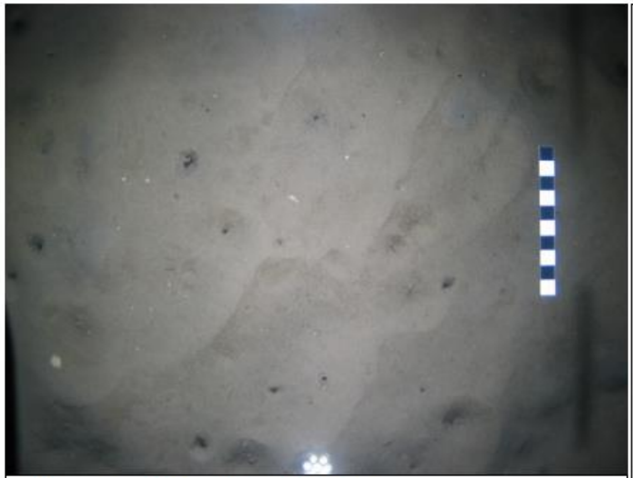
Fauna Description:
Fix197: None visible

Fix211: None visible

Caister CM:



Fix: 364 E: 463734 N: 6006616 Depth: 41



Fix: 375 E: 463731 N: 6006631 Depth: 40

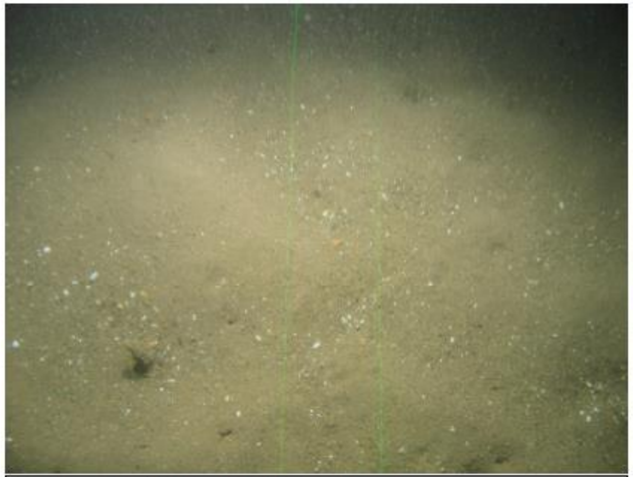
Station: CM_04
Sediment Description:
Fix364: Silty fine to medium sand.

Fix375: Rippled silty fine to medium sand with shell fragments

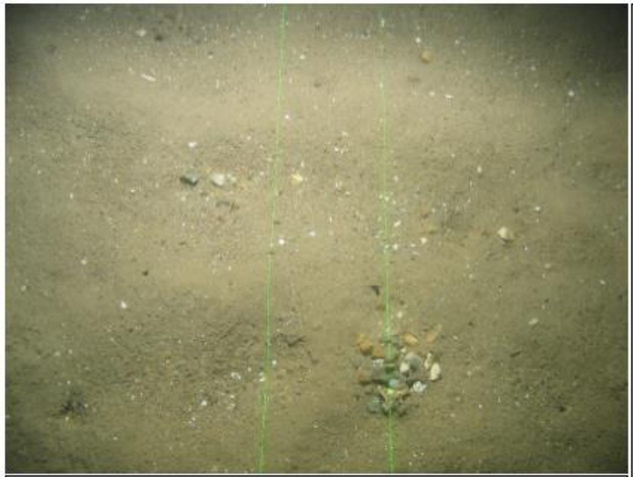
Fauna Description:
Fix364: Echinodermata (*Asterias rubens*)

Fix375: Mollusca (Siphons)

Boulton BM:



Fix: 76 E: 444389 N: 6011247 Depth: 37m



Fix: 102 E: 444395 N: 6011252 Depth: 37m

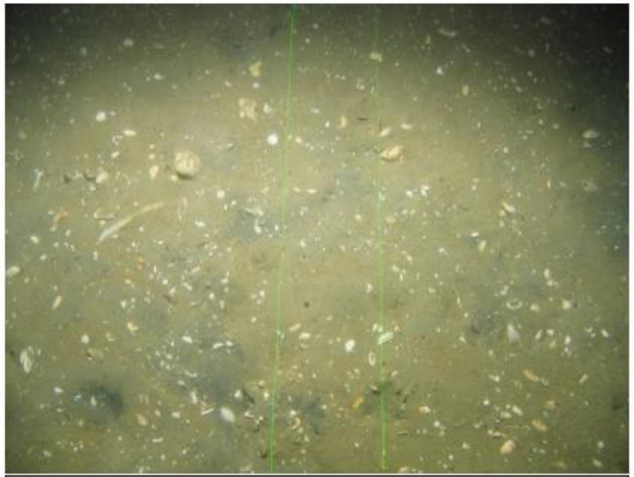
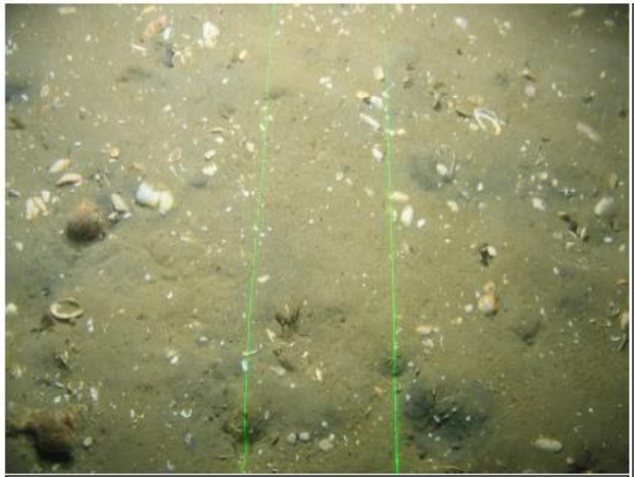
Survey: Boulton BM (11497)
Station: ENV9
Sediment Description:
Fix76: Soft sediment with scattered shell fragments and ripples

Fix102: Soft sediment with scattered shell fragments, gravel and ripples

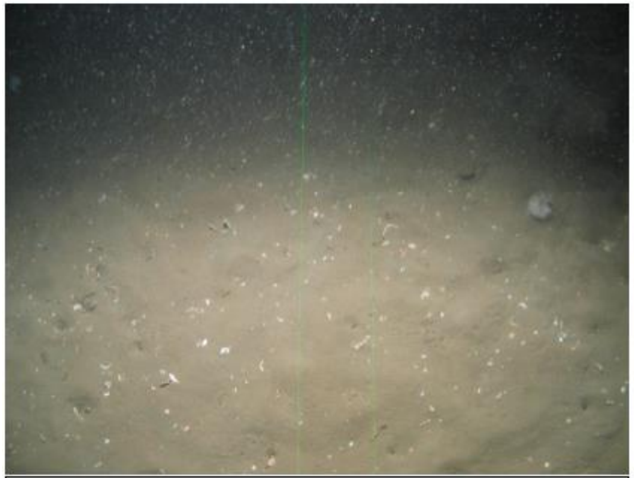
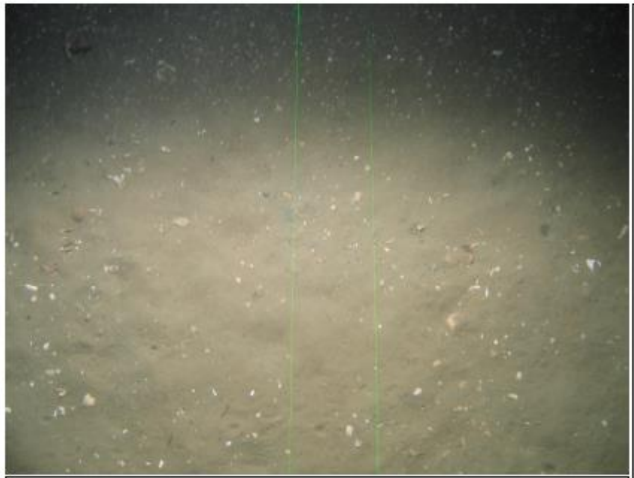
Fauna Description:
Fix76: No visible fauna

Fix102: No visible fauna

Munro MH:

		**Survey:** Munro MH (11498) **Station:** ENV3 **Sediment Description:** **Fix59**: Soft sediment with scattered shell fragments **Fix71**: Soft sediment with scattered shell fragments **Fauna Description:** **Fix59**: No visible fauna **Fix71**: Arthropoda (Paguroidea), Cnidaria (*Hydractinia echinata*)
Fix: 59 **E:** 454389 **N:** 6032326 **Depth:** 28m	**Fix:** 71 **E:** 454411 **N:** 6032321 **Depth:** 28m	

Kelvin TM:

		**Survey:** Kelvin TM (11499) **Station:** ENV1 **Sediment Description:** **Fix78**: Sand with shell fragments and bioturbation **Fix91**: Sand with shell fragments and bioturbation **Fauna Description:** **Fix78**: No visible fauna **Fix91**: No visible fauna
Fix: 78 **E:** 466699 **N:** 6020687 **Depth:** 32m	**Fix:** 91 **E:** 466664 **N:** 6020691 **Depth:** 32m	

Katy KT:

Fix: 59 **E:** 478935 **N:** 6028396 **Depth:** 27m

Fix: 61 **E:** 478934 **N:** 6028395 **Depth:** 27m

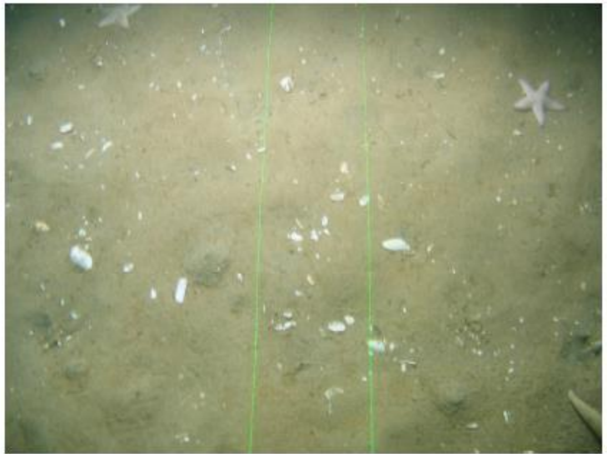
Survey: Katy KT (11500)
Station: CAM1
Sediment Description:
Fix59: Concrete blocks and shell fragments

Fix61: Concrete blocks with small patch of sand and shell fragments

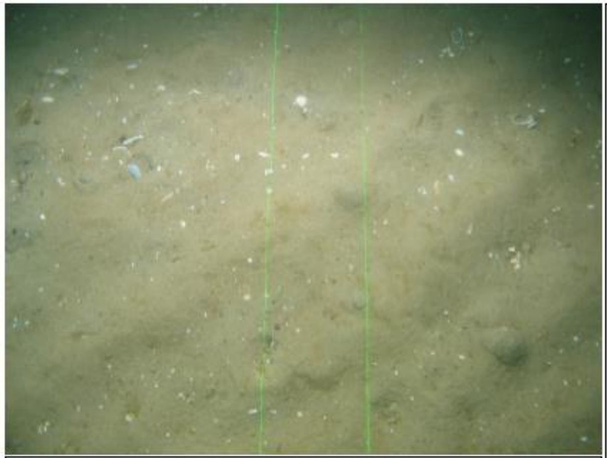
Fauna Description:
Fix59: Arthropoda (*Cancer pagurus*, Cirripedia, Decapoda), Cnidaria (Actiniaria, *Metridium senile*), Porifera

Fix61: Arthropoda (*Cancer pagurus*), Bryozoa (*Flustra foliacea*), Cnidaria (Actiniaria, *Metridium senile*), Porifera (*Sycon* sp.)

Hawksley EM:



Fix: 82 **E:** 458912 **N:** 6034897 **Depth:** 17m



Fix: 92 **E:** 458941 **N:** 6034911 **Depth:** 17m

Survey: Hawksley EM (11501)
Station: ENV3
Sediment Description:
Fix82: Sand with shell fragments

Fix92: Sand with shell fragments

Fauna Description:
Fix82: Echinodermata (*Asterias rubens*, *Astropecten irregularis*)

Fix92: No visible fauna

Figure 4.2.6: Survey images from across the CMS [14][15]

Visible seabed fauna was sparse during the 2020 survey, particularly in areas of seabed which displayed increased sand; this is typical of the mobile SNS environment. There were 16 sightings of bivalve siphons across the seabed surveyed. These represented possible observations of the bivalve *A. islandica*, on the OSPAR list of threatened and/or declining species. However, it is impossible to accurately identify the species from the observation of siphons alone [15]. Only one juvenile *A. islandica* was identified at Katy KT (at station ENV08) [15]. A single *A. islandica* individual was also identified at the Murdoch Hub (at station MUR_02) during the 2015 survey [14]. The rarity with which this species has appeared in the CMS area suggests that the species is not present in great enough number to constitute an aggregation here.

Visible fauna at the Murdoch Hub, surveyed in 2015, consisted of Annelida (Polychaeta); Arthropoda (Brachyura, Cirripedia, Paguridae); Chordata (*Limanda limanda*, *Platichthys flesus*, Soleidae); Cnidaria (Hydrozoa); Echinodermata (Asteroidea including *Asterias rubens*, Echinoidea); Mollusca (Bivalvia, Pharida, Scaphopoda) and Porifera [14]. Owing to the increase in hard surface area the stations MUR_03 (pictured in Figure 4.2.6), MUR_04A, MUR_05 and MUR_08A due to the presence of pebbles and cobbles, there was a higher abundance of epifauna, in particular the Cnidaria *Alcyonium digitatum*, hydroids and sponged. Such species are better able to colonise hard surfaces [14].

Faunal burrows were observed at most of the 2020 survey locations; however, only at one Kelvin TM station (ENV1; pictured in Figure 4.2.6) was the density of burrows recorded at a sufficient level (according to the Marine Nature Conservation Review SACFOR scale) to show any similarity to the 'seapens and burrowing megafauna community' habitat. This habitat is listed as a threatened and/or declining habitat by OSPAR [16]. Crucially, the burrows associated with the OSPAR habitat are generally attributed to species such as *Nephrops norvegicus*, *Calocaris macandreae* or *Callianassa subterranea*. Comparatively, the burrows observed at Kelvin TM and within the CMS area more likely relate to the burrowing urchin *Echinocardium spp*., the razor shell *Ensis spp*., the sand mason worm *Lanice conchilega*, the masked crab *Corystes cassivelaunus* and sand eels. These species are much more characteristic of the Dogger Bank community. Therefore, the burrows identified within the CMS during the 2020 survey cannot be confidently attributed to any of the 'megafauna' species associated with the 'seapen and burrowing megafauna community' habitat [16]. No other designated or priority habitats of conservation interest were observed [16].

As noted in Table 4.1.1, the CMS area is used by a number of fish species for both spawning and nursery behaviours. Cod, *G. morhua*, is listed a 'vulnerable' on the IUCN Global Red List and is listed as an OPSAR threatened and/or declining species. Three juvenile fish of the family Gadidae were recorded during the 2020 survey, one at Kelvin TM station ENV1 and two at Katy KT station ENV10. However, the individuals could not be identified to species level [15]. No other commercially important fish or shellfish species were observed [15].

4.2.2.3 Chemical composition

UKOOA (2001) reported a mean THC of 4.3 µg g^{-1} for samples taken over 5 km from existing infrastructure in the SNS between 1975 and 1995. In this context, samples taken within the CMS were above this level. However, all samples taken within the CMS were within 5 km of infrastructure. Despite this, THC concentrations were below the SEI threshold at all the surveyed locations within the CMS, both in 2015 and 2020 [14][15]. THC was highest at one location at Munro MH: 27.7 µg g^{-1} at station ENV1 [15]. The levels recorded at Munro MH were generally higher than noted during past surveys. Overall, there was no evidence of drilling related hydrocarbon contamination within the CMS [14][15].

Concentrations of total organic matter (TOM) across all five areas surveyed in 2020 (Boulton BM, Munro MH, Kelvin TM, Katy KT and Hawksley EM) were above the UKOOA (2001) mean of 1.2% and generally above the 95th percentile of 2.3%, therefore above what would be expected as background for the SNS [15]. Generally, TOM and total organic carbon (TOC) were higher in areas which had a sandier seabed. Mean TOM was lowest at Hawksley EM (2.3%), and highest at Boulton BM (4.0%).

The total PAH concentration across the whole CMS area was highest at 0.149 µg g^{-1} at Boulton BM and lowest at Hawksley EM <0.001 µg g^{-1} [14][15]. Total, LMW and HMW PAH concentrations were well below their respective Effects Range Low (ERL) values (4.022 µg g^{-1}, 0.552 µg g^{-1} and 1.700 µg g^{-1}) at Boulton BM, Munro MH, Kelvin TM, Katy KT and Hawksley EM, and therefore indicated that toxic effects to fauna by PAHs are unlikely [15]. The PAH concentrations observed during the 2020 survey were found to be lower compared to past surveys, and levels are considered typical of the wider SNS [15].

The seven PCB congeners (PCB28, PCB52, PCB101, PCB118, PCB153, PCB138 and PCB180) were well below the ERL concentration as reported in OSPAR (2009) suggesting toxic effects to fauna from the total PCBs present would rarely be expected to occur, at Caister CM and the Murdoch Hub PCBs were below the LOD of 5.0 $\mu g\ g^{-1}$ [14][15].

All detectable concentrations of As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn (normalised to 5% Al) were above their respective OSPAR (2005) BCs. Additionally, the survey mean values for As, Cr, Cu, Ni, Pb, and Zn exceeded the OSPAR (2005) Background Assessment Criteria (BAC) values, whilst the mean concentrations for Cd and Hg were not calculated due to values <LOD. Across the five surveyed areas from 2020 all detectable concentrations of Li and V were above the upper limit of their respective OSPAR (1997) BRC ranges [15]. In addition to Li and V, results from the Murdoch Hub and Caister CM in 2015 indicated that Fe concentrations were above the upper limit of its BRC range [14]. This is to be expected due to the heavily industrialised nature of the SNS and the region around the CMS in particular [14][15].

Organotin (monobutyltin, dibutyltin and tributyltin) concentrations were below LOD across the CMS, except at a single station at the Murdoch Hub (MUR_03) [14][15]. Concentrations of APEs (including nonylphenol, nonylphenol mono and di-ethoxylates, octylphenol and octylphenol ethoxylates), all fell below their respective LODs across the whole CMS [14][15].

4.3 Commercial fisheries

The infrastructure to be decommissioned as part of the CMS decommission programme is located within International Council for the Exploration of the SEA (ICES) rectangles 35F0, 36F0, 36F1, 37F1 and 37F2. The CMS is itself located within rectangle 37F2 with the PL929 and PL930 passing through the remaining rectangles to shore. Brown and May Marine Ltd undertook a fisheries assessment for Chrysaor in order to identify commercial fishing activity in the vicinity of the CMS decommissioning area, and identified that fishing grounds within the vicinity of the CMS Area are fished to varying degrees by the following fleets:

- Dutch beam trawlers, demersal otter trawlers, and fly seiners;
- UK potters, shrimp beam trawlers, shellfish dredgers, otter trawlers, long-liners, and netters;
- Belgian beam trawlers and demersal otter trawlers;
- Danish sandeelers, midwater and demersal trawlers and seine netters;
- Norwegian purse seiners and midwater otter trawlers;
- German beam trawlers and demersal otter trawlers;
- French otter trawlers (demersal and pelagic); and
- French purse seine netters [54].

With regards to UK fisheries, Table 4.3.1 provides a summary of the landings statistics over the last five data years (2015-2019 inclusive). Within the offshore central CMS area, demersal species were primarily targeted by fishers; they made up 63% of landings and 55% of catch value. In all other rectangles shellfish were dominant, this is most visible closer to shore; in rectangle 36F0 in particular shellfish catch amounted to over 3,000 tonnes, with a value just under £11 million. This is very high within the regional context. Pelagic catch only made up a small component of the catch in rectangles 37F1 and 37F2 [41]. The total live weight of catch across the UK in 2019 amounted to 622 thousand tonnes with a subsequent value of £987 million. The combined totals across all ICES rectangles within which the CMS decommissioning project sits amount to 6,963 tonnes with a value of over £17 million. The waters within which the decommissioning project is located, therefore contributed 1.1% and 1.7% respectively to the overall live weight and value of catch within the UK in 2019 [41].

Table 4.3.2 outlines the effort, according to the number of fishing days between 2015 and 2019. Data was unavailable for past years within rectangle 35F0 and in 2019 the only months with registered fishing effort were disclosive (September to December), therefore this rectangle does not appear in Table 4.3.2 [42]. Fishing effort was highest in rectangle 36F0, reaching a total of 2,344 days in 2019, which corresponds to the high landings and value of catch in that rectangle (see Table 4.3.1). This effort is generally concentrated within the summer months however, effort is consistently moderate (at a minimum) throughout the year in 36F0. Comparatively, the other rectangles experience much lower fishing effort with most months showing either disclosive data or <100 fishing days. Rectangle 36F1, experienced the second highest fishing effort which equated to a total of 551 days in 2019 (though still ~5 times less than the effort recorded in 36F0). Again, this fishing effort is highest in the summer months, although there is some level of effort almost all year round [42].

Figure 4.3.1 shows AIS vessel tracks around the CMS according to fishing gear type. Figure 4.3.2 shows AIS tracks by vessel nationality. This allows for an understanding of the use of the area by foreign vessels and the fishing methods utilised. Dutch fishing effort is low in the CMS area across all fishing types, with respect to the seine netting and netting fleets, values and effort recorded by both these gear types are negligible throughout the CMS area (maximum of €5,000 and 2 to 5 days of effort) [54]. The Belgian beam trawl fleet in the northern area of the CMS shows low levels of fishing activity (maximum annual average of €10,000 and 5 days of fishing effort). Comparatively higher activity is recorded in the southern area although this is still relatively low level (maximum of €25,000 and 10 days effort). Higher values are recorded outside to the south in an area which is intersected by the CMS to TGT export pipeline (a maximum of €500,000 and 50 days effort) [54]. Activity by the Norwegian, German and French fishing fleets is negligible throughout all areas of the CMS area [54].

Published AIS data from the UK fishing fleet shows the average annual number of fishing tracks which cross pipelines (considered representative of fishing intensity), as recorded between 2007 and 2015 (Figure 4.3.3) [55]. Along the pipelines within the CMS area trawling intensity is low-moderate (up to 50-100 tracks), with some higher intensity areas in the north of the CMS particularly along the PL2109 and PL2110 between Munro MH and Hawksley EM. The PL1922 and PL1925 (from Hawksley EM to Murdoch MD via McAdam MM), the PL2430 with its associated umbilical PLU2431 (from Kelvin TM to the Murdoch Hub), and the PL2894 and PL2895 (from Katy KT to Kelvin TM) also experience higher fishing intensity. Along the PL929 and PL930 to shore, the trawling intensity is variable; offshore closest to the CMS the intensity is highest (200-353 tracks, approximately between KPs 140-160), along the rest of the pipeline trawling intensity is negligible (<10 tracks).

Table 4.3.1: Recent fisheries landings data for ICES rectangles 37F2, 37F1, 36F1, 36F0, and 35F0 [41]

ICES rectangle	Fisheries type	Landings data									
		2019		2018		2017		2016		2015	
		Live weight (Te)	Value (£)	Live weight (Te)	Value (£)	Live weight (Te)	Value (£)	Live weight (Te)	Value (£)	Live weight (Te)	Value (£)
37F2	Demersal	163.50	290582.61	502.86	1153239.63	688.39	1018826.65	928.22	1366929.30	1017.30	1490799.85
	Pelagic	0.26	660.73	1.07	640.87	0.99	985.61	0.69	724.27	0.07	45.69
	Shellfish	98.10	240,719.81	101.72	278,572.39	413.51	1,149,483.33	830.62	2,140,745.12	402.66	986,790.44
Total		**261.87**	**531,963.15**	**605.65**	**1,432,452.89**	**1,102.88**	**2,169,295.59**	**1,759.53**	**3,508,398.69**	**1,420.02**	**2,477,635.98**
37F1	Demersal	48.46	69388.60	134.67	276773.02	254.30	339689.47	186.40	258955.38	223.73	276919.16
	Pelagic	0.56	1336.60	0.07	77.82	0.05	37.10	0.12	235.79	0.06	19.82
	Shellfish	287.23	595,779.52	256.30	630,487.30	254.30	534,461.27	468.07	849,830.87	181.16	371,539.93
Total		**336.26**	**666,504.72**	**391.05**	**907,338.14**	**508.64**	**874,187.84**	**654.58**	**1,109,022.04**	**404.94**	**648,478.91**
36F1	Demersal	0.23	1160.87	0.68	1578.37	0.51	504.86	6.22	13191.67	9.88	24511.42
	Pelagic	-	-	-	-	-	-	-	-	-	-
	Shellfish	1,427.35	3,046,907.21	1,161.05	2,371,256.51	1,166.44	1,949,371.04	1,050.43	1,405,270.00	1,265.53	1,584,930.78
Total		**1,427.58**	**3,048,068.08**	**1,161.73**	**2,372,834.88**	**1,166.95**	**1,949,875.90**	**1,056.65**	**1,418,461.67**	**1,275.41**	**1,609,442.20**
36F0	Demersal	15.33	15683.25	9.07	11954.61	5.79	10027.37	7.94	15962.12	22.07	44742.50
	Pelagic	-	-	161.57	87222.38	0.19	165.20	0.00	4.20	3.61	9.00
	Shellfish	3,436.43	10,910,386.83	3,678.11	11,022,651.79	3,857.69	11,129,783.52	3,727.75	9,433,068.53	3,467.20	7,760,575.39
Total		**3,451.76**	**10,926,070.08**	**3,848.75**	**11,121,828.78**	**3,863.68**	**11,139,976.09**	**3,735.69**	**9,449,034.85**	**3,492.88**	**7,805,326.89**
35F0	Demersal	0.80	4310.45	2.46	5579.30	1.03	4253.89	3.01	9311.50	10.87	25680.07
	Pelagic	-	-	-	-	-	-	0.01	22.10	0.23	278.00
	Shellfish	1,484.98	2,006,544.32	1,818.27	2,405,187.00	2,541.20	2,041,489.76	929.28	1,380,714.60	4,386.04	2,501,618.94
Total		**1,485.78**	**2,010,854.77**	**1,820.73**	**2,410,766.30**	**2,542.23**	**2,045,743.65**	**932.30**	**1,390,048.20**	**4,397.15**	**2,527,577.01**

Table 4.3.2: Fisheries effort data for ICES rectangle 37F2, 37F1, 36F1, and 36F0 [42]

ICES Rectangle	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
37F2	2019	-	D	D	21	55	D	31	28	D	D	D	-	**167**
	2018	-	D	D	D	36	28	32	50	36	12	D	D	**224**
	2017	-	D	17	24	106	147	129	102	33	D	D	-	**567**
	2016	-	-	D	D	173	166	222	207	118	21	D	D	**940**
	2015	-	-	-	D	D	190	153	154	63	18	D	-	**601**
37F1	2019	D	D	D	D	25	D	17	18	18	D	D	D	**145**
	2018	D	D	D	D	D	14	16	39	20	14	D	D	**135**
	2017	D	D	7	D	10	56	41	36	17	D	D	D	**189**
	2016	-	D	D	D	16	30	58	33	32	33	D	D	**227**
	2015	-	-	D	D	D	42	36	51	15	D	D	D	**180**
36F1	2019	D	37	29	35	42	34	62	33	51	72	59	68	**551**
	2018	29	D	D	27	29	37	68	82	28	35	21	24	**404**
	2017	16	D	15	23	23	25	83	65	64	41	33	33	**432**
	2016	14	25	D	D	D	27	42	82	64	18	35	D	**401**
	2015	D	D	D	33	51	37	52	65	78	83	41	42	**543**
36F0	2019	142	149	124	173	227	165	277	291	269	243	152	131	**2344**
	2018	136	116	207	248	238	210	285	380	283	246	162	137	**2645**
	2017	167	141	211	230	260	274	306	423	252	258	241	159	**2922**
	2016	106	116	162	158	191	239	297	331	279	226	208	181	**2495**
	2015	118	131	184	263	273	234	277	296	298	264	192	127	**2657**

Note: Monthly fishing effort by UK vessels landing into Scotland: Blank = no data, D = Disclosive data (indicating very low effort, specifically less than 5 over 10 m vessels undertook fishing activity in that month), green = 0 – 100 days fished, yellow = 101 – 200, orange =201-300, red = ≥301

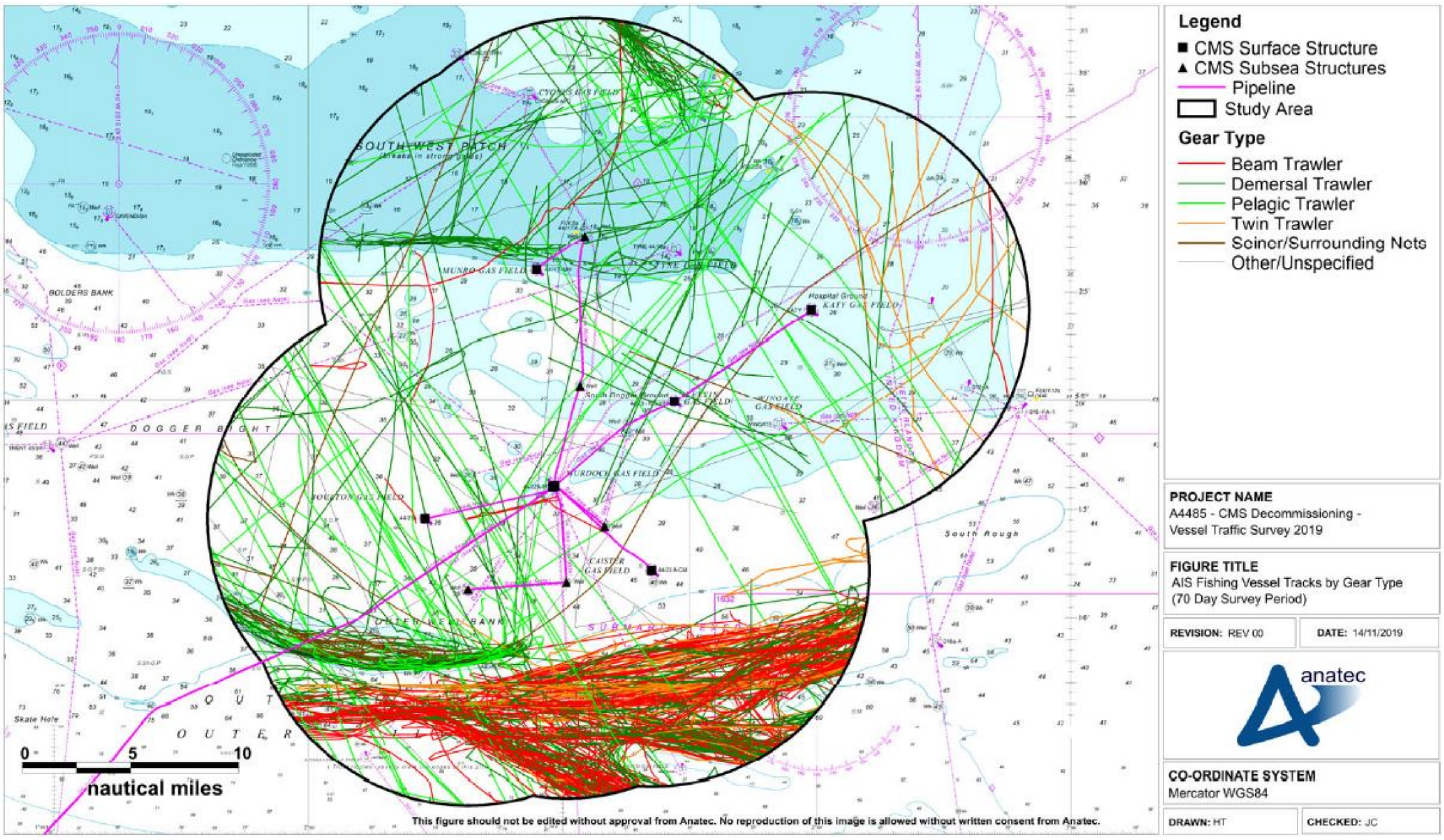


Figure 4.3.1: AIS fishing vessel tracks by fishing gear type [10]

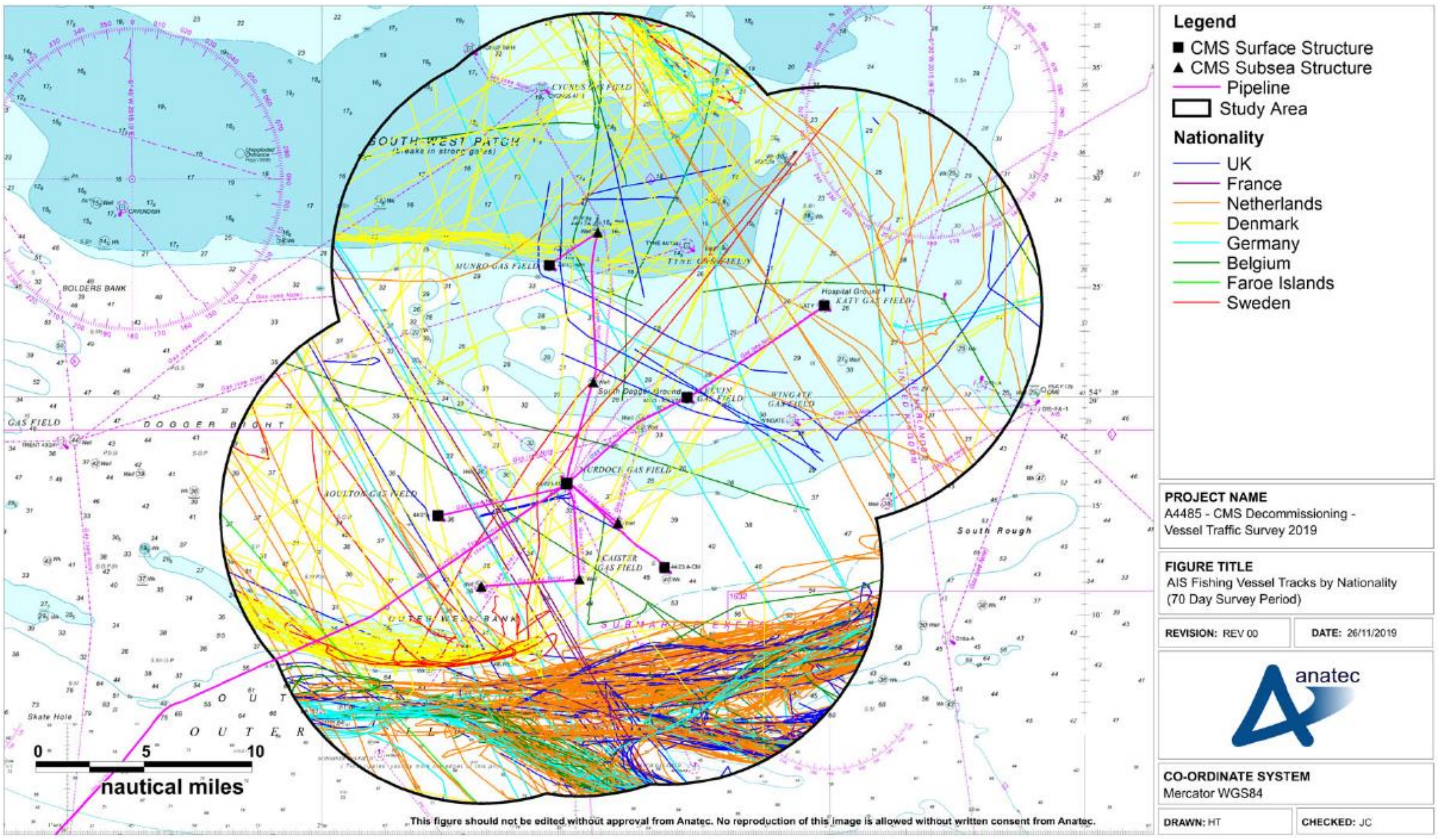


Figure 4.3.2: AIS fishing vessel tracks by vessel nationality [10]

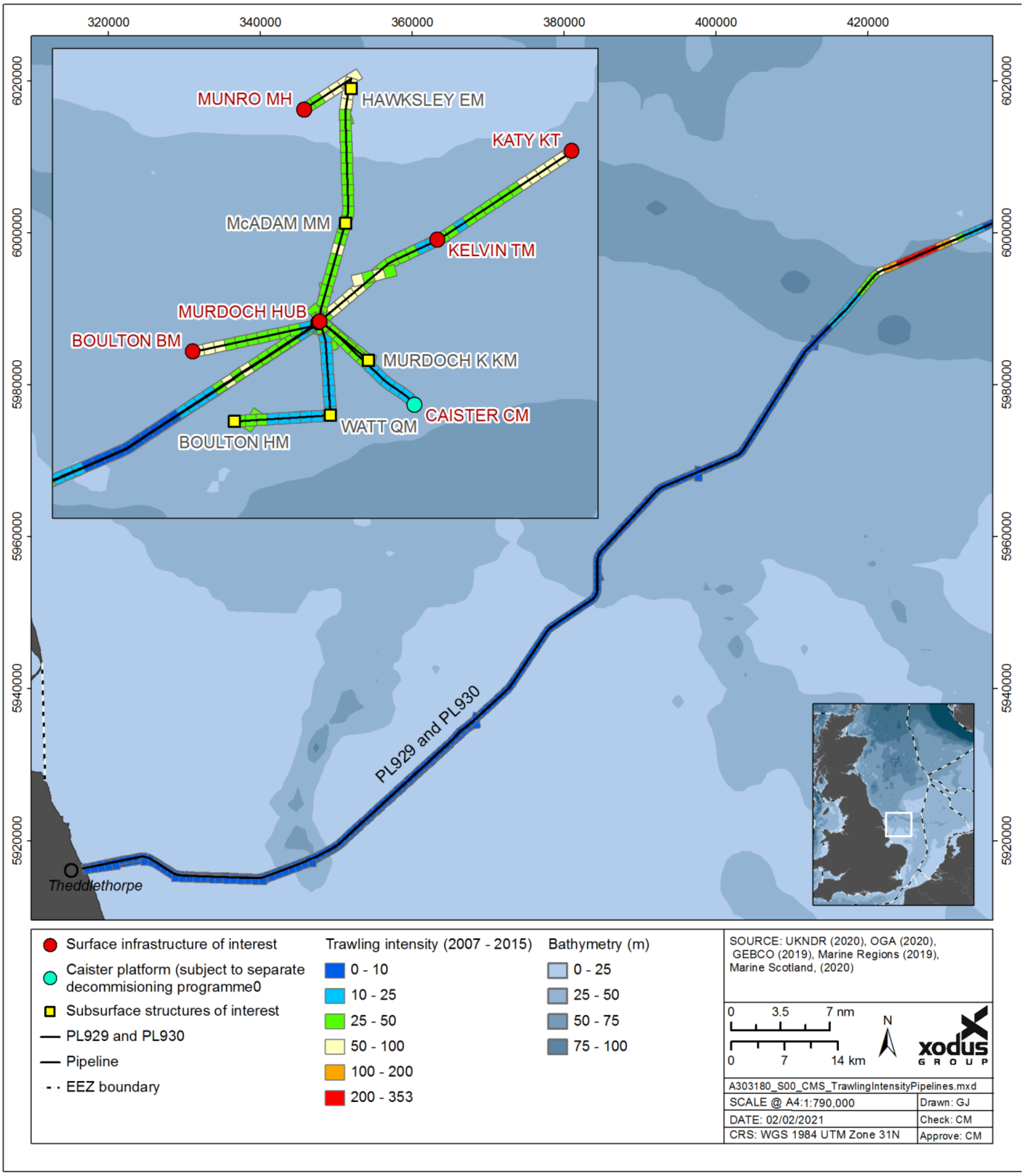


Figure 4.3.3: Trawling intensity along the CMS pipelines [55]

4.4 Marine mammals

4.4.1 Cetaceans

The Atlas of Cetacean Distribution in North-West European Waters compiles the distribution of cetacean species in UK waters [31]. This atlas is based on three sources of cetacean sightings data: JNCC Seabirds at Sea Team, SeaWatch Foundation and data from the first survey of a series called Small Cetacean Abundance in the North Sea. A total of 19 species of cetacean have been recorded in UK waters [31]. Cetaceans regularly recorded in the North Sea include the harbour porpoise *Phocoena phocoena*, bottlenose dolphin *Tursiops truncatus*, minke whale *Balaenoptera acutorostrata*, killer whale *Orcinus orca*, Atlantic white-sided dolphin *Lagenorhynchus acutus* and white-beaked dolphin *Lagenorhynchus albirostris*. Rarer species that are occasionally observed in the North Sea include fin whale *Balaenoptera physalus*, long-finned pilot whale *Globicephala melas*, Risso's dolphin *Grampus griseus* and the short beaked common dolphin *Delphinus delphis* [31]. However, harbour porpoise white-beaked dolphin are the only cetaceans considered as regular visitors in the SNS throughout most of the year, and minke whale *Balaenoptera acutorostrata* as a frequent seasonal visitor [55].

Harbour porpoises are frequently seen across much of the North Sea for much of the year [31]. The predicted density of harbour porpoises in the vicinity of the project area from recent Small Cetaceans in European Atlantic Waters and the North Sea (SCANS-III) surveys is high compared to the rest of the UK waters, with an estimate of around 0.888 animals/km^2 [32]. Harbour porpoise abundance estimates in the North Sea have remained stable between 1994 and 2016, and the species range appears to have expanded [32].

White-beaked dolphins are usually found in water depths of between 50 and 100 m in groups of around 10 individuals, although larger groups have been spotted. They are frequently seen in the central and northern North Sea all year-round in nearshore waters, with sightings in March, May and July in the project area [31]. They have been recorded in the shallower waters of the North Norfolk Sandbanks and within the Dogger Bank and adjacent areas in small numbers [31][55]. The density of white-beaked dolphin in the CMS area is estimated to be 0.002 animals/km^2 [32]. The results of the SCANS-III surveys found that trend analysis of white-beaked dolphin estimates in the North Sea gives no indication of changes in abundance since 1994 [32].

Long-finned pilot whales mostly occur in large pods. The distribution map of pilot whale highlights its use of predominantly deep-water habitat, which constrains them mostly to the north of Scotland within UK waters [31]. However, there appears to be a pattern of seasonality to their sightings as they have been observed further south near the Channel in summer months. Within the project area they have only been observed at a low density in August [31]. Owing to limited observational data the SCANS-III report does not provide a density estimate for the species in the project area [32].

Minke whales are usually found in water depths of 200 m or less and occur throughout the North Sea. They are well distributed in the northern and central North Sea, but occasional sightings have been recorded in the southern half of the North Sea southwards of Flamborough Head and off the north Humberside coast mainly from July to October [55]. On the slopes of the Dogger Bank and in adjacent areas, relatively high densities of minke whales have been reported in spring and summer [31]. Given the lack of sightings in the southern half of the North Sea, minke whales are thought to enter the North Sea from the north [55]. Minke whale density is estimated to be 0.01 animals/km^2 in the CMS vicinity [32]. 2016 abundance estimates for the species were slightly lower than in previous years but still within range of past data therefore there is no support for changes in abundance since 1989 [32].

4.4.2 Pinnipeds

About 38% of the world population of grey seal *Halichoerus grypus* occur in the UK, with 88% of the UK population breeding in Scotland. There are several breeding colonies along the English coast. Breeding takes place in the autumn with mean birth date in eastern England being November-December [55]. Grey seals use the Humber Estuary SAC in autumn to form large breeding colonies on the southern shore of the estuary around Donna Nook [21]. Most of the grey seal population will be on land from October to December during the breeding season, and in February and March during the annual moult, therefore densities at sea are likely to be lower at these times of the year. Grey seal density varies across the CMS and along the associated pipelines to shore. Offshore at the main CMS, grey seal density ranges between 0 and 10 animals per 25 km^2.

Density at the landfall section of the pipelines to shore was between 100 and 150 animals per 25 km^2 [33]. According to the most recent 2020 data, this equates to up to 0.01% of the grey seal population found within a 25 km^2 area in the offshore CMS (Figure 4.4.1) [33].

Harbour seals *Phoca vitulina* are widespread in the Northern Hemisphere. Harbour seals generally haul out on tidally exposed areas of rock, sandbanks or mud. Pupping season is between June and July, and the moult occurs in August and September, therefore from June to September harbour seals are on shore more often than at other times of the year. Harbour seals use the Wash and North Norfolk Coast SAC, ~27 km south of TGT, for breeding and hauling-out [23]. Harbour seal density varies across the project area, ranging from 0-1 animals per 25 km^2 at the CMS area and 5-10 at the PL929 and PL930 landfall [33]. The 2020 data suggests that the CMS area is used by 0.001% of the harbour seal population within each 25 km^2 area (Figure 4.4.1) [33].

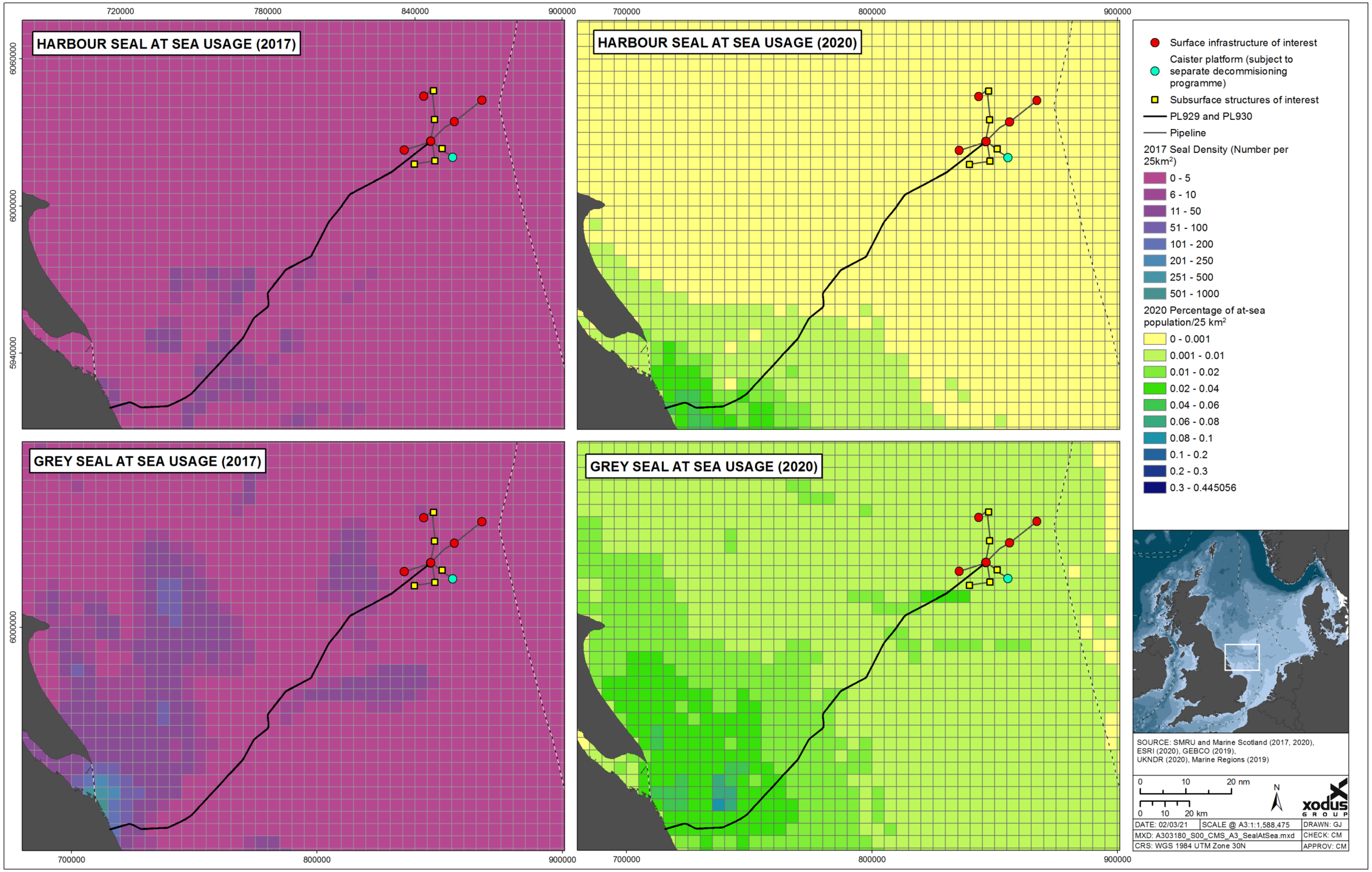


Figure 4.4.1: Grey and harbour seal at sea usage [33]

4.5 Seabirds

The CMS area is important for the following species: northern fulmar *Fulmarus glacialis* (wintering August – February), northern gannet *Morus bassanus* (breeding May – September, and wintering October – April), great black-backed gull *Larus marinus*(Breeding April – August, and wintering September – March), black-headed gull *Larus ridibundus* (breeding April – August), common gull *Larus canus* (breeding May – August, wintering September – April), herring gull *Larus argentatus* (breeding April – August, and wintering September – March), Atlantic puffin *Fratercula arctica* (breeding April – July, wintering August – March), black-legged kittiwake *Rissa tridactyla* (breeding May – September, and wintering October – April), common guillemot *Uria aalge* (breeding May – June, wintering October to April, and between August – September), razorbill *Alca torda* (breeding May – June, wintering October – April, and between August – September), little auk *Alle alle* (wintering November – March) and lesser black-backed gull *Larus fuscus* (breeding May – August) [39].

UK breeding seabird population censuses dating back to the 1960s indicate a change in population trends over time. Black-legged kittiwake populations declined by 29% between 2000 and 2019. Northern fulmar and common tern populations have also declined by 33% and 3% respectively, in the same time frame. Conversely, razorbill, northern gannet, and black-headed gulls have seen populations increases over the same time [57].

Black-legged kittiwake, having a maximum foraging range of 120 km [58], have been recorded nesting on offshore platforms before, as have herring gulls. Black-legged kittiwake utilisation distribution is very high along the PL929 and PL930 and lower offshore in the central CMS area [59].

The Seabird Oil Sensitivity Index (SOSI) [40] identifies regions where seabirds are likely to be most sensitive to oil pollution. It is an updated version of the Oil Vulnerability Index [60] which uses survey data collected between 1995 and 2015 and covers the UKCS and beyond. The SOSI also includes an improved method to calculate a single measure of seabird sensitivity to oil pollution. These data were combined with individual species sensitivity index values and summed at each location to create a single measure of seabird sensitivity to oil pollution [40]. The CMS area and associated PL929 and PL930 cover the following UKCS Blocks: 47/17, 47/18, 47/19, 47/20, 47/15, 48/11, 48/6, 48/7, 48/2, 48/3, 48/4, 43/29, 43/30, 44/26, 44/21, 44/22, 44/23, 44/17, 44/18, and 44/19 (see Figure 2.3.1).

Seabird sensitivity to oil within the offshore CMS area (Blocks 44/21, 44/22, 44/23, 44/17, 44/18, 44/19) is low throughout the year and highest in July and the months of November to January. Along the PL929 and PL930 sensitivity is variable and generally higher throughout the year compared to the CMS area. SOSI is highest approximately half way along the pipelines to shore; in Block 48/2 sensitivity is high, very high or extremely high every month of the year. In the Blocks nearest to the coast (47/17, 47/18) sensitivity is highest between October and December and in March.

Table 4.5.1: SOSI for the CMS area [40]

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43/23	1*	5*	5	5*	2*	2	2	3	2	2*	1*	1
43/24	2*	5*	5	5*	3*	3	1	2	2	2*	2*	2
43/25	2*	5*	5	5*	4*	4	1	2	3	3*	2*	2
43/28	1*	5*	5	5*	3*	3	1	4	1	1*	1*	1
43/29	2*	5*	5	5*	3*	3	1	4	2	2*	2*	2
48/5	1*	5*	5	5*	5*	5	1	5	1	1*	1*	1
43/30	2*	5*	5	5*	2*	2	1	4	3	3*	2*	2
49/1	1*	5*	5	5*	N	1*	1	4	5	5*	1*	1
44/11	1*	5*	5	5*	5*	5	1	5	5	5*	1*	1
44/12	1*	5*	5	5*	5*	5	4	5	5	5*	1*	1
44/13	N	5*	5	5*	5*	5	5	5	5	5*	N	1*
44/16	2*	5*	5	5*	5*	5	1	4	5	5*	2*	2
44/17	3*	5*	5	5*	5*	5	3	4	5	5*	3*	3

44/14	N	4*	4	4*	5*	5	4	5	5	5*	N	1*
44/18	3*	5*	5	5*	5*	5	4	5	5	5*	3*	3
44/24	3*	5*	5	5*	5*	5	1	5	5	5*	3*	3
44/15	N	4*	4	4*	5*	5	5	5	5	5*	N	1*
44/19	1*	5*	5	5*	5*	5	4	5	5	5*	1*	1
43/20	2*	5*	5	5*	4*	4	1	3	4	4*	2*	2
44/21	2*	5*	5	5*	4*	4	1	3	5	5*	2*	2
44/27	3*	5*	5	5*	4*	4	1	4	5	5*	3*	3
44/22	3*	5*	5	5*	5*	5	2	3	5	5*	3*	3
44/28	3*	5*	5	5*	5*	5	1	5	5	5*	3*	3
44/23	3*	5*	5	5*	5*	5	3	5	5	5*	3*	3
44/29	3*	5*	5	5*	5*	5	1	5	5	5*	3*	3
44/26	2*	5*	5	5*	3*	3	1	4	5	5*	2*	2
49/2	3*	5*	5	5*	5*	5	1	5	5	5*	3*	3
47/9	4	2	2	5	5	4	5	3	4	1	2	3
47/10	2	2	2	2*	5	5	4	3	4	2	2	1
47/14	3	3	2	5	5	5	5	3	5	2	1	2
47/15	3	3	2	5	5	5	5	3	5	3	1	2
48/16	3	4	3	3*	5	5	5	4	5	4	2	3
47/11	3	3	2	5	5*	5*	5	5	4	3*	3	3
47/12	4	3	2	5	5	4	5	3	4	1	3	3
47/13	4	3	2	5	5	5	5	3	4	1	2	3
47/16	4	4	2	5	3	5	5	5	5	3*	3	2
47/17	4	4	3	5	5	5	5	5	5	2	2	2
47/21	3*	1*	1*	5*	3*	5*	5*	5*	2*	2*	2*	2*
47/22	4	4	2	5	5	5	5	5	3	2	2	3
47/23	2	2	2	5	5	5	5	4	3	1	2	3
47/18	4	4	2	5	5	5	5	4	4	1	2	2
47/24	2	2	2	5	5	5	5	4	3	3	2	2
47/19	3	3	2	5	5	5	5	4	4	3	1	2
47/25	3	3	2	5	5	5	5	4	3	4	2	2
47/20	3	4	2	5	5	5	5	4	4	3	1	2
48/21	4	4	3	3*	5	5	5	4	4	4	2	3
43/26	1*	2	1	1*	5	1	2	3	1	1*	1*	1
43/27	1*	3	5	1*	1	2	1	3	1	1*	1*	1
48/1	1*	2	2	2*	5	1	3	2	1	1*	1*	1
48/2	1*	2	1	1*	2	2	2	3	1	1*	1*	1
48/8	1*	1	1*	N	3*	3	1	3	2	2*	1*	1
48/3	1*	5*	5	5*	3*	3	1	4	1	1*	1*	1
48/9	1*	1*	3*	N	4*	4	1	4	3	3*	1*	1
48/4	1*	5*	5	5*	4*	4	1	4	1	1*	1*	1
48/10	1*	1*	3*	N	5*	5	1	4	4*	N	1*	1

47/5	1*	1	2	2*	5	2	3	2	3	1*	1	1
48/6	2	2	2	2*	5	5	3	3	2	2	2	1
48/12	2	2	2	2*	5	5	5	3	3	2	1	2
48/7	3	2	2	2*	5	3	3	3	2	2	2	1
48/13	1	2	3	3*	3	5	5	3	3	1*	1	2
48/11	3	3	2	2*	5	5	5	3	5	4	2	2
48/17	3	3	3	3*	5	5	5	3	4	2	1	3
Key	1 = Extremely high		2 = Very high		3 = High		4 = Medium		5 = Low		N = No data	
* in light of coverage gaps, an indirect assessment of SOSI has been made												

4.6 Conservation sites

Sites of conservation importance located within the vicinity of the CMS infrastructure and associated pipelines are shown in Figure 4.6.1. The main impact area (around to the CMS infield infrastructure) is shown in more detail in Figure 4.6.2. Sites for which potential interaction has been identified are described in Table 4.6.1 below, along with those within 40 km of the infrastructure and the Conservation Objectives outlined for the various sites.

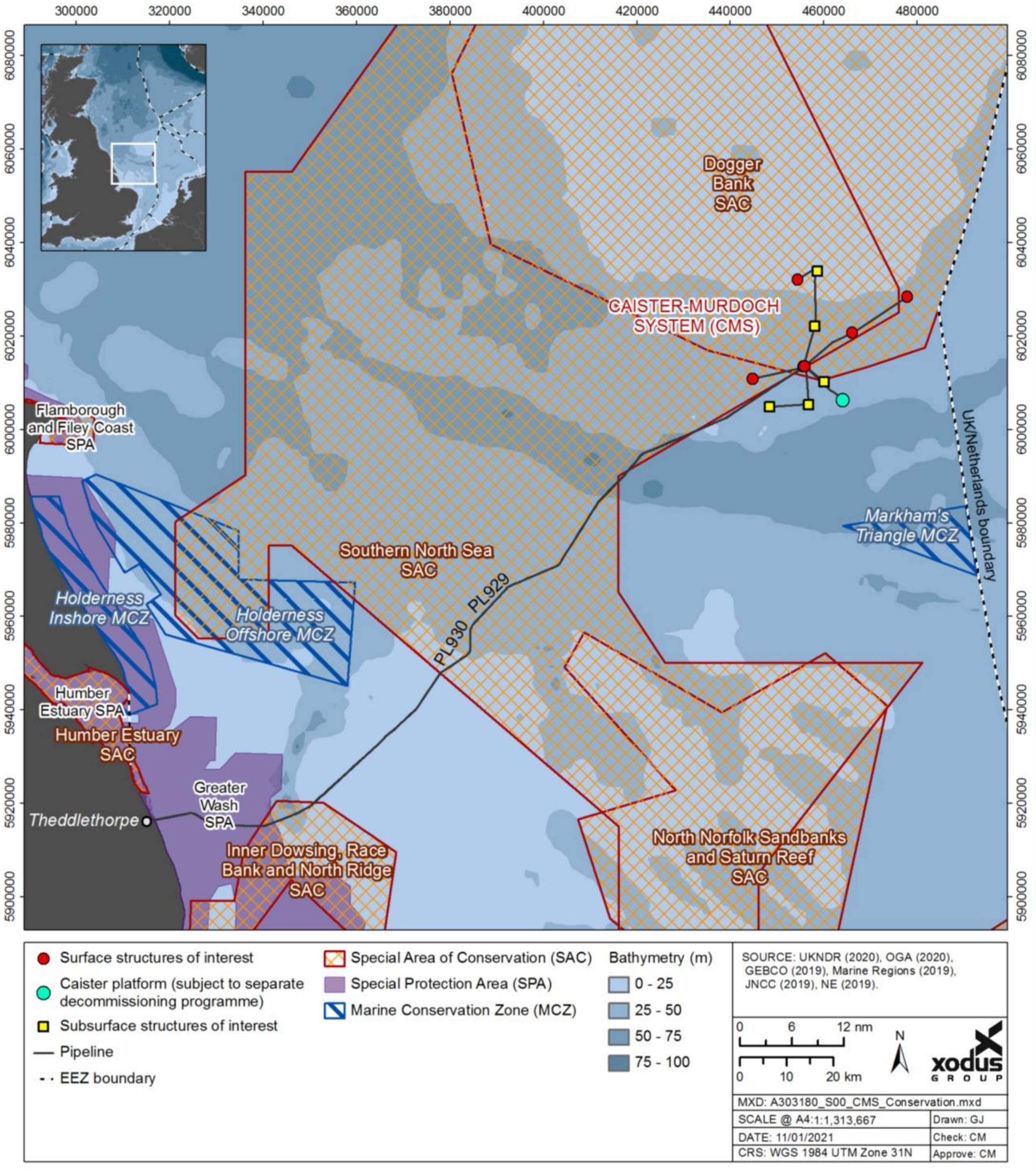


Figure 4.6.1: Offshore sites of conservation importance near CMS and associated PL929/PL930

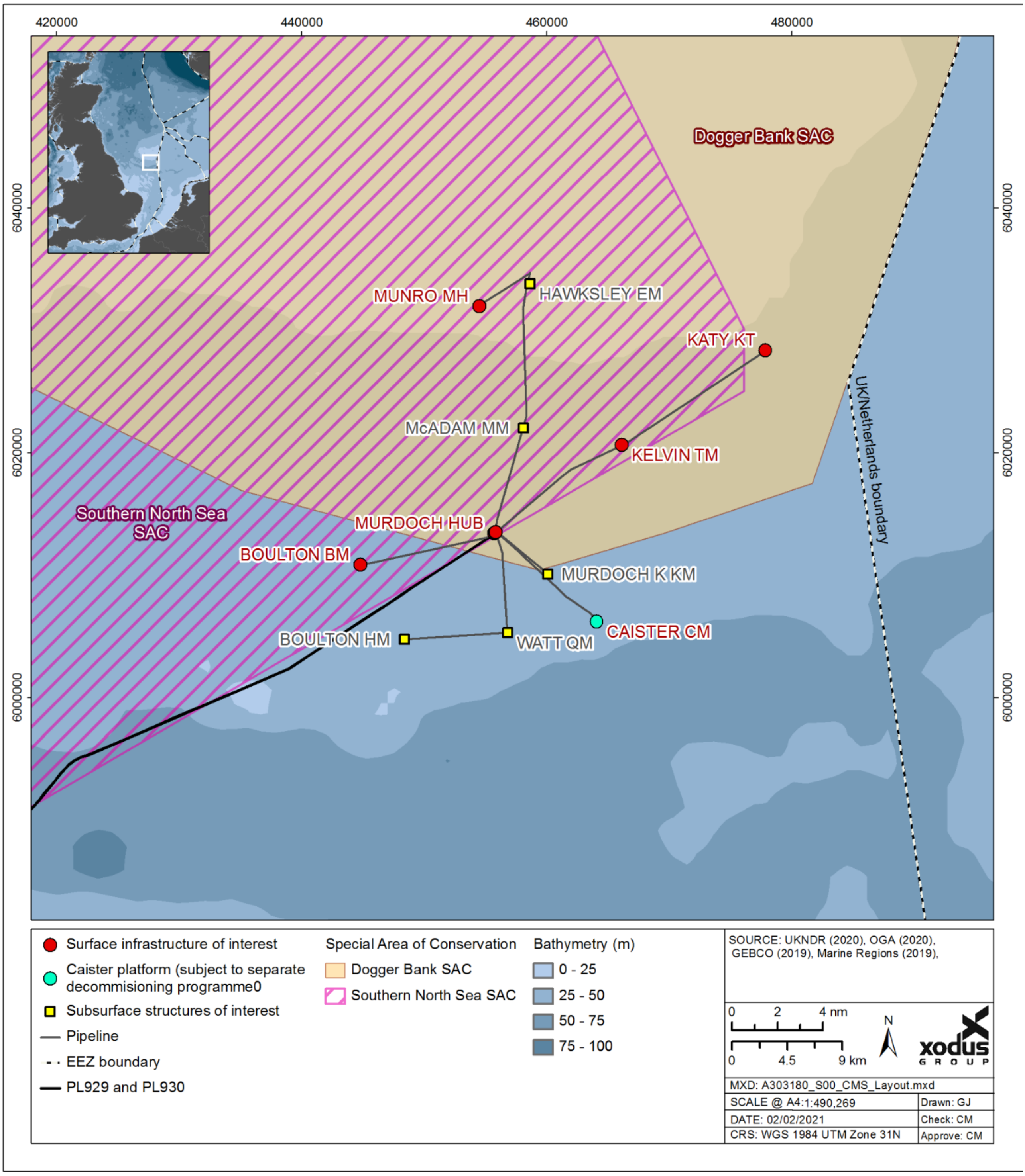


Figure 4.6.2: Offshore sites of conservation importance near the CMS infield infrastructure

Table 4.6.1: Conservation sites within 40 km of the CMS area and PL929/PL930

Site	Designating features	Conservation Objectives	Distance and direction from CMS	Decommissioning activity
Dogger Bank SAC	The Dogger Bank is the largest sandbank in UK waters and is home to a variety of species. The Dogger Bank in located in the open sea and is therefore exposed to waves, which in turn prevents vegetation growing on the shallower parts of the bank. Long thin silver sandeels can be found on the sides of the sandbank which are a food source for many other species. The site is protected for the Annex I feature 'Sandbanks which are slightly covered by seawater all the time' [18]. The site overlaps with the Southern North Sea SAC.	The Conservation Objectives for the site are to ensure that the features are to be in favourable condition thus ensuring site integrity in the long term and contribution to FCS of Annex I 'Sandbanks which are slightly covered by seawater all the time'. This contribution would be achieved by maintaining or restoring, subject to natural change: • The extent and distribution of the qualifying habitat in the site; • The structure and function of the qualifying habitat in the site; and • The supporting processes on which the qualifying habitat relies [57].	CMS located within site	Many of the proposed CMS decommissioning activities will occur within this site.
Southern North Sea SAC	The SNS SAC has been identified as an area of importance for harbour porpoise, an Annex II species. This site includes key winter and summer habitat for this species and covers an area over three times the size of Yorkshire, making it the largest SAC in UK and European waters at the point of designation in 2019 [19]. The site overlaps with the Dogger Bank SAC, North Norfolk Sandbanks and Saturn Reef SAC, and Holderness Offshore MCZ.	The Conservation Objectives of the site are to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: • Harbour porpoise is a viable component of the site; • There is no significant disturbance of the species; and • The condition of supporting habitats and processes, and the availability of prey is maintained [62].	CMS located within site	Many of the proposed CMS decommissioning activities will occur within this site.
Inner Dowsing, Race Bank and North Ridge SAC	The site is designated for 'Sandbanks which are slightly covered by seawater all the time' and 'Reefs'. The main sandbank features of the site occur within the Wash Approaches, the Race Bank-North Ridge-Dudgeon Shoal system and at Inner Dowsing. The tops of the sandbanks are characterised by low diversity communities of polychaete worms and amphipod crustaceans. Comparatively, the trough areas between the sandbank features contain a diverse mosaic of biotopes on mixed and gravelly sands. Biogenic reef attributed to *S. spinulosa* has been consistently recorded within the site. These reef structures support hugely diverse communities [20]. The site overlaps with the Greater Wash SPA.	The Conservation Objectives of the site are to ensure the integrity of the site is maintained and that the Annex I qualifying features are preserved and the site maintains the FCS of its qualifying features by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of the qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of each of the qualifying species; and • The distribution of qualifying species within the site [63].	Intersected by PL929 and PL930	There are no significant planned decommissioning activities within the site, other than decommissioning PL929/PL930 *in situ*.
Greater Wash SPA	The Greater Wash area provides areas of importance for over-wintering for the red-throated diver, little gull and common scoter. In addition, the site aims to protect ideal coastal feeding waters used by breeding populations of common tern, sandwich tern and little tern [24]. The site overlaps with a number of other designated areas: the Holderness Inshore MCZ and Holderness Offshore MCZ to the north, and the Inner Dowsing and Race Bank and North Ridge SAC to the south.	The Conservation Objectives of the site are to ensure that the integrity of the site is maintained or restored and that the site contributes to achieving the aims of the Wild Birds directive by maintaining or restoring; The extent and distribution of the habitats of the qualifying features; • The structure and function of the habitats of the qualifying features; • The supporting processes on which the habitats of the qualifying features rely; • The population of each of the qualifying features; and, • The distribution of the qualifying features within the site [64].	Intersected by PL929 and PL930	There are no significant planned decommissioning activities within the site, other than decommissioning PL929/PL930 *in situ*.
Humber Estuary SPA	The range of habitats within the Humber Estuary support a variety of wintering, passage and breeding birds, including internationally important populations of a number of species. Birds are widely distributed throughout the site, the distribution of individual species reflecting habitat distribution and species ecology. The following bird species contribute to the sites designation: avocet (both breeding and non-breeding populations); bar-tailed godwit (non-breeding population); bittern (both breeding and non-	The Conservation Objectives of the site are to ensure that the integrity of the site is maintained or restored and that the site contributes to achieving the aims of the Wild Birds directive by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features; • The structure and function of the habitats of the qualifying features;	Intersected by PL929 and PL930	There are no significant planned decommissioning activities within the site, other than decommissioning PL929/PL930 *in situ*.

Site	Designating features	Conservation Objectives	Distance and direction from CMS	Decommissioning activity
	breeding populations); black-tailed godwit (non-breeding population); dunlin (non-breeding population); golden plover (non-breeding population); hen harrier (non-breeding population); knot (non-breeding population); little tern (breeding population); marsh harrier (breeding population); redshank (non-breeding population); ruff (non-breeding population); shelduck (non-breeding population); and waterbird assemblage [25]. This site overlaps with the Humber Estuary SAC.	• The supporting processes on which the habitats of the qualifying features rely; • The population of each of the qualifying features; and, • The distribution of the qualifying features within the site [65].		
Humber Estuary SAC	The Humber Estuary is a large estuary with a high tidal range. The high suspended sediment loads in the estuary feed a dynamic and rapidly changing system of mudflats, sandflats, saltmarsh and reedbeds. Grey seals come ashore in autumn to use the area to form large breeding colonies. The site is designated for a number of features, many of which are terrestrial or tidal. The primary features contributing to the designation of the site are 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide' [21]. This site overlaps with the Humber Estuary SPA.	The Conservation Objectives of the site are to ensure the integrity of the site is maintained or restored as appropriate, to ensure the site maintains the FCS of its qualifying features by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of the qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of each of the qualifying species; and • The distribution of qualifying species within the site [66].	~7 km NE of PL929 and PL930	There are no planned decommissioning activities within the site.
North Norfolk Sandbanks and Saturn Reef SAC	North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters. They are a representative functioning example of the feature 'Sandbanks which are slightly covered by seawater all the time'. The banks support communities of invertebrates which are typical of sandy sediments in the SNS such as polychaete worms, isopods, crabs and starfish. Areas of *S. spinulosa* biogenic reef are present within the site, which contribute to the sites designation as 'Reefs' [22]. The site overlaps with the Southern North Sea SAC.	The Conservation Objectives of the site are for the features to be in favourable condition thus ensuring site integrity in the long term and contribution to FCS of Annex I 'Sandbanks which are slightly covered by sea water all of the time' and Annex I 'Reefs'. This contribution would be achieved by maintaining or restoring, subject to natural change: • The extent and distribution of the qualifying habitats in the site; • The structure and function of the qualifying habitats in the site; and • The supporting processes on which the qualifying habitats rely [67].	~15 km S of PL929 and PL930	There are no planned decommissioning activities within the site.
Holderness Offshore MCZ	The seabed is dominated by 'Subtidal coarse sediment' and hosts 'Subtidal sand', 'Subtidal mixed sediments' and part of a glacial tunnel valley. The diverse seabed allows for a wide variety of species which live both in and on the sediment. The site is protected for the sediment features 'Subtidal coarse sediment', 'Subtidal mixed sediments', and 'Subtidal sand' as well as the presence of 'North Sea glacial tunnel valleys' and ocean quahog. Ocean quahog is an OPSAR listed threatened / declining species of bivalve mollusc that can take up to 6 years to reach maturity and can live for over 500 years [28]. The site overlaps with the western area of the Southern North Sea SAC and the Greater Wash SPA.	Formal conservation advice is not yet available; the JNCC and Natural England are jointly in the process of developing advice for the site. However, the overarching conservation objectives for the site is for its designated feature either to remain in or reach favourable condition [28].	~15 km NE of PL929 and PL930	There are no planned decommissioning activities within the site.
Holderness Inshore MCZ	The intertidal area region of the MCZ is made up of a long open beach of relatively mobile sediments, backed by readily eroding cliffs. The subtidal area of the site extends out to three nautical miles and is composed of 'High energy circalittoral rock'; 'Moderate energy circalittoral rock'; 'Subtidal coarse sediments'; 'Subtidal mixed sediments'; 'Subtidal mud' and 'Subtidal sand'. These are all designated features of the site. The varied sediment within the sire enables a diverse community of species to thrive. 'Intertidal sand and muddy sand' also contribute to the site's designation, as does the Spurn Head subtidal geological feature. The Humber Estuary is an important source of sediment for Spurn Head [29]. The site overlaps with the Greater Wash SPA.	Formal conservation advice is not yet available. Natural England are in the process of developing advice for the site [29].	~25 km NW of PL929 and PL930	There are no planned decommissioning activities within the site.

Site	Designating features	Conservation Objectives	Distance and direction from CMS	Decommissioning activity
The Wash and North Norfolk Coast SAC	The SAC covers the largest embayment in the UK and numerous habitats, including intertidal mudflats, sandbanks, and saltmarsh among others. It is designated for a number of features, the exclusively marine features being: 'Sandbanks which are slightly covered by sea water all the time', 'Mudflats and sandflats not covered by seawater at low tide', 'Large shallow inlets and bays', 'Reefs', and Annex II species harbour seal [23].	The Conservation Objectives of the site are to ensure the integrity of the site is maintained or restored as appropriate, to ensure the site maintains the FCS of its qualifying features by maintaining or restoring: The extent and distribution of qualifying natural habitats and habitats of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of the qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of each of the qualifying species; and • The distribution of qualifying species within the site [68].	~27 km SW of PL929 and PL930	There are no planned decommissioning activities within the site.
Gibraltar Point SPA	The site is protected for the following species: bar-tailed godwit (non-breeding); grey plover (non-breeding); little tern (breeding); and sanderling (non-breeding) [26].	The Conservation Objectives of the site are to ensure the integrity of the site is maintained or restored as appropriate, to ensure the site maintains the FCS of its qualifying features by maintaining or restoring: The extent and distribution of qualifying natural habitats and habitats of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of the qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of each of the qualifying species; and • The distribution of qualifying species within the site [69].	~27 km SW of PL929 and PL930	There are no planned decommissioning activities within the site.
The Wash SPA	The site is designated for a number of breeding and non-breeding bird species: bar-tailed godwit (non-breeding); Bewick's swan (non-breeding); black-tailed godwit, (non-breeding); common scoter (non-breeding); common tern (breeding); curlew (non-breeding); dark-bellied brent goose (non-breeding); dunlin (non-breeding); gadwall (non-breeding); goldeneye (non-breeding); grey plover (non-breeding); knot (non-breeding); little tern (breeding); oystercatcher (non-breeding); pink-footed goose (non-breeding); pintail (non-breeding); redshank (non-breeding); sanderling (non-breeding); shelduck (non-breeding); turnstone (non-breeding); wigeon (non-breeding), and waterbird assemblage (non-breeding) [27].	The Conservation Objectives of the site are to ensure the integrity of the site is maintained or restored as appropriate, to ensure the site maintains the FCS of its qualifying features by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of the qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of the qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of each of the qualifying species; and • The distribution of qualifying species within the site [70].	~30 km SE of PL929 and PL930	There are no planned decommissioning activities within the site.
Markham's Triangle MCZ	The site covers an area of 200 km^2, protecting a variety of sediment types from fine mud and sand through to coarse gravel and pebbles. The site is protected for the presence of the following protected designated broad-scale habitats: 'Subtidal coarse sediment', 'Subtidal mixed sediments', 'Subtidal sand' and 'Subtidal mud'. The variety of sediment types found in this site means it can support a wide range of species [30].	Formal conservation advice is not yet available; JNCC is in the process of developing advice for the site. However, the overarching conservation objectives for the site is for its designated feature either to remain in or reach favourable condition [30].	~37 km SE of CMS	There are no planned decommissioning activities within the site.

5 Impact Assessment

5.1 Impact identification outcome

Table 5.1.1 summarises the findings of the impact identification workshop, providing justification for the inclusion and exclusion of impact mechanisms. More information regarding industry standard and project-specific mitigation and controls can be found in the ENVID tables in Appendix 5.

Table 5.1.1: Impact identification

Impact	Further assessment	Justification	Mitigation
Atmospheric emissions	No	Emissions during decommissioning activities, (largely comprising fuel combustion gases) will occur following CoP. Emissions generated by infrastructure, equipment and vessels associated with operation of the assets will be replaced by those from vessel use as well as the recycling of decommissioned materials. Reviewing historical EU Emissions Trading Scheme data and comparison with the likely emissions from the proposed workscope suggests that emissions relating to decommissioning will be minor relative to those generated during production. The estimated CO_2 emissions to be generated by the selected decommissioning options are 136,732 Te, this equates to 1.04% of the total UKCS emissions in 2018 (13,200,000 Te) [9]. These emissions present a total value for the overall project; the figure has been calculated assuming approximately 842 days of vessel emissions across the duration of the project and includes any theoretical emissions associated with the recovery of items, as well as the emissions relating to manufacture for replacement of items decommissioned *in situ*. The project vessel time is split across eight types of vessels which will participate in a variety of activities including: flowline removal, rock placement and a post-decommissioning survey. The total emissions estimate also includes any emissions associated with the infrastructure being removed and remaining *in situ*. See Appendix 6 for a summary of the emissions associated with the project vessels, operational activity and recovery of remaining materials. Review of available decommissioning EAs shows conclusively that atmospheric emissions in highly dispersive offshore environments do not present significant impacts and are extremely small in the context of UKCS and global emissions. Most submissions also note that emissions from short-term decommissioning activities are small compared to those previously arising from the asset over its operational life. Considering the above, atmospheric emissions do not warrant further assessment.	• Vessel management • Minimal vessel use/movement • Vessel sharing where possible • Engine maintenance

Impact	Further assessment	Justification	Mitigation
Seabed disturbance	Yes	There is potential for decommissioning activities to generate disturbance to the seabed; including the decommissioning of pipelines *in situ* and any associated remediation, and the removal of substructures. Seabed impacts may range in duration from short-term impacts, such as temporary sediment suspension or smothering, to permanent impacts, such as the introduction of new substrate or any consequential habitat or community level changes which may transpire. As the majority of pipelines will be decommissioned *in situ*, there is an associated potential impact of long-term degradation of infrastructure on the receiving environment. Degradation is expected to occur over a long period of time and will be highly localised as the pipelines will not degrade equally along their length. In instances where partial removal of some pipelines will occur, the sections to be removed will be done so using cut and lift methods. This will have a relatively localised area of impact. All subsea installations will be fully removed. The piles which support the platform jacket structures will be cut ~3 m below the seabed. An estimated one in three installations within the CMS may require excavation prior to removal, this includes the piles supporting the platforms. While not confirmed, MFE could be a method of excavation. As a result of the MFE, sediment suspension is locally increased which could have a temporary impact on the surrounding benthos, however it should be noted that this area of the North Sea is used to significant natural turbidity. Overall, the decommissioning activities are expected to impact an area of 0.0926 km^2, of which 0.0697 km^2 is likely to be within the Dogger Bank SAC. This equates to 0.0006% of the site (12,331 km^2). The proposed decommissioning activities will be supported by a number of vessels, all of which will employ dynamic positioning (DP). Therefore, there are no potential additional seabed impacts associated with vessel mooring. Well decommissioning activities in the CMS required a jack-up rig and pipeline flushing has made use of an AWV. These activities have already taken place and no further scope is likely to be required for these vessels. The use of these vessels incurs an additional seabed footprint associated with rock stabilisation and moorings. However, late-life activities and those conducted during well decommissioning/pipeline flushing are out of scope of decommissioning and this EA. As such, use of the jack-up rig and AWV is not assessed within this EA as part of the decommissioning activities themselves, but it is considered within the context of cumulative impacts to the seabed. Chrysaor are committed to leaving a clear, unstructured seabed in the wake of the decommissioning activities. The clear seabed will be validated by a verification survey over the installation sites and pipeline corridors. Non-intrusive verification techniques will be considered in the first instance. Should these prove inconclusive then there is a possibility that seabed clearance	• Mitigation addressed in Section 5.2.5

Impact	Further assessment	Justification	Mitigation
		verification is likely to require conventional overtrawl survey methods. The methods used will be discussed and finalised with OPRED. The ENVID exercise deemed the risk associated with these activities to range from minor to medium. Due to the location of the activities within the Dogger Bank SAC and the potential stakeholder interest in potential seabed impacts from project activities, this aspect has been assessed further in **Section 5.1** (including an assessment of the cumulative impacts associated with the CMS late-life activities and Chrysaor's wider SNS decommissioning campaign).	
Physical presence of infrastructure decommissioned *in situ*	Yes	The preferred option from the CA is to decommission all the pipelines/ umbilicals *in situ*, with some sections of some pipelines qualifying for partial removal. The physical presence of infrastructure decommissioned *in situ* has the potential to impact other sea users. Infrastructure to be decommissioned *in situ* includes all the flexible and rigid flowlines (aside from some sections being removed) and any protection materials associated with third party crossings. The mattresses are to be fully removed off pipeline ends and the cut ends of the pipelines decommissioned *in situ* are to be remediated during decommissioning (the addition of rock placement is investigated further in Section 5.1 as a potential impact to the benthic environment). Some pipelines have been identified for partial removal. Depth of Burial (DoB) surveys have confirmed the burial status of these flowlines (see Appendix 6 for DoB profiles of the pipelines associated with the CMS). The PL929 was trenched to a depth of 0.5 m to 0.7 m along its length. The PL930 is trenched to a depth of at least 1.0 m along its length. Looking back on past survey data of the PL929, a number of exposures of varying sizes have been identified. However, overall the percentage exposure of the pipeline is low (<5%). Only a single Fish Safe reportable span, as defined by BEIS 2018 guidance [2], was identified in 2006 and another in 2016. The 2006 span was not identified during later surveys therefore is assumed to no longer be present. The 2016 reportable span is a closing span on approach to Murdoch MD (ie. not in-field along the pipeline). Survey data for the PL2109 and PL2110 connecting Hawksley EM and Munro MH found that the number and length of exposures appears to fluctuate between survey years. These pipelines are fitted with spoilers (to aid self-burial). There is potential evidence to suggest that the movement of the exposures corresponds to sandwave or sandbank migration. Other than the span on approach to Murdoch MD, there are no reportable spans along any other pipelines within the CMS. The remaining pipelines associated with the CMS have few exposures and often no spans. The PL2109/PL2110 and PLU4685 will be partially removed in order to remove the snag risk in perpetuity. It is proposed that the first 1.5 km of PL2109/PL2110 will be removed and 52 m of the PLU4685 will also be removed. Movement of the sediment could expose different parts of the	• Mitigation addressed in Section 5.3.3

Impact	Further assessment	Justification	Mitigation
		pipeline over time presenting a snagging hazard. Removing such a section of pipeline would completely eliminate the potential for snag risk to arise in the future. The rest of the pipelines would be decommissioned *in situ*. The partial removal CA options will be conducted using the cut and lift method. It is considered that the pipeline survey data across multiple years, along with the future pre-decommissioning surveys will be used as evidence of pipeline stability and to fully address the potential risk of future exposures. Future monitoring work will evaluate pipeline spans and exposures with respect to seabed topography to identify pipeline sections that are at risk of developing into snagging hazards for other users of the sea. This monitoring work will also aim to identify any exposures or spans on the surface laid flowline sections which may need remediation under the BEIS 2018 guidance [2]. The frequency of this monitoring work and any subsequent maintenance will be established in consultation with OPRED. All subsea installations will be fully removed. The piles which support the platform jacket structures will be cut ~3 m below the seabed. Mattresses and grout bags will be fully removed and either reused, recovered as aggregate for infrastructure projects or disposed of in landfill sites. Should it be required, MFE may generate depressions and berms in the seabed thereby introducing a snagging risk, in addition to the risk attributed to pipelines decommissioned *in situ*. Chrysaor are committed to leaving a clear, unobstructed seabed. Non-intrusive verification techniques, agreed with OPRED, will be used to confirm that the seabed is clear of snag hazards. Dropped objects, considered under Accidental Events below, are generally evident within the 500 m zones and will be required to be removed during debris clearance activities. No additional snagging risk is derived from dropped objects and have therefore been scoped out of this assessment as an impact pathway. In spite of the above and the ranking of the risk as minor during the ENVID exercise, the impact of infrastructure decommissioned *in situ* and potential depressions generated during decommissioning activities pose a potential snag risk to commercial fisheries. Stakeholder concern in this case warrants it to be considered further. As such, these two impact pathways have been fully assessed in **Section 5.3**.	
Physical presence of vessels in relation to other sea users	No	The presence of a small number of vessels for decommissioning activities will be short-term in the context of the life of the CMS fields. Activity will occur using similar vessels to those currently deployed for oil and gas installation, operation and decommissioning activities across the SNS. Furthermore, the majority of decommissioning works will be carried out within the 500 m zones (with the exception of some pipeline remediation activities), thereby using the area around existing	• Minimal vessel use/movement • Notification to Mariners • Opening up of 500 m safety exclusion zones

Impact	Further assessment	Justification	Mitigation
		infrastructure and not occupying ‘new’ areas. Vessel presence will be spatially and temporally restricted so exclusion will only be short-term. The proposed decommissioning of the CMS area is estimated to require eight different vessel types. These would not all be on location at the same time. Vessel activities are expected to cover approximately 842 days; most of these days are attributed to the removal of the surface installations. Overall levels of vessel activity attributed to the decommissioning are likely to be similar to those experienced under typical conditions. The nearshore activities associated with this project are very likely to be limited in duration (limited to passing vessels). Chrysaor have commissioned a Navigational Risk Assessment (NRA) which covers the wider CMS area [10]. While the offshore CMS area experiences moderate to high shipping, with standard mitigation measures in place, and the short-term nature of these operations, the risk of collision is not expected to be significant. Such measures include Notice to Mariners, the maintained presence of 500 m safety exclusion zone around the platforms and use of navigation aids and safety standby vessels. The NRA also determined that there are unlikely to be any cumulative impacts between the CMS activities and other industries in the area (ie. military activities, renewables and other oil and gas decommissioning) [10]. Other sea users will be excluded from the 500 m safety zone during active operations. The 500 m safety zones will remain until such time the installations are fully removed. Thereafter applied safety zones will remain until such time debris clearance and seabed remediation has been completed. The decommissioning of the CMS area will result in a positive impact by opening up new fishing grounds previously unavailable due to the 500 m safety exclusion zones currently imposed around the Chrysaor installations. Other sea users will be notified in advance of planned activities through the appropriate mechanisms, meaning those stakeholders will have time to make any necessary alternative arrangements during the finite period of operations. Assessment of the impact of the decommissioning on this receptor is therefore not required.	following seabed-clearance
Underwater noise	Yes	The location of project activities within the Southern North Sea SAC, designated for harbour porpoise, makes underwater noise a key sensitivity. There is potential for localised injury and disturbance to marine mammals and fish through noise from cutting operations and vessels across the project area, however, recent research findings regarding noise levels emitted during diamond wire cutting procedures determined they were not easily discernible above the background noise levels (mostly attributed to vessel activity) [11]. In the absence of recorded field measurements, it seems likely that this form of cutting would not generate a great deal of noise and may not be detectable above other sources operating simultaneously (i.e. vessels) within the SNS.	• Mitigation addressed in Section 5.4.5

Impact	Further assessment	Justification	Mitigation
		The need for geophysical surveys undertaken for post-decommissioned infrastructure left *in situ* will be determined in the future and assessed through the process of permit applications as appropriate. Multibeam echosounder survey equipment is likely to be used for imaging and identification of pipeline exposures. The JNCC (2020) Guidelines will be employed for mitigation of noise impacts to marine mammals for future survey work involving seismic survey equipment [12]. As presented in the ENVID exercise, the activities associated with the decommissioning of the CMS are likely to be minor and are unlikely to generate significant noise levels, however, owing to the location of the project within the Southern North Sea SAC, assessment of underwater noise on marine mammals is detailed in **Section 5.4.**	
Discharges to sea	No	Discharges from vessels are regulated activities that are managed on an ongoing basis through existing legislation and compliance controls. All subsea infrastructure in the CMS area has been drained and flushed at CoP. This is a pre-decommissioning activity which has been permitted as appropriate, and therefore, falls outside the scope of this EA. Any discharges from infrastructure occurring during decommissioning activities will similarly be assessed in more detail as part of the environmental permitting process (e.g. through Master Application Templates/Subsidiary Application Templates). Controls will be in place, as relevant, through the Offshore Chemical Regulations and the Oil Pollution Prevention and Control regulations. Residual liquids present during the decommissioning of pipelines and subsea infrastructure will be treated before being discharged to sea, such that the discharge will comprise treated water. Any residual remaining material will be in trace levels/volumes and will not pose any significant risk to water quality. Although there are sections of the PL929/PL930 to shore which transit through a number of protected sites, any deposition of degradation products is expected to be highly localised to the pipeline and of such low concentration/volumes as to pose no significant risk to the qualifying features. Pipelines have been flushed to achieve a hydrocarbon concentration in flush fluids of less than 30 mg/l and are currently filled with seawater. All residual solids will be shipped to shore for disposal. Considering the above, discharges to sea during decommissioning activities are not assessed further herein.	• MARPOL compliance • Bilge management procedures • Vessel audit procedures • Contractor management procedures
Resource use	No	Generally, resource use from the proposed activities will require limited raw materials and be largely restricted to fuel use. Any opportunities for increasing fuel efficiency and reducing use of resources will be identified and implemented by Chrysaor where possible. The estimated total energy usage for the project is 1,270,462 GJ. This number accounts for all operations, material recycling, and the resource loss associated with decommissioning items *in*	• Adherence to the Waste Hierarchy • Vessel management

Impact	Further assessment	Justification	Mitigation
		situ. This is considered very low, compared to the resources generated during the production phase of the project. A summary breakdown of energy use associated with the project is available in Appendix 6. Considering the above, resource use does not warrant further assessment.	• Minimal vessel use/movement • Vessel sharing where possible • Engine maintenance
Waste	No	The onshore treatment of waste from the CMS decommissioning activities will be undertaken according to the principles of the waste hierarchy, a conceptual framework which ranks the options for dealing with waste in terms of sustainability. The waste hierarchy is a key element in OSPAR Decision 98/3 and DECC 2011 Guidance Notes [2]. Wastes will be treated using the principles of the waste hierarchy, focusing on the reuse and recycling of wastes where possible. Raw materials will be returned to shore with the expectation to recycle the majority of the returned non-hazardous material. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Facilities requiring removal as part of the CMS DPs will be transferred to shore by a heavy lift vessel for decontamination, dismantlement, disposal, recycling or reuse. Typically, around 95% of the materials from decommissioning projects can be recycled [13]. There may be instances where infrastructure returned to shore is contaminated (e.g. by Naturally Occurring Radioactive Material (NORM), hazardous, and/or special wastes) and cannot be recycled. In these instances, the materials will require disposal. Hazardous waste resulting from the dismantling of the CMS facilities will be pre-treated to reduce hazardous properties or render it non-hazardous prior to recycling or disposing of it to a suitable landfill site. Under the Landfill Directive, pre-treatment is necessary for most hazardous wastes destined to be disposed of to a landfill site. However, the weight and/or volume of such material is not expected to result in substantial landfill use. The recycling and disposal of wastes are covered by Chrysaor's Waste Management Strategy, which is compliant with relevant regulations relating to the handling of waste offshore, transfer of controlled, hazardous (special) waste, and TFSW (Trans-Frontier Shipment of Waste). The Waste Management Strategy is guided by Harbour Energy's HSE Policy (in Appendix 4) and commitments to best practice in waste management. This includes the mapping and documenting of waste management arrangements for ongoing monitoring of waste procedures and performance review against target Key Performance Indicators (KPIs). It should be noted that, only licenced contractors which can demonstrate they are capable of handling and processing the material to be brought ashore will be considered for onshore activities and this will form an integral part of the commercial tendering process. Due diligence audits will	• Overall 'Duty of Care' • Waste Management Strategy • Active waste tracking (cradle to grave) • Adherence to the Waste Hierarchy • Transfrontier Shipment of Waste (if applicable) • Permitting for hazardous wastes • Communication with relevant Regulator(s) • EEMs tracking • Close-out reporting • Contractor management

Impact	Further assessment	Justification	Mitigation
		take place of waste contractors/sub-contractors to ensure that all necessary handling and reporting measures (including tracking of wastes, accounting and identification of wastes, wastes generated per asset and waste segregation) are taking place. Specific audit/monitoring schedules will be set up as part of the disposal yard contract award. No further assessment of waste is necessary.	
Disturbance to nesting seabird	Yes	In recent years, there has been an increase in the number of seabirds utilising offshore installations for nesting. Opportunistic species such as kittiwake and herring gull are utilising artificial nest locations and successfully rearing chicks. In some instances, colonies of several hundred birds have established and return each year. Although for most offshore platforms, the number of breeding birds remains very low. All nesting birds and nesting activities are protected from damage by conservation legislation. under the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2017, Chrysaor have undertaken surveys to determine the presence of birds nesting on the CMS platforms. Evidence was found of seabird nesting behaviour on two of the CMS installations and thus potential disturbance to seabird nests has been scoped in for further assessment in **Section 5.5**.	• Mitigation addressed in Section 5.5.5
Accidental events	No	Well decommissioning is outside of the scope of this specific impact assessment, since it not dependent on approval of the DP. The possibility of a well blowout therefore does not require consideration in this assessment (it is assessed as part of separate well intervention and marine licence applications). Pipelines and umbilicals have been flushed and cleaned prior to the decommissioning activities described herein being carried out. Release of a hydrocarbon and chemical inventory is therefore also out of scope of this assessment. Therefore, the most likely origin of an accidental event would be from an unplanned instantaneous diesel release from the largest vessel employed in the decommissioning activities. This is expected to be an HLV with a maximum fuel capacity of approximately 1,569 m^3. The fuel inventory of the HLV vessel is likely to be split between a number of separate fuel tanks, significantly reducing the likelihood of an instantaneous release of the full inventory. Any spills from vessels in transit or participating in decommissioning activities are covered by a Communication and Interface Plan of the Southern North Sea Offshore Oil Pollution Emergency Plan [71], and by separate Shipboard Oil Pollution Emergency Plans (SOPEPs). Chrysaor will support response of any vessel-based loss of fuel containment through the vessel owner's SOPEP. There is a very low likelihood of vessel to vessel collision occurrence, an estimated one collision in 685 years which is in line with the areas' baseline collision risk [10]. Considering this, and in line with the mitigation measures in place, a vessel collision scenario does not require further assessment here. Vessel collision with any of the surface installations is in some cases an order of magnitude less likely [10].	• OPEP and SOPEP in place for operations • Navaids (Cardinal Buoys) in place • 500 m zones operational until seabed clearance certified • SOPEP on all vessels • Spill response procedures • Bunkering procedures in place (if necessary) • Contractor management and communication • Lifting operations management of risk

Impact	Further assessment	Justification	Mitigation
		In addition to the mitigation measures outlined in the individual vessel SOPEPs, Chrysaor maintains manned bridges, navigational aids and monitoring of safety zones. Only project vessels will be present when activity is taking place within 500 m safety exclusion zones. Other vessels will not be present within the 500 m zone at any time prior to well decommissioning, therefore the likelihood of fishing vessels overtrawling in the vicinity of the wellheads is negligible, making a well blowout scenario highly unlikely. Dropped object procedures are industry-standard and will be employed. All unplanned losses in the marine environment will be attempted to be remediated, and notifications to other mariners will be sent out. The post-decommissioning Clear Seabed Verification Survey will aid in the identification of in-field dropped objects. All lift operations will happen within platform safety zones or at the dockside therefore there is minimal risk from dropped objects on live third-party infrastructure from these activities. During transport the infrastructure will either be transported on deck with suitable sea fastening or held 'in the hook' securely for transport as per safe vessel operating procedures. As a result, there will be minimal risk from significant dropped objects during transport. Should such an event occur, the likely destination ports would mean transport over gas or condensate lines only which would result in a low risk hydrocarbon release which could be managed by offshore spill procedures with minimal environmental impact. As the methodology for platform removal to shore has not been defined, there exists the possibility that jackets and/or topsides could be transported by a vessel using a crane. Where these would be suspended over the side of the vessel for the transfer, the possibility of dropping onto a live pipeline cannot be ruled out. However, dropped object procedures are industry standard and there is only a very remote probability of any interaction with any live infrastructure, when planning for such transport efforts will be made to minimise the transit over live infrastructure. In line with the mitigation measures in place, accidental events are not assessed further herein.	• Dropped object recovery and debris clearance surveys • PON2 submission

5.2 Seabed Disturbance

5.2.1 Introduction

This section discusses the potential environmental impacts associated with seabed interaction resulting from the proposed CMS decommissioning activities. The measures planned by Chrysaor to minimise these impacts are detailed in Section 5.2.5.

The decommissioning activities have the potential to impact the seabed in the following main ways:

- Direct impact through:
    - Removal of subsea infrastructure including jackets, subsea structures and stabilisation materials;
    - Presence of subsea infrastructure decommissioned *in situ*;
    - Removal of pipeline ends; and
    - Rock-placement for pipeline ends.
- Indirect impact through:
    - Re-suspension and re-settling of sediment; and
    - Footprint of remaining infrastructure.

A vessel utilising DP will be deployed to remove the topsides, therefore there are no additional seabed impacts associated with mooring lines. A jack-up vessel is not expected to be required for topside removal. However, a jack-up and an AWV (also likely jack-up) have already completed well decommissioning and flushing and cleaning activities in the CMS. As these are all considered late-life activities they fall outwith the scope of the DP and this EA. While the impacts associated with these activities are not directly considered here, they are quantified and presented within Section 5.2.6 as part of the discussion regarding cumulative impacts.

5.2.2 Description and quantification of impact

5.2.2.1 Jackets

As the mass of the CMS jackets are <10,000 tonnes, they fall within the OSPAR 98/3 category of steel structures for which derogation cannot be sought. Therefore, the only option available for these seven platforms is full removal, as presented in Section 3.2.

The piles on all seven jackets will be removed to approximately 3 m below the seabed and should be suitable for removal via internal cutting methods. The area of impact for each pile has been calculated using the footprint of the structure plus a 0.5 m buffer which accounts for the slight disturbance generated by internal cutting procedures.

A full inventory of the CMS infrastructure, including quantities and dimensions is available in Appendix 3. Access to cut the pile will only be confirmed when internal inspections are completed for all platforms. It is possible that some degree of excavation will be required at one in three structures, including piles.

For excavation, sediment will likely be removed by using MFE and will be deposited down-current of the jacket piles, where it will undergo natural dispersal which will be transient in nature. As these processes are similar to normal processes in the SNS (as discussed in Section 4.2), it is expected that the displaced sediment will be rapidly incorporated into the local sediment transport regime. However, in the interest of providing conservative estimates, the use of MFE has been accounted for in the area calculations by adding a buffer of 15 m to the diameter of the piles[7].

The potential use of MFE at one in three structures has been determined as the worst-case scenario with regards to seabed disturbance, compared to the base case or expected scenario which assumes no

[7] This buffer has been calculated based on the understanding that dredging would be undertaken to -7.5 m to enable external cutting at -3 m with the addition of a 3 m wide area on the horizontal plane to allow tool clearance. The 15 m buffer also accounts for the nature of the sandy seabed, estimating a 30° excavation slope to allow sufficient clearance for cutting.

excavation will be required. This has been calculated separately and presented in Table 5.2.1 as an expected situation with additional columns indicating a contingency estimate (which quantifies additional disturbance arising from use of MFE). The total represents the worst-case impact (the expected disturbance plus the contingency area).

Indirect impacts are considered to cover twice the area of the direct impact as a worst-case scenario, to account for any sediment disturbance and resettlement.

Table 5.2.1: Seabed footprint related to the removal of jacket piles

Activity	DP	Quantity and dimensions	Expected duration of disturbance	Expected[8]		Additional contingency[9]		Total[10]		Within protected site
				Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)	
Excavation and removal of Murdoch MA piles	CDP3	4 x 1372 mm piles, with an additional 0.5 m buffer	Temporary	0.000018	0.000035	0.003292	0.006584	0.003310	0.006620	Dogger Bank SAC
Excavation and removal of Murdoch MC piles	CDP3	4 x 1372 mm piles, with an additional 0.5 m buffer	Temporary	0.000018	0.000035			0.000018	0.000035	Dogger Bank SAC
Excavation and removal of Murdoch MD piles	CDP3	8 x 1524 mm piles, with an additional 0.5 m buffer	Temporary	0.000040	0.000080			0.000040	0.000080	Dogger Bank SAC
Excavation and removal of Boulton BM piles	CDP2	4 x 1067 mm piles, with an additional 0.5 m buffer	Temporary	0.000013	0.000027	0.003230	0.006461	0.003244	0.006488	n/a
Excavation and removal of Munro MH piles	CDP2	3 x 1524 mm piles, with an additional 0.5 m buffer	Temporary	0.000015	0.000030			0.000015	0.000030	Dogger Bank SAC
Excavation and removal of Kelvin TM piles	CDP2	3 x 1524 mm piles, with an additional 0.5 m buffer	Temporary	0.000015	0.000030			0.000015	0.000030	Dogger Bank SAC
Excavation and removal of Katy KT piles	CDP2	3 x 1524 mm piles, with an additional 0.5 m buffer	Temporary	0.000015	0.000030	0.002492	0.004985	0.002507	0.005015	Dogger Bank SAC
			Total	**0.000134**	**0.000268**	**0.009015**	**0.01803**	**0.009149**	**0.01830**	

[8] No excavation required therefore the area of impact equates to the dimensions of the item with an additional 0.5 m buffer.
[9] One in three structures will require excavation using MFE therefore an additional buffer has been added.
[10] Expected area plus the additional contingency.

5.2.2.2 Subsea structures

As discussed in Section 3.2, the recommended option for decommissioning subsea structures of this type is full removal. The dimensions of the various structures have been used to calculate the area of impact; see Appendix 3 for a full inventory of CMS infrastructure. The area of indirect disturbance is assumed to be twice the direct disturbance area, as a worst case.

As for the jacket removal, an estimated one in three structures may require excavation. Some of the larger structures are piled and so the assumptions remain the same for the area calculations regarding every third piled item. An additional buffer of 15 m has been added to every third item to account for the disturbance associated with excavation around its perimeter. This is additional to the area associated with excavation of piles. The expected scenario assumes that excavation will not be required at all and therefore only a 0.5 m buffer has been added. The contingency area indicates the additional area of disturbance generated by the excavation of every third item. The total area is the expected plus the contingency and therefore represents the wort-case scenario. Table 5.2.2 shows the expected, contingency and total areas of impact associated with the removal of subsea structures.

Table 5.2.2: Seabed footprint related to the removal of subsea structures

Activity	DP	Quantity and dimensions	Expected duration of disturbance	Expected[11]		Additional contingency[12]		Total[13]		Within protected site designated for seabed features
				Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)	
Removal of Boulton HM	CDP2	16.0 x 10.2 x 5.0 m, with an additional 0.5 m buffer	Temporary	0.00018	0.00035	0.002827	0.005655	0.003004	0.006008	n/a
Removal of Hawksley EM	CDP2	7.9 x 6.2 x 5.0 m, with an additional 0.5 m buffer	Temporary	0.00006	0.00011			0.000056	0.000113	Dogger Bank SAC
Removal of McAdam MM	CDP2	16.0 x 10.2 x 5.0 m, with an additional 0.5 m buffer	Temporary	0.00018	0.00035			0.000177	0.000353	Dogger Bank SAC
Removal of Murdoch K.KM	CDP2	10.2 x 10.2 x 5.0 m, with an additional 0.5 m buffer	Temporary	0.00011	0.00023			0.000114	0.000229	n/a
Removal of Watt QM	CDP2	10.2 x 10.2 x 5.0 m, with an additional 0.5 m buffer	Temporary	0.00011	0.00023	0.002827	0.005655	0.002942	0.005884	n/a
Removal of Katy Tee Protection Structure	CDP2	8.4 x 4.5 x 3.4 m, with an additional 0.5 m buffer	Temporary	0.00004	0.00009			0.000045	0.000089	Dogger Bank SAC
Removal of Kelvin/Murdoch Subsea Pigging Skid	CDP2	10.5 x 5.1 x 4.0 m, with an additional 0.5 m buffer	Temporary	0.00006	0.00012			0.000062	0.000123	Dogger Bank SAC
Removal of Kelvin PMA	CDP2	9.5 x 6 x 3.4 m, with an additional 0.5 m buffer	Temporary	0.00007	0.00013			0.000065	0.000130	Dogger Bank SAC
Removal of Kelvin STA	CDP2	10.5 x 4.8 x 2.7 m, with an additional 0.5 m buffer	Temporary	0.00006	0.00012			0.000058	0.000117	Dogger Bank SAC
Removal of McAdam Tee	CDP2	3.1 x 1.6 x 1.4 m, with an additional 0.5 m buffer	Temporary	0.00001	0.00002			0.000008	0.000015	Dogger Bank SAC
Removal of PSNL	CDP2	5.5 x 5.5 x 3.5 m, with an additional 0.5 m buffer	Temporary	0.00004	0.00007			0.000036	0.000072	Dogger Bank SAC
Removal of PSSL	CDP2	6.3 x 4.3 x 1.8 m, with an additional 0.5 m buffer	Temporary	0.00003	0.00007			0.000033	0.000065	Dogger Bank SAC
			Total	**0.000944**	**0.001888**	**0.005654**	**0.01131**	**0.006599**	**0.01320**	

[11] No excavation required therefore the area of impact equates to the dimensions of the item with an additional 0.5 m buffer.
[12] One in three structures will require excavation using MFE therefore an additional buffer has been added.
[13] Expected area plus the additional contingency.

5.2.2.3 Stabilisation materials

There are a total of 917 mattresses, of varying types, and an estimated 3,500 grout bags within the CMS area. It is currently proposed that the majority (739) mattresses are removed. Of mattresses within the CMS which are to be removed, the vast majority (approximately 588) are within the Dogger Bank SAC. Those not within the Dogger Bank SAC are associated with the following assets which lie outwith the SAC: Boulton BM, Boulton HM, and Watt QM. Those remaining *in situ* are mostly associated with third party infrastructure and pipeline crossings. All grout bags are to be removed.

Of the mattresses within the CMS there are three types of concrete mattresses, seven types of fronded mattresses and 3 types of Linklok mattresses all of varying dimensions. The number and dimensions of the mattresses are presented in Appendix 3. The exact locations of the grout bags are not known therefore, for simplicity, all grout bags have been attributed to CDP2, the largest DP.

The dimensions have been used to calculate an area for all stabilisation materials which is shown in Table 5.2.3. The method of calculation assumes that all mattresses and grout bags will be laid on the seabed in a single layer, however it is important to note that this is highly unrealistic. Mattresses and grout bags are used to stabilise and support infrastructure therefore they are more likely to be piled on top of one another, or even on top of certain items/structures. As such the numbers presented are highly conservative estimates. The expected scenario in Table 5.2.3 assumes removal of 739 mattresses. The contingency scenario assumes a further 79 mattresses are removed should it be deemed necessary at the time of decommissioning. The total area represents the worst-case area of impact generated by the expected plus contingency areas. Of that area, the impact within the Dogger Bank SAC has been provided separately.

Table 5.2.3: Seabed footprint related to the decommissioning of stabilisation materials

Activity	DP	Quantity and dimensions	Expected duration of disturbance	Expected		Additional contingency[14]		Total[15]	
				Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)	Direct disturbance area (km^2)	Indirect disturbance area (km^2)
Removal of mattresses	CDP1b	• 21 mattresses to be removed of various dimensions	Temporary	0.00059	0.00118	0.00031	0.00062	0.00090	0.00180
	CDP2	• 705 mattresses to be removed of various dimensions • Of which 588 are within the Dogger Bank SAC	Temporary	0.01228	0.02456			0.01228	0.02456
	CDP3	• 15 mattresses to be removed of various dimensions	Temporary	0.00033	0.00065	0.00187	0.00374	0.00220	0.00440
Removal of grout bags	CDP2[16]	• 3,500 grout bags (0.6 x 0.3 m)	Temporary	0.00630	0.01260			0.00630	0.01260
Total		**Overall**		**0.01953**	**0.03906**	**0.00218**	**0.00437**	**0.02171**	**0.04343**
		Within the Dogger Bank SAC		**0.01058**	**0.02117**	**n/a**	**n/a**	**0.01058**	**0.02117**

[14] Contingency accounts for mid-line sections that may be removed should the mattresses be exposed. They have been assessed as a contingency but are included in the worst case scenario. Refer to Table 5.2.4.

[15] Expected area plus the additional contingency.

[16] For simplicity, owing to the fact that the exact location of grout bags is unknown, all the grout bags have been assigned to CDP2 as it covers the greatest number of assets, therefore it is likely the majority of stabilisation materials will be associated with items in this DP.

5.2.2.4 Pipelines

Following the removal of the pipeline ends, the remaining pipelines/umbilicals and associated support materials will be either decommissioned *in situ* or fully/partially removed, as described in 3.2. Table 5.2.5 presents the approximate footprint of seabed affected by decommissioning the pipelines/umbilicals *in situ* or due to partial removal. Any associated rock placement at the cut ends is also calculated separately as a source of permanent impact. The length of the ends to be cut from each pipeline/umbilical varies per determination of the CA (lengths to be removed are recorded in Table 5.2.5).

Where the pipeline will be partially removed or have its ends cut, a 10 m corridor centred (5 m each side) around each pipeline/umbilical has been assumed. This corridor takes account of any pipeline/umbilical stabilisation features (mattresses and grout bags) and any excavation works.

An estimated 25 Te (covering an area of 50 m^2) of rock is thought to be required per cut end. The expected case and contingency scenarios both assume the need for rock placement at all of the ends. The total area is the expected plus contingency areas. As before, the indirect impact area is double the direct impact area (Table 5.2.5).

As described in Section 3.4.2, there may be some additional mid-line sections cut and removed. Table 5.2.4 below shows five in-field pipeline sections which may be removed in a worst-case scenario and remediated with rock. However, as this is not expected activity, these sections have only been considered within the worst-case contingency column within Table 5.2.5.

Table 5.2.4: Locations of contingency in-field sections of pipeline to be cut and removed

Pipeline	Cut length (m)	KP (start)	Remediation	Within protected site
PL930	40	KP 4.8	Rock	n/a
	80	KP 20	Rock	Inner Dowsing, Race Bank and North Ridge SAC
	60	KP 180.409	Rock	Dogger Bank SAC
PL936	65	KP 0.493	Rock	Dogger Bank SAC
	40	KP 10.485	Rock	n/a

As noted throughout the EA, much of the CMS infrastructure is within the Dogger Bank SAC. In Table 5.2.6 above, one of the contingency areas which may be removed is located within the Inner Dowsing, Race Bank and North Ridge SAC. The areas of impacts to seabed associated with pipeline decommissioning within these SACs have been calculated separately in Table 5.2.6.

Once ends have been cut and removed and/or partial removal has occurred (where relevant), there will be a length of pipeline decommissioned *in situ*. The footprints of the pipelines and umbilicals decommissioned *in situ* are split by designated site in Table 5.2.6. The areas in the table represent those which arise based on the expected levels of disturbance (ie. not including the contingency cut sections in Table 5.2.4 above). Note that due to overlap between some designated sites the area of pipeline/umbilical left *in situ* within each site will not total the overall length of pipeline decommissioned *in situ* in Table 5.2.7.

5.2.2.5 Clear seabed verification

As explained in Section 3.4.3, a clear seabed verification survey is required following all decommissioning projects to ensure there is no residual risk to other sea users, particularly those who make contact with the seabed, such as trawl fisheries.

Non-intrusive verification techniques will be used to confirm that the seabed is clear of snag hazards (e.g. berms, dropped objects etc), such as SSS and ROV surveys. The chosen method of verification will be agreed with OPRED.

Although an important activity for limiting the potential for safety hazards, the use of overtrawling often constitutes the greatest potential temporary impact to the benthic environment from decommissioning activities. Particularly within the context of designated sites. Therefore, post-decommissioning, Chrysaor will seek to engage with OPRED to determine the most effective course of action with regard to clear seabed verification.

Table 5.2.5: Seabed footprint related to the decommissioning of pipelines and umbilicals

Activity	Group	DP	Quantity and dimensions	Expected area overall			Contingency			Total[17]			Within protected site (see Table 5.2.6 for quantification of this impact)
				Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbanc e area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	
PL929 - decommission *in situ* with ends cut and remediated	1	CDP3	• 147 m removed at offshore end • 10 m buffer added to removed section • 50 m^2 rock placed at offshore cut end	0.0015	0.0030	0.0001				0.0015	0.0030	0.0001	Dogger Bank SAC
PL930[18] – decommission *in situ* with ends cut and remediated	1	CDP3	• 147 m removed at offshore end • 10 m buffer added to removed section • 50 m^2 rock placed at offshore cut end	0.0015	0.0030	0.0001	0.0018	0.0042	0.0003	0.0033	0.0072	0.0004	Dogger Bank SAC Inner Dowsing, Race Bank and North Ridge SAC
PL935 – decommission *in situ* with ends cut and remediated	1	CDP1b	• 185 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0019	0.0039	0.0001				0.0019	0.0039	0.0001	Dogger Bank SAC
PL936[19] – decommission *in situ* with ends cut and remediated	1	CDP1b	• 185 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0019	0.0039	0.0001	0.00105	0.0025	0.0002	0.0029	0.0064	0.0003	Dogger Bank SAC
PL1436 & PL1437 – decommission *in situ* with ends cut and remediated	2	CDP2	• 380 m removed (4 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0038	0.0080	0.0002				0.0038	0.0080	0.0002	Dogger Bank SAC
PL1922 & PL1925 – decommission *in situ* with ends cut and remediated	2	CDP2	• 929 m removed (8 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0086	0.0179	0.0004				0.0086	0.0179	0.0004	Dogger Bank SAC
PL1923 & PL1926 – decommission *in situ* with ends cut and remediated	2	CDP2	• 201 m removed (4 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0020	0.0044	0.0002				0.0020	0.00442	0.0002	Dogger Bank SAC
PL1924 & PL1927 – decommission *in situ* with ends cut and remediated	2	CDP2	• 809 m removed (8 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0081	0.0170	0.0004				0.00809	0.01698	0.0004	n/a
PL2109 & PL2110 – decommission *in situ* with ends cut and remediated	2	CDP2	• 2,054 m removed (4 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0205	0.0415	0.0002				0.0205	0.04148	0.0002	Dogger Bank SAC

[17] Expected area plus the additional contingency.
[18] The worst-case contingency area for the PL930 includes the in-field sections to be removed, listed in Table 5.2.4. This worst-case scenario potentially results in some activities within the Inner Dowsing, Race Bank and North Ridge SAC.
[19] The worst-case contingency area for the PL936 includes the in-field sections to be removed, listed in Table 5.2.4.

Activity	Group	DP	Quantity and dimensions	Expected area overall			Contingency			Total[17]			Within protected site (see Table 5.2.6 for quantification of this impact)
				Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	
PL2430 & PLU2431 – decommission *in situ* with ends cut and remediated	2	CDP2	• 396 m removed (4 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0040	0.0083	0.0002				0.0040	0.0083	0.0002	Dogger Bank SAC
PL2894 & PL2895 – decommission *in situ* with ends cut and remediated	2	CDP2	• 294 m removed (4 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0029	0.0062	0.0002				0.00294	0.00618	0.00015	Dogger Bank SAC
PLU4685 – decommission *in situ* with ends cut and remediated	3	CDP2	• 292 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0029	0.0060	0.0001				0.0015	0.0031	0.00005	Dogger Bank SAC
PLU4686 – decommission *in situ* with ends cut and remediated	3	CDP2	• 432 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0043	0.0088	0.0001				0.00292	0.00604	0.0001	Dogger Bank SAC
PLU4888 – decommission *in situ* with ends cut and remediated	3	CDP2	• 196 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0020	0.0041	0.0001				0.00432	0.00884	0.0001	Dogger Bank SAC
PLU4889 – decommission *in situ* with ends cut and remediated	3	CDP2	• 315 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end •	0.0032	0.0065	0.0001				0.00196	0.00412	0.0001	Dogger Bank SAC
PLU4890 – decommission *in situ* with ends cut and remediated	3	CDP2	• 315 m removed (2 ends) • 10 m buffer added to removed sections • 50 m^2 rock placed at each end	0.0032	0.0065	0.0001				0.00315	0.0065	0.0001	Dogger Bank SAC
			Total	**0.0720**	**0.1492**	**0.0026**	**0.0067**	**0.0147**	**0.0007**	**0.0732**	**0.1525**	**0.0030**	

Table 5.2.6: Seabed footprint related to the decommissioning of pipelines within protected sites

Activity	Group	DP	Quantity and dimensions	Expected area overall			Contingency			Total[20]		
				Temporary direct disturbance area (km²)	Temporary indirect disturbance area (km²)	Permanent disturbance area (km²)	Temporary direct disturbance area (km²)	Temporary indirect disturbance area (km²)	Permanent disturbance area (km²)	Temporary direct disturbance area (km²)	Temporary indirect disturbance area (km²)	Permanent disturbance area (km²)
PL929	1	CDP3	• 1 end in the Dogger Bank SAC (147 m) • End remediated with rock (50 m²)	0.00147	0.00304	0.00005				0.00147	0.00304	0.00005
PL930	1	CDP3	• 1 end in the Dogger Bank SAC (147 m) • End remediated with rock (50 m²) • 1 additional contingency in-field section for possible removal (see Table 5.2.4) in the Dogger Bank SAC (remediated with rock)	0.00147	0.00304	0.00005	0.0004	0.00100	0.0001	0.00187	0.00404	0.00015
			• 1 additional contingency in-field section for possible removal (see Table 5.2.4) in the Inner Dowsing, Race Bank and North Ridge SAC (remediated with rock)[21]				0.0004	0.00085	0.0004	0.0004	0.00085	0.0004
PL935	1	CDP1b	• 1 end in the Dogger Bank SAC (100 m) • End remediated with rock (50 m²)	0.00100	0.00210	0.00005				0.001	0.0021	0.00005
PL936	1	CDP1b	• 1 end in the Dogger Bank SAC (100 m) • End remediated with rock (50 m²) • 2 additional contingency in-field sections for possible removal (see Table 5.2.4) in the Dogger Bank SAC (remediated with rock)	0.00100	0.00210	0.00005	0.00105	0.00250	0.0002	0.00205	0.0046	0.00025
PL1436	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00077	0.00164	0.00005				0.00077	0.00164	0.00005
PL1437	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00113	0.00236	0.00005				0.00113	0.00236	0.00005
PL1922	2	CDP2	• 4 ends in the Dogger Bank SAC • Ends remediated with rock (200 m²)	0.00412	0.00864	0.0002				0.00412	0.00864	0.0002
PL1925	2	CDP2	• 4 ends in the Dogger Bank SAC • Ends remediated with rock (200 m²)	0.00443	0.00926	0.0002				0.00443	0.00926	0.0002
PL1923	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00045	0.001	0.00005				0.00045	0.001	0.00005
PL1926	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00045	0.001	0.00005				0.00045	0.001	0.00005
PL1924	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00157	0.00324	0.00005				0.00157	0.00324	0.00005
PL1927	2	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m²)	0.00194	0.00398	0.00005				0.00194	0.00398	0.00005
PL2109	2	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00228	0.00476	0.0001				0.00228	0.00476	0.0001
PL2110	2	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.01826	0.03672	0.0001				0.01826	0.03672	0.0001
PL2430	2	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00204	0.00428	0.0001				0.00204	0.00428	0.0001
PLU2431	2	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00192	0.00404	0.0001				0.00192	0.00404	0.0001
PL2894	2	CDP2	• 2 ends in the Dogger Bank SAC • End remediated with rock (100 m²)	0.00144	0.00308	0.0001				0.00144	0.00308	0.0001
PL2895	2	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00150	0.00320	0.0001				0.0015	0.0032	0.0001
PLU4685	3	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00292	0.00604	0.0001				0.00292	0.00604	0.0001
PLU4686	3	CDP2	• 2 ends in the Dogger Bank SAC • Ends remediated with rock (100 m²)	0.00432	0.00884	0.0001				0.00432	0.00884	0.0001
PLU4888	3	CDP2	• 0 ends in the Dogger Bank SAC									
PLU4889	3	CDP2	• 1 end in the Dogger Bank SAC	0.00200	0.00410	0.00005				0.002	0.0041	0.00005

[20] Expected area plus the additional contingency.
[21] As this in-field section is a contingency and its removal is not a planned activity, there is no expected area associated with it.

Activity	Group	DP	Quantity and dimensions	Expected area overall			Contingency			Total[20]		
				Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)	Temporary direct disturbance area (km^2)	Temporary indirect disturbance area (km^2)	Permanent disturbance area (km^2)
			• End remediated with rock (50 m^2)									
PLU4890	3	CDP2	• 1 end in the Dogger Bank SAC • End remediated with rock (50 m^2)	0.00200	0.00410	0.00005				0.002	0.0041	0.00005
Total			**Dogger Bank SAC**	**0.05848**	**0.12056**	**0.0018**	**0.00145**	**0.00390**	**0.00050**	**0.05993**	**0.12406**	**0.00210**
			Inner Dowsing, Race Bank and North Ridge SAC	**n/a**	**n/a**	**n/a**	**0.0004**	**0.00085**	**0.0004**	**0.0004**	**0.00085**	**0.0004**

Table 5.2.7: Seabed footprint related to CMS pipelines decommissioned in situ

Pipeline	Group	DP	Area remaining *in situ* (km^2)	Remaining infrastructure split by SAC/SPA (km^2)[22]				
				Southern North Sea SAC[23]	Dogger Bank SAC	Inner Dowsing, Race Bank and North Ridge SAC	Greater Wash SPA	Humber Estuary SPA
PL929	1	CDP3	0.1185	0.0535	0.0017	0.0085	0.0211	0.0003
PL930	1	CDP3	0.0182	0.0082	0.0003	0.0013	0.0032	<0.0001
PL935	1	CDP1b	0.0045	<0.0001	0.0017	n/a	n/a	n/a
PL936	1	CDP1b	0.0008	<0.0001	0.0003	n/a	n/a	n/a
PL1436	2	CDP2	0.0029	0.0028	0.0010	n/a	n/a	n/a
PL1437	2	CDP2	0.0009	0.0028	0.0012	n/a	n/a	n/a
PL1922	2	CDP2	0.0064	0.0064	0.0064	n/a	n/a	n/a
PL1925	2	CDP2	0.0016	0.0014	<0.0001	n/a	n/a	n/a
PL1923	2	CDP2	0.0013	0	0.0005	n/a	n/a	n/a
PL1926	2	CDP2	0.0004	0.0054	0.0056	n/a	n/a	n/a
PL1924	2	CDP2	0.0042	0.0012	0.0015	n/a	n/a	n/a
PL1927	2	CDP2	0.0013	0	0.0008	n/a	n/a	n/a
PL2109	2	CDP2	0.0012	0.0012	0.0012	n/a	n/a	n/a
PL2110	2	CDP2	0.0002	0.0008	0.0010	n/a	n/a	n/a
PL2430	2	CDP2	0.0038	0.0037	0.0037	n/a	n/a	n/a
PLU2431	2	CDP2	0.0010	0.0037	0.0040	n/a	n/a	n/a
PL2894	2	CDP2	0.0036	0.0030	0.0035	n/a	n/a	n/a
PL2895	2	CDP2	0.0007	0.0030	0.0038	n/a	n/a	n/a
PLU4685	3	CDP2	0.0014	0.0014	0.0014	n/a	n/a	n/a
PLU4686	3	CDP2	0.0010	0.0010	0.0010	n/a	n/a	n/a
PLU4888	3	CDP2	0.0007	n/a	n/a	n/a	n/a	n/a
PLU4889	3	CDP2	0.0008	0	0.0002	n/a	n/a	n/a
PLU4890	3	CDP2	0.0005	0.0005	0.0005	n/a	n/a	n/a
		Total	**0.1757**	**0.1001**	**0.0414**	**0.0098**	**0.0243**	**0.0003**

[22] These totals represent the area within each specific designated site and, owing to overlap between designated sites, do not add up to the overall total area of each CMS pipeline remaining *in situ*.
[23] Some of the pipelines are currently only within the Southern North Sea SAC for a number of metres, thus when their ends are cut there will be no area left associated with that pipeline decommissioned *in situ* in that designated site.

5.2.2.6 Summary

Table 5.2.8 provides a condensed summary of the estimated potential seabed disturbance associated with the various decommissioning activities outlined in Sections 5.2.2.1 to 5.2.2.4. The totals are presented as an overall figure and an area within the Dogger Bank SAC. Please note that as the only activity within the Inner Dowsing, Race Bank and North Ridge SAC is contingency (and therefore not confirmed), it is not included in Table 5.2.8; the area of impact in the SAC, should the activity ultimately, occur can be seen in Table 5.2.6. In comparison, Table 5.2.9 shows the area of impact as associated with activities covered by each of the three CMS DPs (CDP1b, CDP2, CDP3). For a breakdown of the areas of impact associated with each activity and pipeline CA Group see the sections above.

The overall expected temporary area of disturbance associated with all the CMS activities is 0.0926 km^2, the majority of occurs in the Dogger Bank SAC and which is associated with activities covered by CDP2. A further 0.0026 km^2 of permanent impact, exclusively attributed to rock placement is also expected. These numbers reflect the expected scenario with regards to the proposed activities. Should any additional contingency remediation or excavation actives be required (as discussed throughout Section 5.2.2), the total area of direct impact will increase to 0.1123 km^2, with 0.0031 km^2 permanent impact.

Table 5.2.8: Summary of the areas of impact associated with all the CMS decommissioning activities

Activity	Overall area of impact vs area within a designated site	Expected/Total scenario[24]	Temporary direct disturbance (km^2)	Temporary indirect disturbance (km^2)	Permanent direct disturbance (km^2)
Jacket removal	Overall	Expected	0.0001	0.0003	n/a
		Total	0.0091	0.0183	n/a
	Dogger Bank SAC	Expected	0.0001	0.0002	n/a
		Total	0.0059	0.0118	n/a
Subsea structure removal	Overall	Expected	0.0009	0.0019	n/a
		Total	0.0066	0.0132	n/a
	Dogger Bank SAC	Expected	0.0005	0.0011	n/a
		Total	0.0005	0.0011	n/a
Removal of stabilisation materials	Overall	Expected	0.0195	0.0391	n/a
		Total	0.0217	0.0434	n/a
	Dogger Bank SAC	Expected	0.0106	0.0212	n/a
		Total	0.0106	0.0212	n/a
Removal of pipeline cut ends/sections and remediation	Overall	Expected	0.0720	0.1492	0.0026
		Total	0.0749	0.1559	0.0031
	Dogger Bank SAC	Expected	0.0585	0.1206	0.0018
		Total	0.0599	0.1241	0.0021
	Inner Dowsing, Race Bank and North Ridge SAC	Expected	n/a	n/a	n/a
		Total	0.0004	0.0009	0.0004
	Overall	**Expected**	**0.0926**	**0.1904**	**0.0026**

[24] The total area of impact is the expected scenario plus the additional contingency (calculated throughout Section 5.2.2).

Total area of impact		**Total**	**0.1123**	**0.2308**	**0.0031**
	Dogger Bank SAC	**Expected**	**0.0697**	**0.1430**	**0.0018**
		Total	**0.0770**	**0.1581**	**0.0021**
	Inner Dowsing, Race Bank and North Ridge SAC	**Expected**	**n/a**	**n/a**	**n/a**
		Total	**0.0004**	**0.0009**	**0.0004**

Table 5.2.9: Summary of the areas of impact associated with each CMS DP

Activity	**DP**	**Expected/Total scenario[25]**	**Temporary direct disturbance (km²)**	**Temporary indirect disturbance (km²)**	**Permanent direct disturbance (km²)**
Jacket removal	CDP2	Expected	0.00006	0.00012	n/a
		Total	0.00578	0.01156	n/a
	CDP3	Expected	0.00008	0.00015	n/a
		Total	0.00337	0.00674	n/a
Subsea structure removal	CDP2	Expected	0.00094	0.00189	n/a
		Total	0.00660	0.01320	n/a
Removal of stabilisation materials	CDP1b	Expected	0.00059	0.00118	n/a
		Total	0.00090	0.00180	n/a
	CDP2	Expected	0.01858	0.03716	n/a
		Total	0.01858	0.03716	n/a
	CDP3	Expected	0.00033	0.00065	n/a
		Total	0.00220	0.00440	n/a
Removal of pipeline cut ends/sections and remediation	CDP1b	Expected	0.00370	0.00780	0.00020
		Total	0.00475	0.01030	0.00040
	CDP2	Expected	0.06539	0.13528	0.00225
		Total	0.06374	0.13188	0.00220
	CDP3	Expected	0.00294	0.00608	0.00010
		Total	0.00474	0.01028	0.00040
Total area of impact	**CDP1b**	**Expected**	**0.00429**	**0.00898**	**0.00020**
		Total	**0.00565**	**0.01210**	**0.00040**
	CDP2	**Expected**	**0.08497**	**0.17445**	**0.00225**
		Total	**0.09470**	**0.19380**	**0.00220**
	CDP3	**Expected**	**0.00334**	**0.00688**	**0.00010**
		Total	**0.01031**	**0.02141**	**0.00040**

[25] The total area of impact is the expected scenario plus the additional contingency (calculated throughout Section 5.2.2).

5.2.3 Direct disturbance of seabed habitats during decommissioning activities

Sediment disturbance and re-distribution due to jacket and subsea infrastructure removal

Removal of the jackets and subsea infrastructure from the seabed will cause sediment disturbance and re-distribution in the localised area. The area of impact of is expected to be 0.0926 km^2. Within the Dogger Bank SAC the area of expected impact is estimated to be 0.0697 km^2.

Sediments that are redistributed and mobilised as a result of the proposed decommissioning activities will be transported by the seabed currents before settling out over adjacent seabed areas. The marine environment in the Southern North Sea is dynamic in nature, with wave energy at the seabed shown to be between 0.21 – 1.2 N/m^2 and increasing above 1.2 N/m^2 towards shore [71]. The dynamic environment will result in suspended sediment, in particular the fines, being transported away from the source of the disturbance. The natural settling of the suspended sediments is such that the coarser material (sands) will quickly fall out of suspension with the finer material being the last to settle. This natural process will ensure that all the suspended sediment is not deposited in one location. Based on the mobility of the seabed in the area [71][73], as indicated by the lack of drill cuttings piles around wellheads within the SAC [14][15], the deposition resulting from the decommissioning activities is likely to be comparable to the background sediment redistribution processes.

In such a high energy area, the expected sediment recovery time from dredging activities is approximately within a year [73]. For example, areas of dredging on sandbanks which are subject to naturally high sediment mobility may disappear within a few tidal cycles [73]. Infrequent, high-energy (storm) conditions will also result in sediment suspension and redistribution. Published calculations of wave and tidal current-induced bed shear stress, clearly show that the large waves have the capability to mobilise seabed sediments, increasing sediment suspension particularly for those sizes of coarse sands and smaller [74].

A recent study found that the nearby Dogger Bank sub-units are composed of generally stiff to very stiff clays, with multiple sand-rich layers [75]. Although this is described as a high energy area, the presence of stiff clays below the unconsolidated surface layers could result in a higher degree of seabed disturbance and longer recovery time where decommissioning activities interact with the clay layers. Studies carried out on the physical impacts to the seabed caused by towed fishing gear, indicate that the longevity of the physical scars in the seabed left in the wake of towed gear depends on the sediment type and the energy of the local seabed environment [76]. However, as identified in the Gardline surveys, the seabed within the CMS is mostly sandy [14][15]. Furthermore, sands of variable thickness overlie the geological Dogger Bank Formation and reach thicknesses of 20 m in the southeast of the Dogger Bank. This is in comparison to thinner sand layers (0.1 – 0.2 m) in the west and north of the site [49]. The CMS is within the south of the Dogger Bank and therefore it is unlikely that excavation to a maximum depth of -7.5 m (as has been estimated for pile cutting at one in three structures, see Section 5.2.2) will penetrate far enough into the Formation as to disturb and displace clay sediment.

Following completion of the proposed activities, the natural physical processes of sediment transportation and natural backfilling are therefore expected to restore the seabed habitat to its equilibrium state within a year and will be qualified by post platform removals surveys.

Benthic disturbance and habitat loss due to removal of jackets, subsea infrastructure and rock-placement

Removal of the jackets and subsea infrastructure from the seabed will physically disturb the benthic fauna living on or in the sediment in the localised area. The area of impact is estimated to be 0.0926 km^2. Within the Dogger Bank SAC the area of impact is estimated to be 0.0697 km^2. No other designated sites are expected to be impacted by decommissioning activities where seabed sensitivities are a reason for designation. However, Conservation Objectives for the Southern North Sea SAC concern the supporting habitats and prey of the species. As a result there is an indirect opportunity for harbour porpoise of the Southern North Sea SAC to be affected by the decommissioning activities.

The CMS PL929 and PL930 pipelines to shore pass through a number of protected areas though of those, only the Inner Dowsing, Race Bank and North Ridge SAC is designated for seabed features. However, only contingency (ie. not currently planned to take place) decommissioning activities are expected to occur within this protected site.

The proposed decommissioning activities will cause some direct impact to fauna living on and in the sediments. Mortality is more likely in non-mobile benthic organisms, such as the ocean quahog. Ocean quahog (where found in aggregations) are protected within Marine Protected Areas (MPAs) in the North Sea under OSPAR (1992) Annex V ‘on the protection and conservation of the ecosystems and biological diversity of the maritime area.' It is possible that disturbance to individual ocean quahog (and to other benthic species) will occur, however, the disturbance associated with the removal of the CMS platforms is not expected to significantly affect the population(s) in this area as a whole as only two individuals were identified during environmental surveys of the CMS [14][15].

Another species of conservation interest is *S. spinulosa*, of which 21 adult individuals were identified at one Murdoch Hub station (MUR_05) [14]. While this does not constitute an aggregation, small patches of biogenic reef were identified along the PL935 and PL936 within the CMS, between Caister CM and the Murdoch Hub [17]. *S. spinulosa* are tolerant of both smothering and an increase in suspended sediment, as may occur as a result of the proposed decommissioning activities. However, they are sensitive to substrate loss which may arise due to rock placement [77]. The ends of the PL935 and PL936 will be cut and removed at the Murdoch Hub end (85 m and 100 m respectively). This is unlikely to directly coincide with the *S. spinulosa* reef patches along the pipelines which ~500 m from the Murdoch Hub. Chrysaor will ensure that that rock placement is accurate to limit the spread of introduced substrate within the CMS (see Section 5.2.5 for mitigation measures regarding rock placement), therefore it is not likely that at any point, *S. spinulosa* reef will be adversely affected by the CMS decommissioning.

With regards to biogenic reef along the PL929/PL930 to shore, there is an area of *S. spinulosa* reef in the north of the Inner Dowsing, Race Bank and North Ridge SAC [53] which may be close to the PL929/PL930, however no activity is expected along the length of pipeline which intersects the SAC, therefore there is no opportunity for the reef to be affected by the decommissioning. Should the contingency removal of pipeline within the SAC (as referenced in Table 5.2.4) be required, every effort will be made to avoid reef habitat. Furthermore, should these contingency sections be removed, seabed sediment is the proposed method of cut end remediation therefore disturbance due to placement of rock is highly unlikely.

With regards to other benthos within the CMS, as noted in Section 4.2.2.2, juvenile urchins belonging to the order Spatangoida of heart urchins were dominant across the CMS [14][15]. While the species could not be identified, urchins are generally able to bury themselves and are therefore somewhat tolerant to smothering and increased sedimentation. However, they are not particularly mobile therefore any direct impacts, including habitat loss, may cause mortality. Of the common molluscs identified within the CMS, *F. fabula* was dominant at Katy KT [14]. While similarly sensitive to habitat loss, as a filter feeder, *F. fabula* is tolerant of increased sedimentation [78]. Therefore, the impacts associated with the proposed decommissioning activities are not likely to significantly negatively impact the benthos typical of the CMS area.

Although operations will be undertaken within the Dogger Bank SAC, it is considered that this is a very small area compared to other areas of similar habitat available within the region. The area is unlikely to be used by benthic spawners during the proposed operational period; species like plaice and sandeel spawn in the winter months and therefore spawning is unlikely to coincide with project activities (Table 4.1.1). Furthermore, due to the dynamic nature of the SNS, benthic species are well adapted to a dynamic seabed environment. It is therefore considered that seabed disturbance from the proposed operations will recover quickly and will not result in a significant environmental impact.

Mobile benthic organisms will be able to move away from the area of disturbance. Upon completion of the subsea decommissioning activities, it is expected that the resettled sediment will be quickly recolonised by benthic fauna typical of the area. This will occur as a result of natural settlement by larvae and plankton and through the migration of animals from adjacent undisturbed benthic communities [79]. A series of large-scale field experiments investigated the response of marine benthic communities within a variety of sediment types (clean sand, silty sand, muddy sand and mud) to physical disturbance (sediment removal down to 10 cm). Of the four sediment types investigated, the communities from clean sands had the most rapid recovery rate of between 0.45 – 0.6 individuals per day following disturbance [79].

Studies of seabed dredging sites indicate that faunal recovery times are generally proportional to the spatial scale of the impact (where the impact is between 0.1 m^2 and 0.1 km^2) [80]. Biological recovery is therefore expected to be even quicker in less extensive, dynamic sandy habitats [73] such as those observed at the majority of the CMS sites. In low-energy areas of the North Sea subject to extensive dredging, local fauna took approximately three years to recover to the original level of species abundance and diversity. It has been reported that offshore circalittoral mixed sediments have a high recoverability following disturbance [81]. Although the authors did not feel there were sufficient data to conclude on offshore circalittoral sand recoverability, all other similar habitats for which a recovery description was assigned were considered to show moderate or high recoverability. An evaluation of threats and impacts to circalittoral muddy sand and slightly mixed sediment (which is similar to that recorded in the CMS area), suggested that the threat from infrastructure installation offshore was low. Although substratum loss caused a decline of species in the area of direct footprint, species that inhabit this type of benthic habitat were deemed to be highly recoverable [82].

Based on the dynamic characteristics of the seabed in the Dogger Bank area of the SNS, recovery would be expected to be more rapid than estimates for the low-energy areas of the North Sea.

Seabed disturbance can present a risk to fish and shellfish species which use the seabed for spawning and/or nursery grounds. Low intensity herring spawning is likely to occur within the CMS area, as described in Table 4.1.1 [36][37]. Herring spawn is usually deposited demersally, on marine vegetation or on a substrate with a high percentage of gravel and a low fine sediment component [37][83]. Based on the patches of gravelly/ shelly substrate identified around some of the CMS platforms, it is possible that small-scale herring spawning grounds could be present. It is thought that remote and historic spawning grounds (such as those on parts of the Dogger Bank) currently have no, or very little, spawning activity, and that most current important spawning grounds have been identified in high-energy coastal locations [37]. Nevertheless, it should be recognised that spawning grounds can be 'recolonised' over time [84].

As shown in Table 4.1.1, there is the potential for demersal fish species such as sandeel and plaice to be present within the CMS area over the duration of the planned operations; however, considering that the CMS is located >100 km from shore and that the preference for plaice nursery grounds are sandy beaches and coastal estuaries, plaice are unlikely to be found within the CMS. Sandeels may use the area for nursery during the period of operations [37].

Given the very localised area of decommissioning activities and the transient nature of the disturbance to benthic sediments in this naturally energetic area with very good recovery potential, the disturbance to fish and shellfish is not expected to be significant. Fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the activities. The potential release of contaminants from the sediments may affect the early life stages of some fish species. However, both metal and THC concentrations in the CMS area sediments are generally low (see Section 4.2.2.3) and the proposed activities will be localised. Therefore, the proposed activities are unlikely to have an impact on species populations or their long-term survival.

With regards to impact on the supporting habitat and prey of harbour porpoise in the Southern North Sea SAC, the Murdoch Hub, Kelvin TM, Boulton BM, Munro MH surface installations and McAdam MM and Hawksley EM subsea installations are all located within the SAC, in addition to a number of associated pipelines. The decommissioning activities associated with this infrastructure will take up a relatively small area of the SAC. Additionally, as outlined above, recovery of sediments is expected to occur relatively rapidly and prey species, such as fish, are highly mobile and therefore will be able to avoid use of the area over the limited period of activities. Considering the predicted recovery of the seabed it is expected once activities cease, fish will return to the area. Overall, no impacts are expected on the habitats and species underpinning harbour porpoise of the Southern North Sea SAC.

5.2.4 Footprint of remaining infrastructure impacts

Habitat change caused by introduced hard substrate due to rock-placement

The introduction of approximately 0.0026 km^2 of new hard substrate in the form of rock-placement would have a permanent but very localised impact on the surrounding environment. The area of rock placement within the Dogger Bank SAC is smaller at 0.0018 km^2.This impact would be particularly apparent within the context of the sandy SNS.

The proposed decommissioning activities will cause some direct impact to fauna living on and in the sediments. Mortality is more likely in non-mobile benthic organisms, whereas mobile benthic organisms are more sparsely distributed and may be able to move away from the area of disturbance. Whilst the introduction of a new substratum into the area may be influenced by scour from tides and mobile sediments and it may even become partially buried in places from time to time, it is likely that parts of it will eventually support a low-diversity epifaunal community similar to that present on naturally occurring stones and boulders in the area. This will occur as a result of natural settlement by larvae and plankton and through the migration of animals from adjacent undisturbed benthic communities. As described above, sand-based communities recover most quickly from disturbance [79].

The concrete mattress dump at Katy KT (as described in Section 4.2.2.2 and pictured in Figure 4.2.6) was identified as the EUNIS biotope A4.21 echinoderms and crustose communities on circalittoral rock which is characterised by echinoderms, faunal crusts and anemones. This area was judged to exhibit a medium resemblance to rocky reef, according to the Irving (2009) definition [16]. Based on this example within the CMS area, it is likely that any new rock placement would be colonised by a similar community.

The operations could have an impact on any benthic fauna, such as the two ocean quahog individuals identified in the CMS surveys [14][15]. Ocean quahog (where found in aggregations) are protected within MPAs under OSPAR (1992) Annex V, in addition to being an OSPAR listed threatened and/or declining species and Annex I listed. Given the localised nature of the individuals identified, the disturbance associated with the placement of rock is not expected to significantly affect the population(s) in this area as a whole.

The introduction of the proposed rock will cover a very small area (0.0026 km^2) and is very unlikely to change the character of the species typically present in the area as a whole.

Seabed morphological change due to presence of rock placement, support structures and pipelines/umbilicals decommissioned *in situ*

The long-term presence of the pipelines, existing support materials and the introduction of rock for the pipeline ends, could influence sediment dynamics in the CMS area, which is located within the Dogger Bank SAC. The rate at which sandbanks (such as those characteristic of the Dogger Bank SAC) are reported to move varies depending on their location. It has been estimated that at the rate that sandbanks move it could take in excess of 100 years for the sandbanks to move 100 m [83]. Although, movements of between 11 m and 15 m/year are also known to occur [83][86]. At these relatively slow rates of movement, any possible effect the physical presence of rock may potentially have on the mobility of the sandbank feature would be difficult to detected.

Bathymetry and seabed data collected during pre-decommissioning baseline environmental surveys show evidence of sand ripples and megaripples throughout the CMS area (see Section 4.2.2.1). At Boulton BM, the seabed was partially characterised by low relief sand features (up to 1.5 m high) with intermittent ripples (up to 0.3 m high). This was the clearest example of such seabed features within the CMS (see Figure 4.2.1). The presence and continuation of these megaripples in areas containing a platform and pipelines suggests that small scale installations such as these do not present barriers to sandbank maintenance or formation. As such, it is not expected that the elongation and subsequent structure of the sandbanks to be compromised by the proposed decommissioning activities.

The Inner Dowsing, Race Bank and North Ridge SAC (designated for benthic features), also contain infrastructure that is to be decommissioned *in situ*: the PL929 and PL930 pipelines to shore. The sandbank features of the site, as mapped by the JNCC, are in the south of the SAC, away from the location of the PL929/PL930 [53]. Therefore, these features are unlikely to be influenced by the pipeline being decommissioned *in situ*.

Impact on sediment and benthos due to subsea infrastructure breakdown

Structural degradation of the pipelines in the CMS areas will be a long-term process caused by corrosion and the eventual collapse of the pipelines under their own weight and that of the overlying mattresses, pipeline coating material, scale and sediment. During this process, degradation products derived from the exterior and interior of the pipe will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity.

The primary degradation products will originate from the following pipeline components:

- Pipeline scale;
- Steel;
- Sacrificial anodes;
- Coal tar enamel coating;
- Concrete coating; and
- Plastic coating.

Note: pipeline contents will be limited to treated seawater and are not discussed further herein.

Heavy metals

Metals with a relatively high density or a high relative atomic weight are referred to as heavy metals. It is expected that these metals will be released into the sediments and water column during the breakdown of the components of the pipeline scale, steel and sacrificial anodes.

The toxicity of a given metal varies between marine organisms for several reasons, including their ability to take up, store, remove or detoxify these metals [87]. Concentrations of the metals are not expected to exceed acute toxicity levels at any time. However, chronic toxicity levels may be reached for short periods within the interstitial spaces of the sediments or in close proximity to the pipelines. At these levels, heavy metals act as enzyme inhibitors, adversely affect cell membranes, and can damage reproductive and nervous systems. Changes in feeding behaviour, digestive efficiency and respiratory metabolism can also occur. Growth inhibition may also occur in crustaceans, molluscs, echinoderms, hydroids, protozoans and algae [87]. It is expected that any toxic impacts will be short lived and localised with minimal potential to impact populations of marine species. The potential for uptake and concentration of metals would also be limited to the local fauna and due to the slow release of these chemicals not likely to result in a significant transfer of metals into the food chain.

A benthic species of concern in the area is *S. spinulosa*. Some practitioners consider *S. spinulosa* relatively insensitive to metal or chemical contaminants [88], although direct evidence is limited. Studies of the response of *S. spinulosa* to an outfall from a bromide extraction works containing free halogens [89] suggest that it is generally tolerant of changes in water quality [90]. A further study recorded that down-tide of a sewage discharge in Dublin Bay *S. spinulosa* was present in greater densities and diversities than elsewhere in the bay, indicating a level of tolerance for environmental change [91]. Given its few key environmental requirements, and its tolerance of poor water quality, *S. spinulosa* is naturally common around the British Isles. A good supply of sand grains put into suspension by strong water movement (either tidal currents or wave action) such as that found in the Dogger Bank SAC, is thought to be essential for tube building [92]. *S. spinulosa* are also known to have life history strategies which enable them to exist in variable or unpredictable environments, responding to suitable conditions with a high rate of reproduction and rapid development [93][94].

The slow release of the metals associated with the pipeline steel and steel associated with the concrete coating and mattress protection is expected to have a negligible impact on the local environment. It is anticipated that failure of the pipelines due to through-wall degradation would only begin to occur after many decades (of the order of 60 to 100 years) [95].

Along buried pipeline corridors there may be accumulations of heavy metals in the sediments. Where present, the finer fraction of these sediments (silts and clays) are likely to form bonds with these metals, making them less bioavailable to marine organisms. The sandy (coarser fraction) of the sediments surrounding the pipelines are less likely to retain metals [96]. Much of the surrounding seabed is composed of sand and will therefore release any metals to the surrounding seawater, making them bioavailable, but also diluting them into the wider environment.

Due to the highly localised nature of any degradation products and the low concentrations of contaminants being released over an elongated period it is highly unlikely that these products will be detectable above current background conditions in the area given proximity to production assets or the run-off via the Humber Estuary. As a result, no likelihood of significant effect is expected to any of the designated sites within which a pipeline will be decommissioned *in situ*.

Naturally Occurring Radioactive Material (NORM)

Marine organisms can potentially bioaccumulate radium from solution in seawater, from ingested seabed sediments or from their food. Studies of the impacts of ^{226}Ra released into the North Sea via produced water and natural processes indicate that it is unlikely that observed levels of radioactive substances entrained in sediments or found in seawater will cause effects on marine organisms [97]. NORM scale discharged from offshore installations is known to be insoluble in seawater and when produced water rich in barium and radium is discharged to sulphate rich seawater, the radium precipitates rapidly as a complex of barium, radium and sulphate which is also insoluble. ^{226}Ra therefore has a very low concentration in solution in seawater and has a low bio-availability to marine organisms. Dissolved cations in seawater, particularly calcium and magnesium, also inhibit the bioaccumulation of NORM [98].

Due to the highly localised nature of any degradation products and the potentially very low concentrations of NORM being released over an elongated period it is highly unlikely that these will be detectable above current background conditions in the area given proximity to production assets or the run-off via the Humber Estuary. As a result, no likelihood of significant effect is expected on the environment generally or to any designated site.

Polycyclic Aromatic Hydrocarbons

The likely base material of some of the concrete coated pipelines is coal tar. There is no standardised formula for the composition of coal tar, but it is thought that its constituents are over 60% inert and may comprise up to 15% of PAHs [96].

The coal tar coating degrades when the internal pipeline steel corrodes or if the concrete coat is damaged. There are no known records of concrete durability, but it is expected that the concrete will decay at a very slow rate. It is presumed that PAH will be released once the coal tar layer is open to the seawater, and over time will be released into the surrounding environment. PAHs in marine sediments will have a low biodegradation potential due to low oxygen and low temperatures [99]. PAHs are almost insoluble and only become available to marine organisms through ingestion of particulate matter [96][100].

Two factors, lipid and organic carbon, control to a large extent the partitioning behaviour of PAHs between sediment, water, and tissue. Accumulation of PAHs occurs in all marine organisms; however, there is a wide range in tissue concentrations from variable environmental concentrations, level and time of exposure, and a species' ability to metabolize these compounds. There are many variables, such as chemical hydrophobicity, uptake efficiency, feeding rate, and ventilatory volume, which may affect the outcome. The route of uptake may be an important issue for short-term events; however, under long-term exposure and equilibrium conditions between water, prey, and sediment, the route of uptake may be immaterial because the same tissue burdens will be achieved regardless of uptake routes [101]. Due to their poor solubility in water these substances will partition in organic material including plankton and marine snow (cell water release) and marine sediments (cell water and sediment release). All substances in this group are persistent with a half-time in the marine environment ranging from weeks (water column) to several years (sediments). Evidence of carcinogenicity, mutagenicity or teratogenicity attributable to PAHs in the marine environment is very limited and the amounts concerned are not thought to pose a threat to marine organisms [96]. Given that PAHs are expected to be released in very low concentrations during the deterioration of the coating over time, it is unlikely that marine organisms will accumulate them to a significant extent.

Due to the highly localised nature of any degradation products and the low concentrations of contaminants being released over an elongated period it is highly unlikely that these products will be detectable above current background conditions in the area given proximity to production assets or the run-off via the Humber Estuary. As a result, no likelihood of significant effect is expected to any designated sites.

Plastics

Methanol and gas pipelines in the CMS area are coated with 3 Layer Polyethylene (3PLE) and Fusion-bonded Epoxy (FBE). 3PLE and FBE are considered non-toxic in the marine environment [102]. However, as no micro-organisms have evolved to utilise the chemically resistant polymer chains as a carbon source, these plastics can be expected to persist in the environment for centuries [103]. As biodegradability in the marine environment is also low, it can be assumed that the environmental effect of leaving these plastics in place is insignificant [96].

Due to the highly localised nature of any degradation products and the low concentrations of contaminants being released over an elongated period it is highly unlikely that these products will be detectable above current background conditions in the area given proximity to production assets or the run-off via the Humber Estuary. As a result, no likelihood of significant effect is expected to any designated sites.

5.2.5 Mitigation measures

Mitigation measures to minimise seabed impacts within the CMS area are detailed below:

- Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment;
- The requirements for further excavation will be assessed on a case-by-case basis and will be minimised to provide access only where necessary. Internal cutting will be used preferentially where access is available;
- Heavy lift vessels are most likely to be equipped with dynamic positioning (DP) rather than relying on anchors to remain in position which interact with the seabed.
- The rock mass will be carefully placed over the designated areas of the pipelines and seabed in order to ensure rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance;
- The *in situ* decommissioning of the existing rock stabilisation will prevent the need for additional rock placement as support on pipelines to be decommissioned *in situ*;
- The profile of the rock-placement over the pipeline ends will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear;
- Survey data collected in the area will be reviewed for potential sensitive seabed habitats prior to the commencement of operations; and

- Post decommissioning debris clearance, surveys and monitoring shall be carried out using non-intrusive methodologies such as side scan sonar, using ROVs etc.

5.2.6 Cumulative assessment

5.2.6.1 Cumulative impact from additional CMS activities

Decommissioning preparation (including well decommissioning) activities in the Chrysaor CMS are out of the scope of the main assessment of this EA, but it is recognised that these will have an additional, cumulative impact on the CMS area and the Dogger Bank SAC.

Decommissioning preparation includes the flushing and cleaning of the CMS pipelines and the platform processing systems. The wells associated with the CMS will also be decommissioned prior to any of the platform and subsea decommissioning activities progressing and will require drill rig and jack-up accommodation work vessels (AVWs) to be in position. Both drill rigs and jack-up vessels require a stable seabed to ensure the spud-cans do not penetrate the seabed and risk destabilisation. Where the seabed is unstable the stability required is achieved based on soil stability limits and ensuring scour does not undermine vessel stability. In order to achieve this a rock berm may be required under each of the legs. Where and how often rig stabilisation may be required is dependent on the seabed conditions at each location which is determined at the time by a site-specific assessment. The expected worst-case for the additional CMS activities is provided in Table 5.2.10. It is anticipated that additional activities associated with the CMS decommissioning activities will impact a total area of 0.0035 km^2.

Table 5.2.10: Potential cumulative seabed impact associated with additional activities at CMS

Installation	Number of wells[26]	Estimated area of rock required for drilling rig (m^2)[27]	Area of rock for AWV (m^2)[28]
Boulton BM	4	400	0
Boulton HM	1	0	0
Kelvin TM	1	400	0
Munro MH	1	400	765
Katy KT	1	400	0
Murdoch MA	0	0	0
Murdoch MC	0	0	765
Murdoch MD	8	0	0
Murdoch K KM	1	400	0
	Total (m^2)	2,000	1,530
	Sub-Total (km^2)	0.002	0.0015
	Total area (km^2)	**0.0035**	

Table 5.2.11 summarises the cumulative seabed impacts associated with the main scope of the decommissioning works (Section 3) and the additional associated preparation and well decommissioning activities (Table 5.2.10). In total, a temporary and permanent area of 0.1123 km^2 and 0.0049 km^2 respectively will be affected by the proposed CMS decommissioning activities, as discussed throughout this EA, and additional out of scope activities associated with decommissioning preparation.

[26] The wellheads associated with the CMS infrastructure located within the footprints of the jackets and are to be cut internally, therefore the worst-case scenario of excavation of the jacket piles incorporates the area associated with any wellhead removal and the footprint has therefore already been accounted for.
[27] Based on 3000 Te per rig location.
[28] Based on 881 Te per AWV location.

Table 5.2.11: Total seabed impact from all cumulative CMS decommissioning activities

Activity	Table reference	Total temporary (physical impact) footprint (km^2)	Total permanent (physical impact) footprint (km^2)
Jacket removal	Table 5.2.1	0.0091	
Subsea structure removal	Table 5.2.2	0.0066	
Removal of stabilisation materials	Table 5.2.3	0.0221	
Removal of pipeline cut ends/sections and remediation[29]	Table 5.2.5 and Table 5.2.7	0.0749	0.0018
Additional CMS decommissioning activities	Table 5.2.12		0.0031
	Total	**0.1123**	**0.0049**

5.2.6.2 Cumulative impact from additional CMS activities within the Dogger Bank SAC

Given the protection status of the Dogger Bank SAC and its designation for 'Sandbanks which are slightly covered with water all the time', this cumulative assessment is focussed on the in-combination activities occurring within this SAC. The Southern North Sea SAC will also be impacted and is overlapped by the Dogger Bank SAC, however, the Southern North Sea SAC covers a far greater area and is not designated for seabed features. Any impact within this SAC is likely to be insignificant on the prey populations within the range of harbour porpoise.

The estimates provided for inclusion in the Dogger Bank SAC Oil and Gas Decommissioning Strategic Habitats Regulations Assessment (HRA) [104] are shown in Table 5.2.12. Chrysaor have also presented their expected worst-case (as they stand) for each of the CMS platforms within the SAC. The installations accounted for in Table 5.2.12 are located within the Dogger Bank SAC, as shown on Figure 4.6.2.

[29] It is worth noting that under the HRA objective, pipelines decommissioned *in situ* are not considered as having an additional impact on the integrity of the site [104].

Table 5.2.12: Potential cumulative seabed impact within the Dogger Bank SAC

Installation	Seabed disturbance footprint			
	Current estimation based on ongoing activity		Estimation provided for HRA [104][30]	
	Estimated area of rock required for drilling rig (m^2)[31]	Area of rock for AWV (m^2)[32]	Estimated area of rock required for drilling rig (m^2)	Estimated area of rock for possible AWV (m^2)
Kelvin TM	400	0	4,800	4,800
Munro MH	400	765	4,800	4,800
Katy KT	400	0	4,800	4,800
Murdoch MA	Well decommissioning complete with no need for rock placement	0	4,800	4,800
Murdoch MC		765	0	0
Murdoch MD		0	0	0
Total (m^2)	1,200	1,530	19,200	19,200
Sub-Total (km^2)	0.0012	0.00153	0.0192	0.0192
Total area (km^2)	**0.0027**		**0.0384**	
Proportion of SAC impacted (%)	**0.00002**		**0.0003**	

Currently, additional CMS decommissioning activities are expected to have a worst-case habitat loss footprint of 0.0027 km^2, constituting 0.00002% of the area of the Dogger Bank SAC (12,331 km^2). This is significantly less than the 0.0384 km^2 estimated during the HRA (Table 5.2.12) [104]. The Dogger Bank SAC Oil and Gas Decommissioning Strategic HRA also predicted a worst-case impact for the installation of anchors during platform and subsea structure removal. In reality, the HLVs associated with the platform lifts will use a DP system and there will be no direct impact on the seabed within the Dogger Bank from lifting activities.

The total cumulative impact of well decommissioning activities and the proposed CMS decommissioning activities within the Dogger Bank SAC is expected to have a temporary footprint of 0.0782 km^2. This number is a sum of the worst-case area of impact (0.0770 km^2; see Table 5.2.8) associated with the proposed decommissioning, and 0.0012 km^2 of impact associated with additional CMS activities (as detailed in Table 5.2.12). The area of permanent impact within the SAC is anticipated to be 0.00363 km^2, made up of 0.0021 km^2 associated with the proposed decommissioning (Table 5.2.8), and 0.00153 km^2 attributed to the activities outlined above.

Considering the above in total, this equates to 0.0006% and 0.00003% of the total area of the SAC (12,331 km^2) being affected by temporary and permanent impacts respectively. Given the small area of impact, Chrysaor do not anticipate that the current and future work on the Dogger Bank SAC will have an adverse effect on its integrity.

5.2.6.3 In-combination impact from decommissioning activities on the Dogger Bank SAC

This section outlines the seabed footprint related to potential cumulative impact. It describes project activities, those associated with Chrysaor's wider SNS decommissioning activities, and those outwith the control of Chrysaor (e.g. other oil and gas activity). This impact assessment has been conducted with the best available information at the time of writing, any changes to the proposed decommissioning activities or scientific knowledge will require a review of this assessment.

The Dogger Bank SAC is the largest sandbank in offshore waters and is home to a number of oil and gas fields that went into production prior to its designation as a SAC in 2017 and are now ready for

[30] Based on 3000 Te per rig location.
[31] No further rock is required for the AWV as the vessel will not be required for any additional decommissioning activities.
[32] Based on a worst-case impact of 1,200 m^2 per leg and 4 legs per vessel.

decommissioning. Currently, 13 installations, 40 wells and 457.7 km of pipeline are due for decommissioning within this SAC. The Dogger Bank SAC also encompasses four offshore windfarm sites including the Dogger Bank and Teeside projects.

The impacts from the CMS decommissioning activities on the Dogger Bank SAC have been accounted for within the scope of the Dogger Bank SAC Oil and Gas Decommissioning Strategic HRA [104] in context with other activities including oil and gas (decommissioning and ongoing activity), fishing, renewable energy and aggregate extraction. The results of the HRA are split by physical impact (equivalent to short-term physical disturbance) and physical loss of habitat (equivalent to long-term habitat loss) and are shown in Table 5.2.13 and Table 5.2.14 respectively.

Table 5.2.13: Estimated area of seabed within the SAC physically (temporarily) impacted

Activity	Total footprint (km^2)
Fishing	Unknown but occurred over 8,701 km^2 of the SAC in 2016
Renewables (cable laying)	55.3
Future Infrastructure	1.18
Aggregate extraction	Unknown
Total area of physical impact (km^2)	**56.5 – 8,757**
Proportion of SAC impacted (%)	**0.46% - 71.0%**

Table 5.2.14: Estimated area of seabed physically (permanently) lost from in-combination impacts

Activity	Total footprint (km^2)
Renewables – Wind turbines and Infrastructure	3.0
Renewables – Cable protection	15.0
Existing oil and gas pipelines	0.77
Existing rock dump for rig stabilisation	0.52
Existing rock dump along pipelines	0.33
Existing Mattresses	0.02
Future Infrastructure	0.06
Aggregate Extraction	Currently inactive
Subsea cables	0.02
Total area of physical loss (km^2)	**19.7**
Proportion of SAC impacted (%)	**0.16**

All current and future in-combination activities are estimated to have a shorter-term physical impact of up to approximately 8,757 km^2, affecting up to 71% of the area of the Dogger Bank SAC (Table 5.2.13). Habitat loss is estimated to have a long-term impact on up to 19.7 km^2 (0.16%) of the SAC (Table 5.2.14) [104]. It is worth noting that demersal fishing has the potential to cause a significantly higher level of physical damage to sandbank features within the SAC site [57][105]. This may change in light of recent news of a potential ban on trawling within the Dogger Bank, significantly reducing the physical impact on the seabed within the SAC.

The Dogger Bank SAC Oil and Gas Decommissioning Strategic HRA [104] concluded that the Decommissioning activities (including those associated with the CMS) will not cause a likely significant effect on any qualifying features connected with the designated site either alone or in combination with other plans or projects and will therefore not have an adverse effect on the integrity of Dogger Bank SAC.

5.2.7 Transboundary impacts

The CMS decommissioning activities are located approximately 7 km east of the UK/Netherlands median line at the closest point (Katy KT). Decommissioning activities are not anticipated to create any transboundary impacts with regards to seabed.

5.2.8 Residual impact

Receptor	Consequence	Likelihood
Seabed habitats and benthos	Low	Frequent
Dogger Bank SAC	Low	Frequent
Inner Dowsing, Race Bank and North Ridge SAC	Low	Remote (only if contingency is used)
Southern North Sea SAC	Low	Frequent

Rationale
Decommissioning of the CMS will cause physical disturbance to the local seabed environment. Activities will result in an expected area of temporary direct disturbance equalling 0.0926 km^2. When accounting for temporary indirect disturbance, which arises secondarily due to sediment suspension and resettlement, the total area of impact doubles to 0.1904 km^2. Permanent disturbance due to rock placement will affect approximately 0.0026 km^2. The less mobile benthic taxa within the CMS are vulnerable to direct impacts however the most common species in the area (juvenile urchins belonging to the order Spatangoida, molluscs etc.) are relatively tolerant of smothering and increased sedimentation. *S. spinulosa* which have formed biogenic reef structures within the CMS, are unlikely to be affected by the decommissioning due to their location in relation to proposed activities. While demersal species using the area as a nursery may coincide with the decommissioning activities, demersal spawning is mostly constrained to the winter months and therefore unlikely to be affected by the decommissioning. Furthermore, as mobile species, fish will be able to avoid the area during the course of activities and 'recolonise' it in the future. Any excavation which may be required as part of the decommissioning is unlikely to impact the clay layers which make up the Dogger Bank sub-units. This is both due to the depth of the sediment likely to be within the CMS and the shallow depth to which excavation, if required, will be conducted. Additionally, with regards to the seabed, the presence of features such as sandbanks, sandwaves and megaripples, as within the Dogger Bank SAC, are not likely to be affected by the decommissioning of the majority of pipelines *in situ*. Furthermore, primary degraded products such as plastics, NORM, PAHs and heavy metals are predicted to cause negligible impacts on the surrounding sediments. Underpinning the harbour porpoise of the Southern North Sea SAC are habitats which support their prey. The decommissioning activities occurring within the Southern North Sea SAC will occupy a small area and will be largely temporary in nature. As recovery of the seabed post-decommissioning is predicted, and fish are highly mobile, it is not likely that there will be any impact to harbour porpoise through changes in their habitat and prey availability. The addition of rock is also unlikely to disturb the natural physical processes of the area. While the addition of 0.0026 km^2 of rock will change the substrate, this covers such a small area in proportion to the area of available sandy habitat. There are indications, based on the concrete mattress dump at Katy KT, that the colonisation of hard substrate within the CMS may result in a habitat moderately comparable to that of a typical rocky reef. For these reasons, the impact consequence is considered low across all receptors. Owing to the nature of the proposed decommissioning impacts on the seabed are unavoidable and, for the duration of the activities, the likelihood of disturbance to the seabed is considered frequent the general seabed habitats and benthos, the protected habitat within the Dogger Bank SAC, and the seabed dependent features of the Southern North Sea SAC. However, as the activities within the Inner Dowsing, Race Bank and North Ridge SAC are considered contingency and therefore are not intended to occur, the likelihood of impact against this receptor is considered remote.

Combining the consequence and likelihood rankings, the risk significance is low for the Inner Dowsing, Race Bank and North Ridge SAC and Southern North Sea SAC, and minor for the Dogger Bank SAC and the general seabed and benthos within the CMS. Overall, the impact of seabed disturbance due to the proposed decommissioning activities, in combination with consideration of mitigation measures, is not significant.	
Risk significance	**Impact significance**
Low-Minor	Not significant

5.3 Physical presence of subsea infrastructure decommissioned *in situ*

5.3.1 Introduction

The proposed CMS decommissioning activities have the potential to impact upon other users of the sea, namely commercial fisheries. This may happen during the decommissioning activities themselves or after decommissioning should any infrastructure decommissioned *in situ* interact with fishing gear. Sea users, other than commercial fisheries, are unlikely to be affected by the proposed decommissioning, as explained in Appendix 5. The following issues were considered as potentially having a significant impact on commercial fisheries:

- Physical presence of subsea infrastructure decommissioned *in situ* posing a potential snagging risk.
- Snagging risk arising from seabed depressions.

This is anticipated to be the only impact to fisheries as a result of the decommissioning and is assessed against the receptor throughout the rest of the Section.

5.3.2 Description and quantification of impact

5.3.2.1 Physical presence of subsea infrastructure decommissioned in situ *posing a potential snagging risk*

The long-term presence of subsea infrastructure decommissioned *in situ* has the potential to interfere with other sea users that may use the area. In particular, exposures or even free-spans associated with infrastructure decommissioned *in situ* which may arise during initial decommissioning and long-term degradation, introduce a snagging risk to some fisheries. In addition to the physical presence of the pipelines decommissioned *in situ*, seabed depressions, local rock placement, mattresses and grout bags also increase the potential for interaction with fishing gear. Demersal fishing gears which interact with the seabed are vulnerable to snagging. Snagging may lead to the loss or damage of catch or fishing gear and may result in vessel destabilisation in extreme circumstances. There have been of 15 fishing vessels sinkings due to snagged gear between 1989 and 2014 which resulted in 26 fatalities [106]. Generally, the patterns in interactions between oil and gas infrastructure and fishing gear are spatially concentrated in the muddy Northern North Sea (NNS) where demersal fisheries are generally concentrated [107], as opposed to the SNS where the CMS is located.

Annual fishing effort in the Project area (ICES rectangles 35F0, 36F0, 36F1, 37F1 and 37F2) was variable. Offshore in the CMS (rectangle 37F2) fishing effort equated to a total of 167 days in 2019, mostly over the summer season. Fishing effort was greatly increased in rectangle 36F0, located at the coast. Shellfish were the dominant catch group in all but 37F2, where demersal species contributed the most to fisheries. Demersal catch includes trawl gears which interact with the seabed. Shellfish fisheries are associated with a more passive gear effort. Therefore, with regards to snagging risk, the incidence of interaction between demersal fishing gear and infrastructure decommissioned *in situ* is greatest offshore in the main CMS area (rectangle 37F2). The intensity of fishing vessel tracks is much lower closer to shore owing to the more passive gear types involved in shellfish fisheries in the more coastal ICES rectangles.

All of the pipelines/umbilicals associated with the CMS have a low percentage of exposure. On the whole, the PL929 and PL930 are stably buried. The PL929, upon installation, was trenched to a depth of 0.5 m to 0.7 m but for the ends which, on approach to Murdoch MD and MLWM, are piggybacked by the PL930 and protected using a combination of rock placement and concrete mattresses across the last 200 m. The PL930 is trenched to a depth of at least 0.6 m along its length. The DoB profiles for the CMS pipelines are available in Appendix 7. The PL929 and PL930 have the highest percentage of exposure of all the CMS pipelines, at 3.2% according to the most recent survey [17]. Of these exposures, there were two areas of spanning which are considered reportable: a span ~61 m long identified in 2006 at KP 57.432, and a smaller span which has been consistently recorded across a number of survey years. The 2006 span was not identified in subsequent surveys therefore is assumed to no longer exist. The second span noted here has been identified in the same location at the Murdoch Hub end of the pipeline in 2006, 2007, 2009 and 2013 and appeared to be migrating very slowly in an offshore direction, at Murdoch MD [17]. In 2016, the most recent survey year, this closing span was located between KPs 180.946 and 180.958 and had a length of ~12 m.

Survey data for the PL2109 and PL2110 connecting Hawksley EM and Munro MH found that the number and length of exposures appears to fluctuate between survey years, though there have been no reportable spans observed at any time. These pipelines are fitted with spoilers, to aid self-burial. To minimise the risk of sandwave movement exposing the PL2109/PL2110 in the future, it is proposed that the first 1.5 km of the pipelines will be removed. This section coincides with the area where the exposure fluctuation has been the most considerable. The removal of this section will eliminate the opportunity for snagging. Beyond the initial 1.5 km of the pipeline (at Munro MH), the pipeline is stably buried to a depth below 0.6 m (see Appendix 7).

The PLU4685 which is trenched and buried, also has a number of exposures found on the final approach to Hawksley EM (none of which constitute reportable spans). Similarly, this flowline has been determined for partial removal whereby ~58 m of exposures (including ~33 m of freespans) would be removed between KP 0.222 and KP 0.280.

All other pipelines addressed within CA groups do not have any reportable spans. In some cases, the pipelines have few exposures altogether, and they are usually located at the pipeline connection ends and therefore do not constitute a significant snagging risk.

Currently approximately <5% of the PL929/PL930 are exposed with the remainder of the pipeline achieving good burial depth. Of the exposed area, the two spans cover an even smaller proportion of the pipeline. At present, the proposed approach for the two spans along the PL929/PL930 is to decommission in their current state to avoid adversely impacting the protected features within the designated sites, however monitoring will be undertaken to observe any change in burial status, and should any remediation be required this will be discussed and agreed with OPRED. The project-specific burial study indicates that the location and size of the spans changes over time. Even with the changes in position and size, over time the percentage of exposure is relatively stable.

On review of demersal trawling activity in the North Sea, it was determined that a low percentage (0.93%) of demersal trawling trips specifically targeted oil and gas pipelines compared with surrounding areas [108]. The PL929/PL930 experience variable trawling intensity, which is mostly concentrated offshore at the CMS, approximately between KP 140 and KP 160 (see Figure 4.3.3). These pipelines appear to be trenched and buried to a depth consistent with the 0.6 m accepted ‘safe’ and stable depth (see Appendix 6 for DoB profiles of the CMS pipelines). Furthermore, the sections of pipeline which are exposed to the highest fishing intensity, albeit still relatively low in the regional context, are presently stably buried to a depth considered safe for fisheries and are not near any of the reportable spans. Of the pipelines within the CMS, the PL2109/PL2110 and PL2430/PLU2431 experience higher fishing intensity. As there are no reportable spans within the CMS area, other than the ~12 m end span along the PL929 identified in 2016, there is little potential for snagging of fishing gear to occur. Furthermore, the section of the PL2109/PL2110 which causes the most uncertainty as to the long-term burial of the pipeline will be removed.

For the subsea infrastructure decommissioned *in situ* on the seabed, Chrysaor will ensure all CMS areas are left overtrawlable without snagging risks and that any rock placement required will be appropriately graded to allow fishing gear to trawl across it without snagging. The method of determining snag risk removal will be determined with OPRED. As such, the decommissioning *in situ* of the subsea infrastructure presents no immediate snag risk.

5.3.2.2 Snagging risk arising from seabed depressions

In addition to pipelines to be decommissioned *in situ*, seabed depressions, local rock placement, mattresses and grout bags increase the potential for interaction with fishing gear. There is the potential for a number of depressions and berms to be left on the seabed following decommissioning. This may arise from dredging and excavation at the platform footings to enable these to be severed below the seabed, if internal cutting is not possible. It is also assumed that excavation (possibly using MFE) will be required to remove one in three of the subsea structures in order to facilitate removal. There are also some existing areas of scour observed during surveys at Hawksley EM, Katy KT and Kelvin TM [15]. Based on the dynamic nature of the environment in the vicinity of the CMS, it is anticipated that these depressions will backfill naturally over time. It is estimated that it can take between 1 and 5 years for natural recovery of similar depressions [73][109][110].

As all flexibles (umbilicals) are being decommissioned *in situ*, no reverse reeling will occur as part of the decommissioning; this can often be the source of berm generation if the sediment allows. As described in Section 4.2.2.1, the sediment within the offshore CMS (and within the SNS as a whole) is largely sandy. Sandy substrates are less likely to form a berm. Additionally, fishing gears are better able to pass through sandy sediments compared to clay. Thus, depressions being backfilled over time and the ability of fishing gears to penetrate and pull through sandy seabeds means the snagging risk from such seabed features, should they arise, is minimal.

Post-decommissioning surveys will be undertaken to ensure there are no berms or snagging issues associated with these depressions. As above, if remediation will be required to address any snag risk, discussion with OPRED will be undertaken.

5.3.3 Mitigation measures

A number of mitigation measures will be employed to reduce the impact of the decommissioning on other sea users:

- The CMS subsea infrastructure is currently shown on Admiralty Charts and the FishSafe system. Once decommissioning activities are complete, updated information on the CMS subsea area (i.e. which infrastructure remains *in situ* and which has been removed) will be made available to allow the Admiralty Charts and the FishSafe system to be updated;
- The pipelines will be decommissioned *in situ*;
- Any exposed/cut pipeline/umbilical ends will undergo remediation, as appropriate, to ensure they are overtrawlable to fishing gear. Remediation may entail rock placement or burial of ends using sediment;
- Evaluation of post-decommissioning surveys will identify the requirement for remediation of depressions generated through dredging around piles, although metocean conditions are likely to be sufficient to naturally backfill any such depressions;
- Any objects dropped during decommissioning activities or any existing debris identified will be removed from the seabed where appropriate;
- An appropriate vessel will be engaged to carry out survey work within the 500 m safety exclusion zones, at locations where installations have been removed, where cutting or remediation has occurred along the pipeline to evaluate any potential snagging risks. Decommissioning activities will be considered to be complete subject to acceptance of the Decommissioning Close-out Report by OPRED. The existing 500 m safety exclusion zones will then be removed; and
- Chrysaor recognises its commitment to monitor any infrastructure decommissioned *in situ* and therefore intends to set up arrangements to undertake post-decommissioning monitoring on behalf of the Licence Owners. The frequency of the monitoring will be agreed with OPRED and future monitoring will be determined through a risk-based approach based on the findings from each subsequent survey. A monitoring strategy will be proposed in the decommissioning close out report. During the period over which monitoring is required, the status of the infrastructure decommissioned *in situ* would be reviewed and any necessary remedial action undertaken to ensure it does not pose a risk to other sea users.

5.3.4 Cumulative assessment

When considering the CMS decommissioning within the wider regional context, the proposed decommissioning activities may coincide with other projects in the vicinity. As discussed, the main impact to associated with the decommissioning is the potential snagging risk to commercial fisheries. As this is the only perceived risk to other sea users, it is the only impact to be assessed in a cumulative context.

In the CMS area, landings were dominated by demersal species. UK vessels mainly use demersal gears, and the effort in the CMS area is generally relatively low in terms of fishing days and landing values. Fleets of other nationalities (mainly Dutch and Danish vessels) are also generally engaged in demersal or mid-water trawling. This effort is mainly concentrated to the west and south of the CMS. The majority of the CMS infrastructure is located in an area of low to moderate activity in terms of effort and value with regards to both UK and international fleets.

All infrastructure within the CMS will either be removed or decommissioned *in situ* in an overtrawlable condition, and monitoring will be conducted to ensure the decommissioned *in situ* infrastructure remains overtrawlable. Where decommissioned infrastructure presents an unacceptable risk, Chrysaor will undertake remedial action. This is similarly applicable to any berms or depressions which may form in the seabed as a result of the decommissioning activities. Chrysaor's commitment to leaving an unobstructed seabed extends across all their current SNS decommissioning operations therefore, while it is not possible to quantify the cumulative snag risk associated with decommissioning activities in the region, there is expected to be no cumulative impact with other structures decommissioned as part of the Chrysaor Viking and LOGGS decommissioning projects. This is also relevant for other SNS decommissioning projects such as the DNO operated Schooner (44/26) and Ketch (Block 44/28), Premier's Hunter and Rita Fields (44/21, 44/22, 44/23) and INEOS' Topaz (44/26). The DPs are currently under consideration for the Premier and INEOS assets, the DNO asset DPs were recently accepted by the regulator. Considering the alternative fishing grounds available within the wider region and the overtrawlable decommissioned infrastructure, it is not anticipated that there will be any significant cumulative impacts with respect to the long-term presence of subsea infrastructure decommissioned *in situ*, or any associated berms/seabed features.

As the decommissioning activities proceed, new areas of sea/seabed will become available to fisheries and other sea users, reducing the overall cumulative impact and resulting in a positive impact to these users. These include removal of safety zones within the CMS area. In terms of the scale of the decommissioning activities with regards to other sea users, there are an estimated 651 safety zones in the North Sea within the UKCS, as of 2015 [111]. Since the decommissioning of the CMS area will see the removal of safety zones resulting in approximately 0.785 km^2 of occupied sea area being returned to navigable waters of the North Sea. This will assist in reducing the areas of the North Sea currently unavailable to commercial fisheries and thus in reducing the potential for cumulative impact from decommissioning of North Sea structures.

There are no negative cumulative impacts expected as a result of the decommissioning. The decommissioning of the CMS area will result in a positive impact by opening up new fishing grounds previously unavailable due to the 500 m safety exclusion zones currently imposed around the Chrysaor installations.

5.3.5 Transboundary impacts

As the CMS area is beyond the UK's 12 nautical mile limit, foreign national vessels are also permitted to fish in the area. The Brown and May Marine Ltd report prepared for the CMS area, identified that vessels of Dutch origin have the highest levels of activity in the area, mainly operating beam and demersal otter trawls and, to a lesser extent, fly seiners in the general area [54]. Dutch fishing activity is mainly to the south of the CMS [10][54]. Danish midwater and demersal trawlers are also present in areas west of the CMS [10][54]. The intensity of fishing activity with the CMS area is low to moderate with principal fishing grounds located far enough away from the CMS area. Combined with the removal of infrastructure and the overtrawlable nature of the infrastructure that is to be decommissioned *in situ*, there is no mechanism by which significant transboundary impacts could occur.

5.3.6 Residual impact

<table>
<tr><th>Receptor</th><th>Consequence</th><th colspan="2">Likelihood</th></tr>
<tr><td>Commercial fisheries</td><td>High</td><td colspan="2">Improbable</td></tr>
<tr><th colspan="4">Rationale</th></tr>
<tr><td colspan="4">Of all sea users, commercial fisheries are most likely to be affected by the proposed decommissioning activities. Impacts to fisheries mainly arise from the potential for snagging generated by the decommissioning in situ of pipelines, and the potential creation of berms during decommissioning activities.

Survey data has only discovered two reportable spans associated with the CMS pipelines. Both are on the PL929/PL930 trunkline. There are no other reportable spans within the CMS field area and the majority of non-reportable spans and exposures are associated with pipeline connection ends and therefore do not occur in-field. The cuttings and remediating of pipeline ends will likely address this in many cases. Trawling intensity is highest along a few pipelines within the offshore CMS area. Trawling intensity along the PL929 and PL930 is highest between KP 140 to KP 160 which does not coincide with the locations of the two aforementioned spans. While the consequence of a snagging event may be high, Chrysaor's commitment to leaving the seabed in an overtrawlable condition, and to remediate any snag risks arising during the period of monitoring, will ensure that the likelihood of snagging impacts on fisheries is minimised. This, in combination with recent news regarding the proposed banning of bottom trawling activities within the Dogger Bank thereby reduces the risk further, thus the likelihood of a future snagging event occurring has been deemed improbable.

Although there will be localised exclusion during decommissioning itself, the removal of the safety zones within the CMS will eventually return sea area to the fishing community, which is considered a positive outcome of the activities. Combining the above, the risk significance is defined as low and thus not significant.</td></tr>
<tr><th colspan="2">Risk significance</th><th colspan="2">Impact significance</th></tr>
<tr><td colspan="2">Low</td><td colspan="2">Not significant</td></tr>
</table>

5.4 Underwater Noise

5.4.1 Introduction

Many species found in the marine environment use sound to understand their surroundings, track prey and communicate with members of their own species. Some species, mostly toothed whales, dolphins and porpoise also use sound to build up an image of their environment and to detect prey and predators through echolocation. Exposure to natural sounds in the marine environment may elicit responses in marine species; for example, harbour seals have been shown to respond to the calls of killer whales with anti-predator behaviour [112]. In addition to responding to natural sounds, marine species may also respond to man-made sound. The potential impacts of industrial noise on species may include impacts to hearing, displacement of the animals themselves and potential indirect impacts which may include displacement of prey species. Whilst there is a lack of species-specific information collected under controlled or well-documented conditions, enough evidence exists to suggest that sound may have a potential biological impact and that noise from man-made sources may affect animals to varying degrees depending on the sound source, its characteristics and the susceptibility of the species present [113]. As well as potential behavioural impacts of noise, animals exposed to an adequately high sound source may experience a temporary shift in hearing ability (termed a temporary threshold shift; TTS) [114]. In some cases, the source level may be sufficiently high such that the animal exposed to the sound level might experience physical damage to the hearing apparatus and the shift may not be reversed; in this case there may be a permanent threshold shift (PTS) [115], and the animal could be considered as being injured.

There are a number of activities that will occur during the CMS decommissioning activities that could emit noise to the marine environment, and which could potentially impact to some degree on marine animals:

- Use of vessels;
- Underwater cutting of the jacket (piles, risers and members); and
- Underwater cutting of the exposed ends of the pipeline and umbilicals/jumpers.

During the scoping for the impact assessment outlined herein, the potential for impact on a number of marine species groups was considered. Marine mammals were considered generally to be at a greater risk of potential impact from injury and disturbance from noise, both individually and at the population level, than other species groups. Furthermore, the location of the CMS within the Southern North Sea SAC elevates the sensitivity of this receptor group. The potential impact of the noise-emitting activities from the CMS activities on marine mammals is, therefore, discussed in the following sections. Almost all subsea structures, significant spans and jackets are located in the Southern North Sea SAC and/or the Dogger Bank SAC. However, only the Southern North Sea SAC designated features or habitats have the potential to be impacted to any level of significance above negligible.

5.4.2 Description and quantification of impact

5.4.2.1 Vessel

Noise emissions from vessels occur continuously during operation of the vessel, appearing louder as animals approach the vessels, and appearing quieter as animals move away. Such continuous noise sources are generally of less concern than intermittent sources (e.g. such as seismic conducted during exploration activities) where relatively high doses of noise can be received by animals over a very short period of time with little warning. Indeed, source levels for vessels rarely exceed 190 dB re 1 µPa @ 1 m and are typically much lower. Nevertheless, comparison of the noise emitted from vessels against noise levels at which injury or disturbance might occur can be made to better understand the potential for impact. Typically, such a comparison is done as part of a quantitative noise propagation modelling exercise, since that exercise can also make predictions about the range over which noise levels may exert some sort of negative impact. As part of its Southern North Sea Decommissioning Project, Chrysaor commissioned underwater noise propagation modelling; this modelling gives an indication of likelihood of injury and disturbance occurring, and the potential spatial extent of impact [116]. The modelling made use of the Nedwell *et al*. (2007) $dB_{ht(species)}$ approach which says that all species with well-developed hearing are likely to avoid sound when the level exceeds 50 to 90 dB above their hearing threshold and receive damage to hearing organs at 130 dB above their hearing threshold [117]. The approach permits use of species-specific audiograms (i.e. descriptions of hearing ability) to filter received noise levels according to the hearing ability of a species, giving sound levels in $dB_{ht(species)}$ which represent the loudness of the sound perceived by that species. The distance from the operations to the points at which 130 $dB_{ht(species)}$ and 90 $dB_{ht(species)}$ are exceeded represents, respectively, an estimate of the limits within which injury and likely avoidance might be expected. Predictions are summarised in Table 5.4.1.

Table 5.4.1: Predicted injury and disturbance (i.e. avoidance) zones resulting vessel use

Species	Maximum radii of injury from vessel use	Maximum range of disturbance from vessel use (m)
Harbour porpoise	No injury predicted	95
Bottlenose dolphin	No injury predicted	106
White-sided dolphin	No injury predicted	29
White-beaked dolphin	No injury predicted	14
Minke whale	No injury predicted	16
Long-finned pilot whale	No injury predicted	16
Grey seal	No injury predicted	9
Common seal	No injury predicted	26

It should be noted that the noise propagation modelling conservatively assumed that up to eight vessels could be at a single location at any one time during the decommissioning operations; where fewer vessels are present, the maximum ranges quoted in Table 5.4.1 would be reduced.

5.4.2.2 Cutting

The jacket removal methodology retains an option to cut using a number of possible methods, including diamond-wire cutting, abrasive water jetting and hydraulic shearing. As part of the underwater noise modelling study for its SNS decommissioning activities, a review of cutting noise emissions was undertaken and few relevant studies were found to be available in the literature. Of the limited literature specifically citing source levels that is currently available, studies report the peak source level for oxy arc cutters as 148 dB re 1 µPa @ 1 m and for cable cutters at 163 dB re 1 µPa @ 1 m [118]. Analysis of sound radiating from diamond wire cutting of a conductor in the North Sea found that the noise was not easily discernible above the background noise (which included the presence of several operational vessels) [119]. Since field measurements undertaken to record cutting emissions in the context of potential effects on marine life are otherwise limited, a worst-case assumption has been made in this assessment that noise emissions from diamond-wire cutting and abrasive water jetting may extend up to 195 dB re 1 µPa @ 1 m [120]. As such, as this is a worst-case scenario assumption and in the absence of recorded field measurements, it is not possible to further inform the source levels used in the assessment and subsequent injury and disturbance ranges. It seems likely that this form of cutting would generate less noise than mechanical cutting techniques and may not be detectable above other sources operating simultaneously (i.e. vessels).

The subsea decommissioning options involve the cutting of the ends of lines by hydraulic shears and diamond wire prior to rock placement on, or burial of, the ends. Since the cutting will likely be conducted using only these stated methods, further assessment of cutting for subsea decommissioning activities is not necessary.

5.4.3 Injury

The sound propagation model results outlined above indicate that injury is unlikely to occur for any of the cetacean or seal species within the vicinity of the vessel operations. Source levels for cutting activities are similar to or below those expected from vessels. Given that the noise modelling undertaken for vessels show no injury is likely, the same can be concluded for cutting activities. As such, no injury is expected from the decommissioning activities.

5.4.4 Disturbance

Vessels will be present intermittently within the project area over a two to three-year period and the potential for disturbance cannot be excluded based on a limited time period of activity. It is important therefore to review the potential avoidance zones outlined in Table 5.4.1 to understand whether the presence of vessels for such a period of time could result in significant disturbance (taken to mean changes in the population of the species).

The threshold disturbance (in the form of an avoidance reaction) may be exceeded during vessel operations and there could be some impact on marine mammals in close proximity of vessel operations. Although the size of the avoidance zones will vary by species, potential avoidance is predicted to be limited to a maximum of 106 m, and for most species is less than 30 m. JNCC guidance notes that behavioural changes such as moving away from an area for short periods of time, reduced surfacing time, masking of communication signals or echolocation clicks, vocalisation changes and separation of mothers from offspring for short periods, do not necessarily imply that detrimental effects will result for the animals involved [121]. Given these potential avoidance zones are so small, animals are likely to have to move only a matter of tens of metres away from vessels. Therefore, even though vessels will be present intermittently at different locations, the highly limited zone of potential avoidance means that there is no mechanism to impact the population of any marine mammal species. As such, no significant disturbance is expected from the vessel activities.

Cutting using diamond-wire cutting or abrasive water jetting is retained as an option for cutting of the jacket structure and the piles which fix the jackets to the seabed. For the purposes of worst-case assessment, the cutting of seven jackets (and associated 29 piles) and the additional 24 piles associated with six subsea and pipeline structures (Watt QM, Katy Tee, Kelvin PMA, Boulton HM, McAdam MM, Murdoch KM) can be assumed to occur. Such activities will occur intermittently over a two to three-year period, with each cut taking a matter of hours each. For the 29 jacket piles, cutting will occur internally, limiting somewhat the propagation of noise compared to an open water cut. Additionally, the piles will be cut approximately 3 m below the seabed, providing further limitation on the propagation. As described above, research has also found that sound generated by diamond wire cutting is not easily discernible above background noise levels, namely attributed to vessels [119]. Given that the estimated source level for cutting is similar to those predicted for vessels, it is likely that estimated avoidance zones would be similar to those predicted for vessels (Table 5.4.1).

Again, the likely avoidance zones are so limited that significant disturbance is not likely to occur, therefore no significant effect on the integrity of the Southern North Sea SAC designated features is expected.

5.4.5 Mitigation measures

On the basis of the expected noise emissions, there is no requirement to adopt additional mitigation to limited potential for impact. However, there are control measures built into the project that will ensure noise emissions are not greater than would be required to execute the decommissioning activities. For example, machinery and equipment will be well-maintained and the number of vessels will be minimised as far as possible.

5.4.6 Cumulative impact

It is possible that the various noise sources (e.g. vessels, cutting) associated with the CMS decommissioning activities as described herein could act cumulatively to impact negatively on marine mammals. However, the impact assessment above has considered the use of multiple vessels at any one time (up to eight as a worst case) and demonstrates that injury through cumulative noise emissions is not expected. Whilst disturbance zones will exist from multiple use of vessels, the predicted zones are sufficiently small that significant disturbance is not expected. As such, cumulative impact from sources within the CMS decommissioning activities are therefore not expected.

In theory, any activities that will emit underwater noise in the SNS have the potential to act cumulatively with the CMS decommissioning activities to impact upon marine mammals. This includes well decommissioning activities for the wells associated with the CMS infrastructure, which will see 40 wells decommissioned. As per the schedule in Section 3.3, there could be some overlap in the period during which well decommissioning and jacket/subsea decommissioning activities take place. Whilst assessment of those well decommissioning activities is taking place through the MATs/SATs process (thus outside of the DP submission), since those activities will be undertaken as part of Chrysaor' wider SNS decommissioning activities it is important that they are considered as part of this cumulative impact assessment.

The well decommissioning activities will make use of a jack-up rig, where the legs of the drilling rig are placed on the seabed for the duration of the well decommissioning activities. The use of a jack-up rig as opposed to a dynamically positioned rig means relatively little noise emissions. The jack-up rig expected to be used for the well decommissioning activities is not self-propelled and requires towing to and from location. On this basis, the noise emissions from the manoeuvring of the jack-up rig onto site are likely to be below those anticipated from the jacket and subsea decommissioning activities (since they consider eight vessels rather than the one or two required for well decommissioning). Temporally, the noise emissions will be limited to the manoeuvring of the jack-up rig between well locations, which should extend only to a matter of days.

The actual well decommissioning that will occur once the jack-up is in place should involve relatively little noise emissions and are noted by JNCC to be of little concern for cetaceans in most situations (the exception being extended activities in close proximity to very small populations that are spatially restricted, which does not apply to the offshore SNS) [121]. During well decommissioning operations, there may be a requirement to use either a tubing conveyed perforating gun or jet (explosive) cutter during cutting and perforating operations on the wells. Explosives may be used deep in the well (circa 6000 ft below mudline) as part of the initial suspension to allow communication between the tubing and annulus.

Although the proposed operations are located in the Southern North Sea SAC for harbour porpoise (Annex II species), it is demonstrated that even by using a large zone of behavioural change that <0.0002% of the population would be impacted. The source of noise will be slightly higher than background levels for a brief period during well decommissioning operations. However, significant impacts are not expected to cetaceans using the area and in particular the harbour porpoise which qualifies for European protection. As these explosives will be used downhole, they are not expected to generate levels of underwater noise that could be of any concern to marine mammals [122]. It is concluded that operations would be largely undetectable against natural variation and would have no significant effect at the population level.

On the basis of the limited noise emissions from well decommissioning , there is considered to be no mechanism to injure marine mammals and thus no potential for cumulative impact with the other CMS activities. Whilst it is possible that some disturbance could occur within a few tens of metres of the well decommissioning activities, such disturbance would not result in animals having to move away from the well decommissioning activities. Even if the animals did, the highly limited disturbance zones from the jacket and subsea decommissioning activities would not prevent normal feeding, breeding and functioning taking place, and there will be no significant cumulative impact between the well decommissioning and the jacket/subsea decommissioning activities.

The CMS activities (including well decommissioning) will occur as part of Chrysaor's wider SNS decommissioning activities over a ten-year period, which will include activities assessed in the LDP1, LDP2-LDP5 and VDP1 EAs. Since injury is not anticipated from any decommissioning activities, cumulative impact could only occur through disturbance to marine mammals. If the activities involved in each phase of the decommissioning resulted in animals avoiding large parts of the SNS, such an extended period of activities could have the potential to significantly negatively impact marine mammals. However, as described above for the jacket, subsea and well decommissioning activities, avoidance of activities is anticipated to occur only within tens of metres around even the loudest sources. Since the Viking, LOGGS and CMS decommissioning activities will be phased, there will be a limited number of areas within which activities will be occurring at any one point in time. As such, animals are anticipated to avoid only a few areas immediately around vessels over the duration of the SNS decommissioning programme. Given the extent of the SNS, and the area over which marine mammals are known to range (and for harbour porpoise this is the entire North Sea, as per the Inter-Agency Marine Mammal Working Group (IAMMWG) Management Units for Cetaceans [123]), avoidance of such a small area will not negatively affect feeding, foraging and normal functioning. As such, the ten-year period of decommissioning activities will not result in significant disturbance to marine mammals.

Further to Chrysaor's wider SNS decommissioning programme, it is recognised that the SNS is utilised for a number of other purposes, including other oil and gas extraction, fishing, renewable energy, aggregate extraction and dredging. Animals experiencing noise emissions from the CMS activities, and indeed Chrysaor's wider SNS decommissioning activities, would likely experience noise from these other activities. If the noise overlaps in time and space, additional injury or disturbance compared to the activities alone could occur. For cutting of the jacket and seabed piles associated with the CMS structures and for vessel use associated with the platform and subsea decommissioning, injury is not expected, and disturbance will be limited to tens of metres. Given there should be no non- Chrysaor activities occurring within such close proximity to the platforms, there will be no potential for injury through cumulative impact. The potential avoidance zones from the cutting and vessel use will be localised, noise will be intermittent and will occur in isolation, therefore not contributing to a wider (cumulative) impact. This activity is not deemed sufficient to exclude marine mammals from a significant remaining portion of their habitat. On this basis, the impact is not deemed significant and there can be no cumulative noise-related impacts from the decommissioning activities.

5.4.7 Transboundary impact

The CMS decommissioning activities (from the closest installation Katy KT) are located approximately 7 km west of the UK/Netherlands median line. Given the noise sources involved in the project, direct transboundary impact from noise emissions is not likely to occur. However, marine mammals are free-ranging animals and any impact that occurs in UK waters is likely to involve individuals that belong to a much wider ranging population which are likely to cross median lines. Such a potential impact could qualify as a transboundary impact. However, since injury and disturbance from the activities associated with CMS are not expected to result in significant impact to any population, potential transboundary impacts are also therefore considered not significant.

5.4.8 Residual impact

<table>
<tr><th>Receptor</th><th>Consequence</th><th>Likelihood</th></tr>
<tr><td>Marine mammals within the Southern North Sea SAC</td><td>Negligible</td><td>Frequently</td></tr>
<tr><th colspan="3">Rationale</th></tr>
<tr><td colspan="3">Decommissioning activities within the CMS will result in the production of noise. The main receptor of this noise would be marine mammals, specifically harbour porpoise, within the Southern North Sea SAC (which is designated for the species).

However, noise emissions are expected to be sufficiently low that injury will not occur from any of the activities. With regards to disturbance, potential zones of avoidance around vessels or cutting activities are not predicted to extend beyond approximately 100 m. Even though the decommissioning activities will take place over a number of years, these highly limited potential avoidance zones will not result in significant disturbance to any marine mammal population. On this basis that the impact will be transitory, highly localised and largely undetectable against natural variation, the consequence to marine mammals is ranked as negligible.

As the decommissioning activities are planned to occur in the near future, the likelihood of impact occurring is considered frequent. Combining the consequence and likelihood rankings, the risk significance is defined as minor and thus not significant. Furthermore, the proposed decommissioning activities are not likely to have a significant effect on the Southern North Sea SAC’s Conservation Objectives and so the integrity of the site will not be compromised.</td></tr>
</table>

Risk significance	Impact significance
Minor	Not significant

5.5 Disturbance to Nesting Seabirds

5.5.1 Introduction

As oil and gas infrastructure in the North Sea ages out, the role these structures occupy in seabird ecology, and the subsequent impact of their decommissioning on seabirds, is coming under increasing scrutiny. In recent years, there has been an increase in the number of seabirds utilising offshore installations for nesting. Opportunistic species such as kittiwake and herring gull are utilising artificial nest locations and successfully rearing chicks. In some instances, colonies of several hundred birds have established and return each year. Although for most offshore platforms, the number of breeding birds remains very low.

Prior to the commencement of decommissioning activities, assurances must be made that any potential adverse impacts associated with the activities will be minimised with respect to protected species such as seabirds.

5.5.2 Legislative Context

Chrysaor are fully aware of their responsibilities under the following legislative expectations and requirements. The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) transpose the European Union (EU) Wild Birds Directive and secure protection of wild birds, their eggs and nests in the offshore marine area, including offshore marine installations. It is an offence under Regulation 40 to deliberately injure, kill or disturb any wild bird or take, damage or destroy the nest whilst in use or being built or take or destroy an egg.

The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 amend the 2017 Regulations to ensure that the transposition of the Wild Birds Directive (and Habitats Directive) continues to be operable upon the UK's exit from the EU. The transposition note for the 2017 Regulations indicates that it was intended that Regulation 40 would transpose Article 5 of the Wild Birds Directive so despite deliberate disturbance not being specified it is intended it should be included [124].

5.5.3 Guidance Recommendations

Recent decommissioning operations in the UKCS have reported significant numbers of kittiwake nests on the cardinal faces and undersides of certain platforms. They are colonial nesters and readily utilise offshore platforms as an artificial cliff habitat.

Current advice from JNCC requests that all platforms that will have significant decommissioning operations planned within the following years breeding period, should have a survey undertaken to assess the extent of kittiwakes nesting on the platform. The survey methodology however is applicable to all potential nesting seabirds offshore.

An awareness of the birds utilising the platform will allow the operator the opportunity to implement a deterrence strategy, and/or apply for a licence to disturb if operations will lead to disturbance of nests that cannot be mitigated against. The survey data can be used to inform the planning and scheduling of works in order to avoid the risk of an offence and/or to determine whether a disturbance licence needs to be sought from OPRED.

5.5.4 Description and quantification of impact

The SNS is an important foraging ground for a number of seabird species. Table 5.5.1 shows a list of more common species typically recorded in the SNS. Of these species only two have been recorded nesting on offshore platforms: kittiwake and herring gull.

Table 5.5.1: List of common seabird species recorded in the SNS [125]

Species common name	Scientific name
Arctic skua	*Stercorarius parasiticus*
Arctic tern	*Sterna paradisaea*
Atlantic puffin	*Fratercula arctica*
Black-headed gull	*Chroicocephalus ridibundus*
Black-legged kittiwake	*Rissa tridactyla*
Common guillemot	*Uria aalge*
Common gull	*Larus canus*
Common tern	*Sterna hirundo*
European herring gull	*Larus argentatus*
European storm petrel	*Hydobates pelagicus*
Great black-backed gull	*Laurus marinus*
Great cormorant	*Phalacrocorax carbo*
Great skua	*Stercorarius skua*
Lesser black-backed gull	*Larus fuscus*
Manx shearwater	*Puffinus puffinus*
Northern fulmar	*Fulmarus glacialis*
Northern gannet	*Morus bassanus*
Razorbill	*Alca torda*

5.5.4.1 Nesting Bird Surveys 2021

Ocean Science Consulting Ltd (OSC) was contracted by Chrysaor to perform nesting seabird surveys prior to the commencement of the CMS decommissioning. Work was undertaken on the Murdoch Hub and the nearby satellite installations Boulton BM, Munro MH, Kelvin TM and Katy KT. The survey work was conducted between 3-4th and 11-14th May 2021 [125].

Evidence of nesting and nest presence was observed on Boulton BM and Munro MH; there were four black-legged kittiwake nests on Boulton BM and a further 16 nests on Munro MH. Chicks were not evident on either of these two installations. There was no evidence of nests or nesting behaviour at the remaining installations (Murdoch Hub, Kelvin TM, Katy KT) [125]. Based on the presence of guano, there was evidence of roosting on all installations surveyed. At one nest on Boulton BM an adult black-legged kittiwake was observed sitting on the nest. All other next observations were either of traces of nests with adult(s) present, or of adult(s) standing in a well-built nest [125].

Figure 5.5.1 shows evidence of seabird presence on the Boulton BM installation and Figure 5.5.2 shows seabird presence on Munro MH.

Figure 5.5.1: Evidence of seabird presence on Boulton BM [125]

Figure 5.5.2: Evidence of seabird presence on Munro HM [125]

5.5.5 Mitigation measures

Chrysaor have implement an internal team to discuss all aspects of bird management applicable to decommissioning operations. The remit of this team's work is to:

- Plan and arrange seasonal surveys. Currently, the repeat 2022 nesting surveys are planned for the early breeding season (during Q2);
- Explore technological opportunities for evidence gathering; and
- Develop bird management plans.

Chrysaor will liaise with OPRED and JNCC to confirm expectations and licensing requirements based on the nest status and scheduling, as appropriate.

5.5.6 Cumulative impact

There are no clear cumulative impacts associated with the disturbance or abandonment of nests on platforms in the SNS.

5.5.7 Transboundary impact

There are no transboundary impacts associated with the disturbance or abandonment of nests on platforms in the SNS.

5.5.8 Residual impact

<table>
<tr><th>Receptor</th><th>Consequence</th><th>Likelihood</th></tr>
<tr><td>Seabirds nesting on CMS platforms</td><td>Negligible</td><td>Rare</td></tr>
<tr><th colspan="3">Rationale</th></tr>
<tr><td colspan="3">Decommissioning activities within the CMS will result in the disturbance/abandonment of nests if works or removal operations coincide with breeding periods of seabird species in UK waters. The main receptor for this disturbance will most likely be kittiwakes or herring gulls, although other species cannot be discounted. During all operations, disturbance or forced nest abandonment will be reduced to ALARP.

The risk of either loss of nesting habitat or abandonment of eggs / fledglings is sufficiently low and localised that the impact to the local population is considered temporary, highly localised and largely undetectable against natural variation. The consequence on seabird populations is ranked as negligible. However, the results of future nesting surveys undertaken during 2022 will also be taken into consideration.

Following considered remedial strategies and scheduling to avoid bird breeding periods where possible, the likelihood of occurrence is rare. This impact can only happen should any potential deterrence strategies fail.</td></tr>
</table>

Risk significance	Impact significance
Minor	Not significant

6 Conclusions

The Caister Murdoch System (CMS) is located in the SNS and consists of a number of fields and facilities. This EA addresses the environmental impacts associated with the decommissioning of the CMS infrastructure, which consists of the following eight platforms and associated seabed structures and pipelines: Murdoch MC, MD and MA; Boulton BM; Munro MH; Kelvin TM, and Katy KT. The Caister CM platform (also located within the CMS area) is part of a separate DP along with its own EA, therefore is not within the scope discussed here. The CMS is part of Chrysaor' wider SNS ten-year decommissioning project which also includes the Viking and LOGGS areas.

A CA was completed to determine the appropriate decommissioning methods for all items associated with the asset. The three DPs (CDP1b, CDP2 and CDP3), which cover the activities assessed within this EA, proposed full removal of all surface and subsea installations within the CMS. With regards to pipelines and umbilicals, the CA determined all pipelines be decommissioned *in situ*, with ends cut and remediated. Some pipelines qualified for partial removal.

Following detailed review of the proposed project activities, the environmental sensitivities characteristic of the project area, industry experience with decommissioning activities and of stakeholder concerns, it was determined that assessment of the following issues was required in order to properly define the potential impacts associated with the CMS decommissioning activities:

- Seabed disturbance (Section 5.1);
- Physical presence of subsea infrastructure decommissioned *in situ* (Section 5.3);
- Underwater noise (Section 5.4); and
- Disturbance to nesting seabirds (Section 5.5).

A review of each of these potentially significant environmental interactions has been completed and the results have been summarised below.

Disturbance to seabed was assessed due to the nature of the proposed activities and the location of the CMS within the Dogger Bank SAC. The proposed decommissioning activities may impact a temporary area of 0.0926 km^2 SNS seabed habitat, with an additional area of 0.0026 km^2 of permanent impact associated with rock remediation. Much of this activity is due to take place within the Dogger Bank SAC which is designated for the presence of Annex I 'Sandbanks which are slightly covered by sea water all the time'. While the activities may result in the mortality of some individuals, many of the taxa within the CMS area are relatively resilient; sandy communities are comparatively quick to recover from disturbance. Furthermore, *S. spinulosa*, a sensitive species of conservation interest is unlikely to be directly affected by the project activities within the CMS or associated with contingency activities along the PL929/PL930. With regards to the sediment and benthic features within the Dogger Bank SAC, the CMS activities are unlikely to affect the natural physical processes of the area. Furthermore, only an anticipated 0.0006% of the site may be affected. Pipelines being decommissioned *in situ* are also unlikely to have an impact on these processes and their gradual degradation over time will have a negligible impact on the surrounding sediments. Overall, due to the duration and highly localised spatial scale on which the impacts will be occurring in the context of the wider available sandy habitat, the impact is considered **not significant**.

The potential impacts identified to commercial fisheries were limited to the potential for legacy impacts such as the snagging of fishing gears due to the **physical presence of infrastructure decommissioned *in situ***, and any snagging risk due to existing seabed depressions. The majority of pipelines within the CMS are stably buried to a suitable depth. Most of the pipeline exposures are at the pipeline ends and will be addressed when ends are cut, removed and remediated. Two pipelines qualified for partial removal and these sections to be removed coincide with areas which have higher levels of exposure. The PL929/PL930 to shore have the highest level of exposure and the PL929 is the only pipeline along which reportable spans are located. Of the two reportable spans, one is within 100 m of the Murdoch Hub and neither are located near areas of high intensity trawling. Owing to the nature of the seabed and physical processes in the CMS, depressions are likely to become backfilled over time and the incidence of a snagging event is highly unlikely. Overall, due to the improbability of such a snagging event occurring, the impact is considered **not significant**.

Given the location of the project within the Southern North Sea SAC, the generation of **underwater noise** is also a concern, particularly with regards to Annex II harbour porpoise for which the site is designated. Noise emissions are expected to be sufficiently low that injury will not occur from any of the activities. With regards to disturbance, potential zones of avoidance around vessels or cutting activities are not predicted to extend beyond approximately 100 m. Furthermore, the levels of noise generated by project activities are unlikely to be detectable above background levels. Considering the transitory and highly localised noise levels anticipated, the impact on marine mammals within the SAC is considered **not significant**.

Decommissioning activities within the CMS may result in **disturbance to nesting seabirds** if works or removal operations coincide with breeding periods of seabird species in UK waters. However, following Chrysaor's bird management plan, disturbance or forced nest abandonment will be reduced to ALARP. The consequence on seabird populations will be highly localised and generate a low impact to the local population through the relatively low predicted loss of nesting habitat. Furthermore, impacts may only occur any potential deterrence strategies are unsuccessful. The overall impact of decommissioning activities on nesting seabirds is currently considered **not significant** and should this outcome change in the wake of future survey effort, this will be communicated to OPRED.

Finally, this environmental appraisal has considered the objectives and marine planning policies of the East Inshore and East Offshore Marine Plans across the range of policy topics including biodiversity, natural heritage, cumulative impacts and oil and gas. Chrysaor considers that the proposed decommissioning activities are in broad alignment with such objectives and policies.

In summary, the proposed operations have been rigorously assessed through the CA and EA, resulting in a set of selected decommissioning options which are thought to present the least risk of environmental impact whilst satisfying safety risk, technical feasibility, societal impacts and economic requirements. Based on the findings of this EA and the identification and subsequent application of the mitigation measures identified for each potentially significant environmental impact (which will be managed through Chrysaor' EMS), it is concluded that the proposed activities will result in no significant environmental impact.

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Appendix 1 EA Method

7.1 Impact identification

An EA in support of a Decommissioning Programme should be focused on the key issues related to the specific activities proposed; the impact assessment write-up should be proportionate to the scale of the project and to the environmental sensitivities of the project area. This does not mean, however, that the impact assessment process should be any less robust than for a statutory EIA or consider any fewer impact mechanisms. To this end, an environmental impact identification (ENVID) exercise (Appendix 5) was undertaken early in the EA process. This exercise identified the key environmental sensitivities, discussed the sources of potential impact and identified those aspects which required further assessment and those which could be scoped out. The decision on which issues required further assessment was based on:

- Specific proposed activities and sensitive environmental receptors;
- A review of industry experience of decommissioning impact assessment; and
- An assessment of wider stakeholder interest (informed in part by the stakeholder engagement described in Section 7.2).

7.1.1 Environmental significance

For the potential sources of impact that were assessed in this EA, it is important that a conclusion is reached regarding whether the impact is likely to result in a substantive change to environmental and societal conditions. During EA, there are many ways this can be done; a common approach is to define 'significance', and this approach is taken here. However, it is equally appropriate to employ some other method; the key is that the methods used for identifying and assessing significance are transparent and verifiable.

The first step is to assign a prediction of likelihood is assigned as per Table 7.1.1, this indicates the frequency of the impact mechanism occurring during the project activities (as opposed to the likelihood of a subsequent impact occurring). The next step is to assign a prediction of consequence of environmental and societal impact, based on the criteria presented in Table 7.1.2. These criteria recognise the likely effectiveness of planned mitigation measures to minimise or eliminate potential impact; as such, they represent an impact where mitigation has been taken into account. The consequence and likelihood criteria are then combined as per Table 7.1.3, to give an overall risk score. This risk score is compared against the criteria presented in Table 7.1.4 to give a conclusion regarding significance. In cases where the impact is considered significant, further measures to remove, reduce or manage the impact to a point where the resulting residual significance is at an acceptable level must be adopted and the steps above repeated.

7.1.2 Significance determination method

Table 7.1.1: Definition of likelihood

Category	One-word descriptor	Description	Quantitative range per year
5	Frequent	• - Likely to occur several times a year; • - Very high likelihood or level of uncertainty	$<10^{-1}$
4	Probable	• - Expected to occur at least once in 10 years; • - High likelihood or level of uncertainty	10^{-3} to 10^{-1}
3	Rare	• - Occurrence considered rare; • - Moderate likelihood or level of uncertainty.	10^{-4} to 10^{-3}
2	Remote	• - Not expected nor anticipated to occur; • - Low likelihood or level of uncertainty.	10^{-6} to 10^{-4}
1	Improbable	• - Virtually impossible and unrealistic; • - Very low likelihood or level of uncertainty	$<10^{-6}$

Table 7.1.2: Definition of consequence

Category	Socio-cultural economic impact	Biodiversity impact	Remediation cost	Negative public image exposure
5	- Permanent loss of access or use of area with permanent reduction in associated community; - Major economic impact to surrounding community; Irrevocable loss of culture resources; - Irrevocable loss of culture resources; - Scale typically widespread (national or greater level).	Very High: - Catastrophic loss of natural resources or biodiversity typically over a widespread area, with permanent or long-term consequences; and/or - Irrevocable loss of regionally unique habitat, legally designated conservation site or intact ecosystems; - No mitigation possible	<$10,000,000	International Coverage
4	- Permanent partial restriction on access or use, or total restriction >10 years in duration; - Temporary reduction in quality of life >10 years durations; -Harm to cultural resources requiring major mitigation; -Scale typically regional to national level.	High: - Persistent environmental degradation within and beyond the project area, typically with prospects of short-to-medium term recovery if the cause of the impact is removed or by natural abatement process and/or; - Serious loss (>50%) of unique habitat or legally designated conservation site or intact ecosystems within area of study; - Mitigation only possible through prolonged and resource intensive effort (>50 years).	$1,000,000 to $10,000,000	National Coverage
3	- Temporary restriction <10 years in duration with a moderate reduction in usage levels or quality of life; - Harm to cultural resources recoverable through moderate mitigation efforts; - Scale typically local to regional level.	Medium: - Persistent environmental degradation within and close to the project area, localised within defined areas, typically with prospects of rapid recovery if cause of the impact is removed or by natural abatement processes and/or; - Temporary, but reversible loss (>25% to 50%) of unique habitat or legally designated conservation site or intact ecosystems within area of study; - Moderate mitigation efforts required (>1 to 50 years).	$100,000 to $10,000,000	Regional Coverage
2	- Best restriction <5 years in duration with a minor reduction in usage levels or quality of life; - Minor harm to cultural resources that is recoverable through minor mitigation efforts; - Scale typically localised.	Low: - Temporary environmental degradation, typically within and close to project area, with good prospects of short-term recovery; and/or - Brief, but reversible loss (>10% to 25%) of unique habitat or legally designated conservation site or intact ecosystems within area of study; - Minor mitigation efforts required (<1 year).	$10,000 to $100,000	Local Coverage
1	- Restrictions on access without loss of resources; Temporary but fully reversible impacts on quality of life; - Minor impact on cultural resources; - Typically transient and highly localised.	Negligible: - Highly transitory or highly localised environmental degradation typically contained within the project area and noticeable/measurable against background only within or in very close proximity to the project area; and/or - Some minor loss (<10%) of unique habitat or legally designated conservation site or intact ecosystems within area of study; - Naturally and completely reversible.	$0 to $10,000	No Outside Coverage

Table 7.1.3: Risk matrix

Risk matrix						
Likelihood	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Consequence Category Note: Biodiversity and/or socioeconomic considerations take precedence: for all other factors, worst case score is assumed from severity descriptions				

Table 7.1.4: Definition of significance

Score	Risk category	Significance
IV: 17-25	High Risk. Manage risk utilising prevention and/or mitigation with highest priority. Promote issues to appropriate management level with commensurate risk assessment detail.	Significant
III: 12-16	Medium Risk. Manage risk utilising prevention and/or mitigation with priority. Promote issue to appropriate management level with commensurate risk assessment detail.	Significant
II: 5-10	Minor Risk with controls verified. No mitigation required where controls can be verified as functional.	Not significant
I: 1-4	Low Risk. No mitigation required.	Not significant

7.2 Stakeholder engagement contribution

Throughout the SNS decommissioning planning Chrysaor has continually engaged with a range of stakeholders; Chrysaor recognises the importance of active and appropriate engagement, to ensure that all concerns are addressed through the planning and execution stages of decommissioning. Specifically, Chrysaor has involved stakeholders, including the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), The National Federation of Fishermen's Organisations (NFFO), The Scottish Fishermen's Federation (SFF), The Northern Ireland Fish Producers Organisation (NIFPO), Global Marine Group (GMG), the Oil and Gas Authority (OGA) and the Joint Nature Conservation Committee (JNCC), within the Environmental Appraisal process. With respect to the Environmental Appraisal, key concerns raised included:

- Cumulative impact – considering Chrysaor's SNS decommissioning activities will extend over a ten-year period and result in some infrastructure decommissioned *in situ*, stakeholders expressed concern over the potential cumulative impact. In particular, potential impacts on the seabed were highlighted. Chrysaor has considered this within the EA, and the impact assessment presented in Section 5 includes consideration of cumulative impact; and
- Protected sites – the Chrysaor SNS decommissioning activities will take place within or close to a number of sites designated for protection of various environmental sensitivities. Considering the temporal scale and the nature of the proposed activities, along with the other potential activities occurring within the protected sites, stakeholders raised concern around the potential impact on the integrity of the protected sites. Consideration of these sites has been an integral part of the Environmental Appraisal process.

7.3 Impact identification outcome

Having used the method outlined throughout Section 7.1, each possible impact associated with the decommissioning is considered against the understanding of the environmental and societal baseline conditions for the area (Section 4). Each impact is scoped in or out of further assessment. A justification is provided for each impact scoped out.

Section 5 of this EA contains the Impact Assessment for the CMS decommissioning, with Section 5.1 providing a justification for aspects scoped out.

7.3.1 Cumulative impact assessment

Although the scope of this impact assessment is restricted to the decommissioning of the CMS infrastructure as outlined in Section 3, it is recognised that the decommissioning work-scope is one part of the Chrysaor's wider SNS Decommissioning Project and the possibility of cumulative impact with other elements of the project exists. The activities will also occur in the context of other oil and gas and non-oil and gas activities, with which there is the potential to interact. To this end, the impact assessments presented in the following sections specifically consider the potential for cumulative impact within the definition of significance.

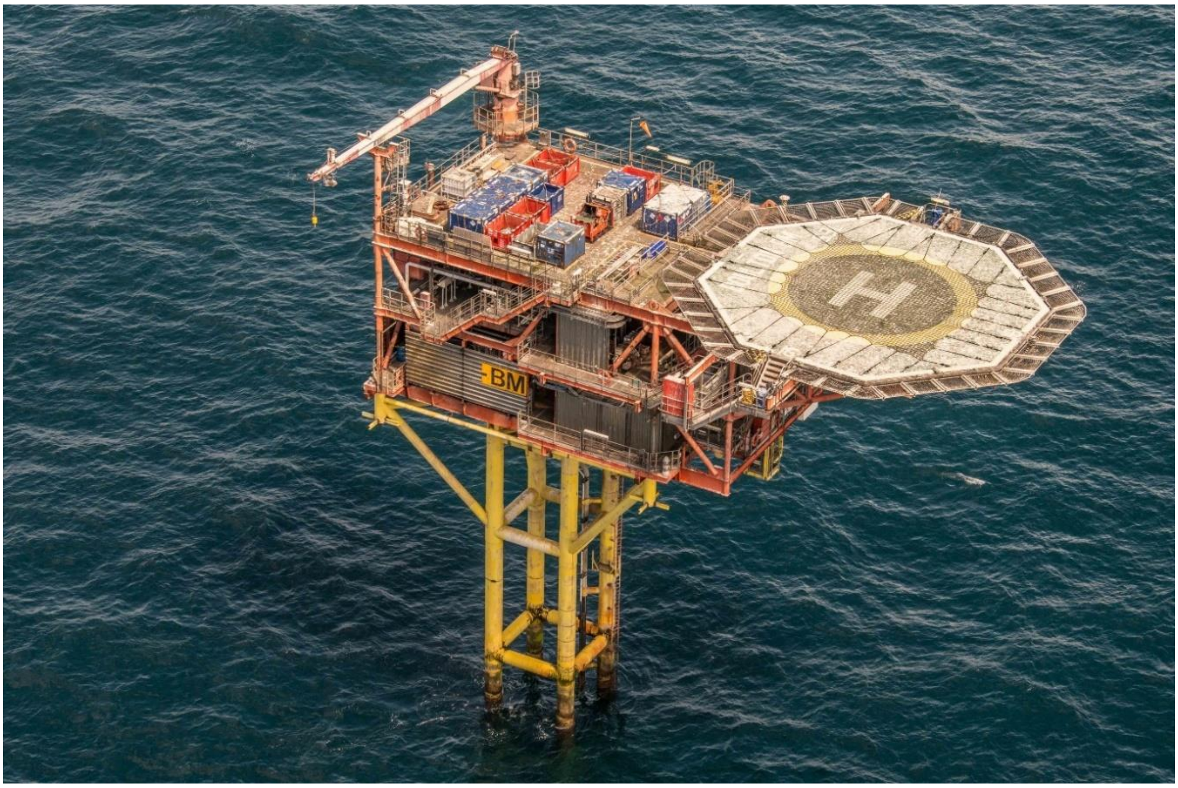
7.3.2 Transboundary impact assessment

For most potential impacts from decommissioning, the likelihood of transboundary impact is low. The impact assessments presented in Section 5 have assessed the potential for transboundary impacts as a result of the proposed activities, and the potential for transboundary impact is considered within the definition of significance.

Appendix 2 Surface Facility Installations (Topsides and Jackets)

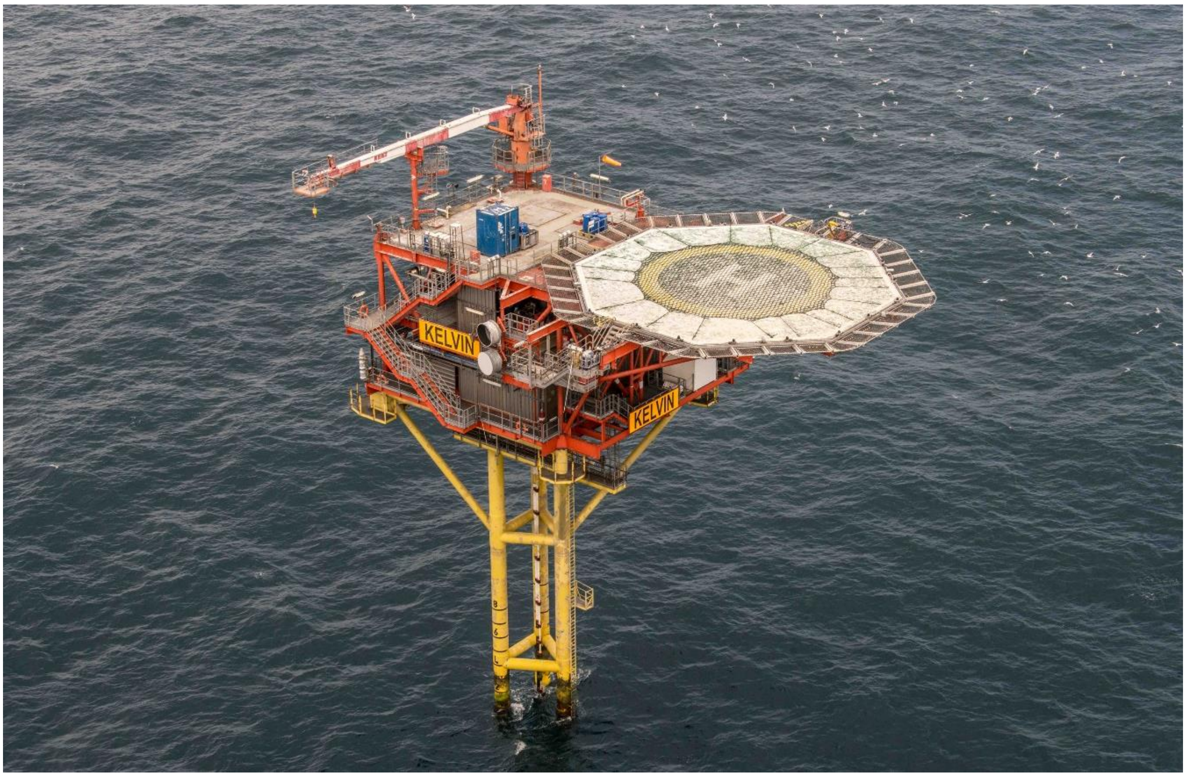
Appendix 2.1 Murdoch Hub (left to right: MA, MC & MD)

Appendix 2.2 Boulton BM

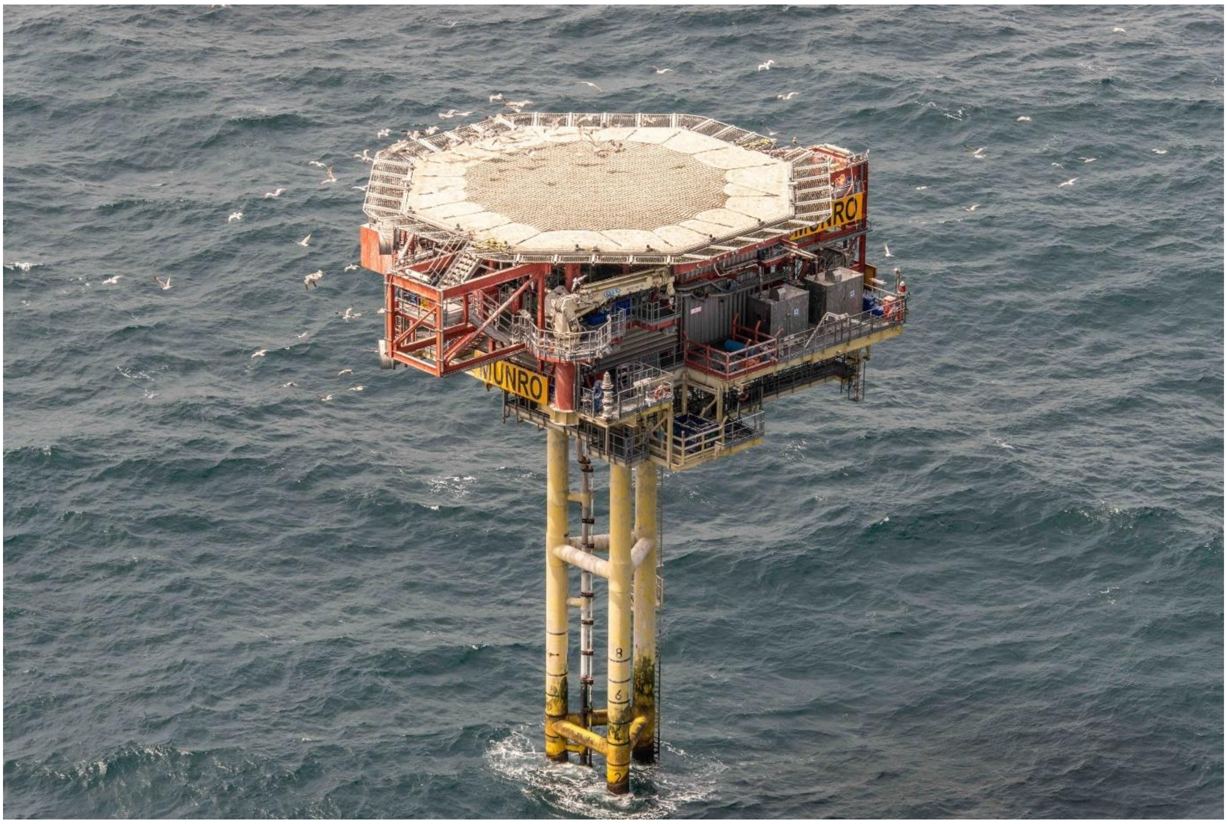


Appendix 2.3 Katy KT

Appendix 2.4 Kelvin TM



Appendix 2.5 Munro MH



Appendix 3 Item Inventory

Appendix 3.1 Surface installations

Name	DP	Facility Type	Location	Topsides/Facilities		Jacket		
			WGS84 Decimal WGS84 Decimal Minute	Mass (Te)	No of modules	Mass (Te)[33]	No of Legs, Piles	Mass of piles (Te)
Boulton BM	CDP2	Wellhead platform	54.243061° N 2.152678° E 54°14.5837' N 02°9.1607' E	351.0	1	605.1	4, 4	202.7
Katy KT	CDP2	Wellhead platform	54.403075° N 2.659367° E 54°24.1845' N 02°39.5620' E	353.5	1	580.6	3, 3	251.7
Kelvin TM	CDP2	Wellhead platform	54.332917° N 2.479342° E 54°19.9750' N 02°28.7605' E	288.6	1	483.6	3, 3	213.1
Munro MH	CDP2	Wellhead platform	54.433867° N 2.298772° E 54°26.0320' N 02°17.9263' E	210.9	1	384.9	3, 3	165.3
Murdoch MA	CDP3		54.269009° N 2.321724° E	835.3	1	672.9	4, 4	340.0

[33] Jacket weight excluding piles.

		Fixed Steel Jacket	54°16.1405' N 02°19.3034' E					
Murdoch MC	CDP3	Fixed Steel Jacket	54.269407° N 2.322904° N 54°16.1644' N 02°19.3742' E	4,393.3	1	1,217.6	4, 4	474.4
Murdoch MD	CDP3	Fixed Steel Jacket	54.269861° N 2.323702° N 54°16.1916' N 02°19.4221' E	2,256.5	1	2,089.6	4, 4	817.7

Appendix 3.2 Subsea installations

Subsea Installations Stabilisation Features	DP	Number	Size (m) Mass (Te)	Location WGS84 Decimal WGS84 Decimal Minute	Comments/Status
Boulton HM	CDP2	1	16.0 x 10.2 x 5.0 118.4Te	54.188556° N 2.209373° E 54°11.3134' N 02°12.5624' E	Piled, 4 x 762 mm diameter piles
Hawksley EM	CDP2	1	7.9 x 6.2 x 5.0 70.0Te	54.459081° N 2.362254° E 54°27.5449' N 02°21.7352' E	Not piled. Held in place by self-weight
McAdam MM	CDP2	1	16.0 x 10.2 x 5.0 118.4	54.344658° N 2.356208° E 54°20.6795' N 02°21.3725' E	Piled, 4 x 762 mm diameter piles
Murdoch K.KM	CDP2	1	10.2 x 10.2 x 5.0	54.237468° N	

				2.388368° E	Piled, 4 x 762 mm diameter piles
			93.4	54°14.2481' N 02°23.3021' E	
Watt QM	CDP2	1	10.2 x 10.2 x 5.0	54.194150° N 2.338275° E	Piled, 4 x 762 mm diameter piles
			93.4	54°11.6490' N 02°20.2965' E	

Appendix 3.3 Pipelines and umbilicals

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
Gas Export Pipeline	CDP1b	**PL935**	16	11.188	CTE coated steel pipeline coated with CWC for most of its length	Natural gas, condensate, water	Cut point B at Caister CM to ESDV at Murdoch MD topsides	Trenched and buried. As-built burial to >0.5 m to top of pipe. Depth of cover between 0.5 m and >1.0 m	Out of Use	Seawater
MeOH import pipeline	CDP1b	**PL936**	3	10.692	FBE resin coated steel pipeline with 4x polyethylene flexible tie-in spools	Methanol and corrosion inhibitor	ESDV at Murdoch MD topsides to Flexible Spool End Fitting at Caister	Trenched and buried. As-built burial depth min. 1.0 m to top of pipe.	Out of Use	Seawater
Gas pipeline	CDP2	**PL1436**	10	11.56	3LPP coated steel pipeline	Natural gas, condensate, water	ESD Valve (Boulton BM) to Riser Tie-in Flange (Murdoch MD Platform)	Trenched and buried, no exposures except for ends overlain with mattresses. PL1436 piggybacked by PL1437	Out of Use	Inhibited seawater

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
MeOH pipeline	CDP2	**PL1437**	3	11.56	3LPP coated steel pipeline	Methanol and corrosion inhibitor	Subsea Tie-in Flange (Murdoch MD Platform) to ESD Valve (Boulton BM)		Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL1922**	10/12	21.62	PP coated steel pipeline	Natural gas, condensate, water	Hawksley Subsea Well Head to ESDV Valve (Murdoch MD)	Trenched and buried, no exposures except for ends overlain with mattresses. Deposited rock used to mitigate upheaval buckling (UHB). PL1922 piggybacked by PL1925 between McAdam MM and Murdoch MD	Out of Use	Inhibited seawater
MeOH pipeline	CDP2	**PL1925**	3	21.53	PP coated steel pipeline	Methanol and corrosion inhibitor	ESDV Valve (Murdoch MD) to Hawksley Subsea Well Head		Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL1923**	10	5.25	PP coated steel pipeline	Natural gas, condensate, water	Murdoch K.KM Subsea Manifold to PSNL	Trenched and buried, no exposures except for ends overlain with mattresses. PL1923 piggybacked by	Out of Use	Inhibited seawater

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
								PL1926		
MeOH pipeline	CDP2	**PL1926**	3	5.25	PP coated steel pipeline	Methanol and corrosion inhibitor	PSNL to Murdoch K.KM Subsea Well Head		Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL1924**	10	16.76	PP coated steel pipeline	Natural gas, condensate, water	ESDV at Murdoch MD to Boulton Subsea Well Head	Trenched and buried, except for ends overlain with mattresses. Deposited rock used to mitigate UHB. possible exposure 133 m long	Out of Use	Inhibited seawater
MeOH pipeline	CDP2	**PL1927**	3	16.85	PP coated steel pipeline	Methanol and corrosion inhibitor	ESDV at Murdoch MD to Boulton HM Subsea Well Head		Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL2109**	10	5.08	FBE coated steel pipeline coated with CWC for most of its length	Natural gas, condensate, water	Cut Point A at Munro MH to Hawksley EM	Trenched and buried, except for ends overlain with mattresses. Multiple exposures for first 1.5 km of pipelines. PL2109 piggybacked by PL2110	Out of Use	Inhibited seawater

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
MeOH pipeline	CDP2	**PL2110**	3	5.08	3LPP coated steel pipeline	Methanol and corrosion inhibitor	Hawksley EM to Cut Point C, at Munro MH		Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL2430**	12	12.67	3LPP coated steel pipeline	Natural gas, condensate, water	ESDV at Kelvin TM to PSSL	Trenched and buried, no exposures except for ends overlain with mattresses	Out of Use	Inhibited seawater
MeOH pipeline	CDP2	**PLU2431**	3	12.67	3LPP coated steel pipeline	Methanol and corrosion inhibitor	PSSL to ESDV at Kelvin TM	As per PL2430, piggybacked	Out of Use	Inhibited seawater
Gas pipeline	CDP2	**PL2894**	10	14.19	3LPP coated steel pipeline	Natural gas, condensate, water	ESDV at Katy KT to Kelvin TM Subsea Tee	Trenched and buried, no exposures except for ends overlain with mattresses. PL2894 piggybacked by PL2895	Out of Use	Inhibited seawater
MeOH pipeline	CDP2	**PL2895**	2	14.19	3LPP coated steel pipeline	Methanol and corrosion inhibitor	Kelvin TM Subsea Tee to ESDV at Katy KT		Out of Use	Inhibited seawater
Umbilical	CDP2	**PLU4685**	4.2	13.00	Electrohydraulic umbilical	Chemicals, hydraulic oil	McAdam MM WHPS SUTU to Hawksley EM WHPS	Trenched and buried, no exposures except for ends overlain	Out of use	Seawater, hydraulic oil

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
							SUTU	with mattresses		
Umbilical	CDP2	**PLU4686**	4.2	9.20	Electrohydraulic umbilical	Chemicals, hydraulic oil	Murdoch MA TUTU to McAdam MM WHPS SUTU	Trenched and buried, no exposures except for ends overlain with mattresses	Out of use	Seawater, hydraulic oil
Umbilical	CDP2	**PLU4888**	3.2	8.60	Electrohydraulic umbilical	Hydraulic oil	Watt QM SUTU to Boulton HM SUTU		Out of use	Hydraulic oil
Umbilical	CDP2	**PLU4889**	3.8	8.71	Electrohydraulic umbilical	Hydraulic oil	Murdoch MA TUTU to Watt QM SUTU		Out of use	Hydraulic oil
Umbilical	CDP2	**PLU4890**	3.2	5.86	Electrohydraulic umbilical	Hydraulic oil	Murdoch MA TUTU Murdoch KM SUTU		Out of use	Hydraulic oil
26in Gas Export Pipeline	CDP3	**PL929**	26	179.64	FBE coated steel pipeline coated with CWC for most of its length	Natural gas, condensate, water	ESDV Murdoch MD to MLWM	Trenched and buried. Exhibits good burial depth but with exposures varying in length (total ~6.3 km). Historically one reportable span has been recorded at ~KP57, 59 m long.	Out of Use	Seawater

Description	DP	Pipeline ID	Diameter (inches)	Length (km)	Description of Component Parts	Product Conveyed	From – To End Points	Burial Status	Pipeline Status	Current Content
4in Methanol import pipeline	CDP3	**PL930**	4	179.58	FBE resin coated steel pipeline with 3x polyethylene flexible tie-in spools	Methanol and corrosion inhibitor	MLWM to ESDV at Murdoch MD	Trenched and buried. As-built burial depth min. 1.0 m to top of pipe.	Out of Use	Seawater

Appendix 3.4 Subsea structures

Subsea Installations	DP	Number	Size (m) / Mass (Te)	Location: WGS84 Decimal / WGS84 Decimal Minute	Comments/Status
Katy Tee Protection Structure	CDP2	1	8.4 x 4.5 x 3.4	54.402689° N 2.659325° E	Piled, 4 x 610 mm diameter piles.
			39.0	54°24.1613' N 02°39.5595' E	
Kelvin/Murdoch Subsea Pigging Skid	CDP2	1	10.5 x 5.1 x 4.0	54.270711° N 2.324925° E	Not piled. On approach to Murdoch.
			97.6	54°16.2427' N 02°19.4955' E	
Kelvin Pigging Manifold Assembly (PMA)	CDP2	1	9.5 x 6 x 3.4	54.332458° N 2.480250° E	Piled, 4 x 610 mm diameter piles.
			51.4	54°19.9475' N 02°28.8150' E	
Kelvin Subsea Tee Assembly (STA)	CDP2	1	10.5 x 4.8 x 2.7	54.332489° N 2.479664° E	Not piled. Ballast plates inside four corner legs.
			77.8	54°19.9493' N 02°28.7798' E	
McAdam Tee	CDP2	1	3.1 x 1.6 x 1.4	54.346389° N 2.358081° E	Clamped to PL1922.

			40.0	54°20.7833' N 02°21.4849' E	
Pigging Skid Northern Lobe (PSNL)	CDP2	1	5.5 x 5.5 x 3.5	54.270234° N 2.324635° E	Not piled. On approach to Murdoch.
			153.1	54°16.2140' N 02°19.4781' E	
Pigging Skid Southern Lobe (PSSL)	CDP2	1	6.3 x 4.3 x 1.8	54.270338° N 2.324458° E	Not piled. On approach to Murdoch.
			55.5	54°16.2203' N 02°19.4675' E	

Appendix 3.5 Stabilisation and protection features

Type[34]	Length (m)	Width (m)	Total number	Number to be removed	Additional contingency	Total number	Number to be removed	Total number	Number to be removed	Additional contingency	Overall mattress total	Overall number to be removed
			CDP1b			CDP2		CDP3				
Concrete 1	6.6	3				79	79				79	79
Concrete 2	6	3				181	117				181	117
Concrete 3	6	3				15	15				15	15
Frond 1	6.6	3				93	93				93	93
Frond 2	5	2.5				95	95				95	95
Frond 3	6	0.3				32	32				32	32
Frond 4	6	3.4				56	56				56	56
Frond 5	5	5				2	2				2	2
Frond 6	6	3				147	147				147	147
Frond 7	6	3.4				73	73				73	73
Linklok 1	6	4	28	2	13			62	2	54	90	4
Linklok 2	12	4	16	8				13	1	12	29	9
Linklok 3	6	2.4	13	11				12	6		25	17
Total			57	21	13	773	709	87	9	66	917	739

34 The type here refers to a categorisation of mattresses mainly attributed to the differing dimensions, a factor which is largely immaterial in the context of the EA. Frond mattresses are distinguished from other concrete mattresses through the presence of 'fronds' attached to the mattress which are intended to act like natural seaweed. Silt and sediment that is carried in the water column is trapped and builds up within the fronds resulting in eventual burial of the mattress. Linklok mattresses are made of concrete but with a differing structure to other concrete mattresses. All mattresses, regardless of type, provide the same function of protection and stabilisation.

Appendix 4 HSE Policy

Appendix 4.1 Harbour Energy HSE Policy

Harbour Energy

Health, Safety, Environment and Security

Policy

Harbour Energy is committed to operating responsibly and securely, never compromising our Health, Safety, Environmental or Security (HSES) standards. Harbour Energy will do all that is reasonably practicable to reduce HSES risks, ensure the safety and security of everyone affected by our operations, protect the environment by minimising our environmental impacts, and protect our assets and business data.

To achieve this Harbour Energy will:

- Provide strong, visible leadership and commitment at all levels of the business
- Effectively identify hazards, threats and vulnerabilities to assess and manage risks
- Meet or surpass our legal and other requirements (e.g., compliance obligations)
- Set objectives and targets to drive improvement
- Support and train our people and assure their competence
- Provide appropriate resources
- Encourage open and honest communication
- Effectively manage the HSES risks associated with contracted work
- Maintain safe, clean, healthy and secure workplaces to protect our people, environment, assets and data
- Maintain protected high quality documented systems and processes
- Plan and prepare for potential emergencies
- Report, investigate and learn from any incidents and near misses
- Routinely inspect the workplace and audit systems and processes
- Seek opportunities to continually improve our performance

It is the responsibility of everyone in Harbour Energy to conform to our Policies and Standards and to assist the business in their implementation.

Linda Z Cook
CEO Harbour Energy plc
01 April 2021

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Appendix 5 ENVID

Project Activity	Detailed Activity	Summary of Environmental Impact/ Location-Specific Sensitive Habitats and Species	Existing controls - Industry Standard, Legislative or Prescriptive	Initial Ranking taking into account existing controls and mitigation: Consequence	Initial Ranking: Likelihood	Initial Ranking: Initial Risk / Impact Ranking	Project Specific and Chrysaor Best Practice	Final Ranking taking into account project-specific controls and mitigation: Consequence	Final Ranking: Likelihood	Final Ranking: Final Risk / Impact Ranking	Actions: Comments	Actions: Taken Forward for Further Assessment?
Preparatory activities	Engineering down and cleaning	**Discharges to Sea** Flushing/ cleaning operations for topsides, installations and pipelines- discharge targeted 30ppm Liquid discharge to sea - Water quality in immediate vicinity of discharge will be reduced slightly, but effects are usually minimised by rapid dilution in massive receiving body of water; planktonic organisms most vulnerable receptor. Potential NORM impacts.	- Controls will be in place, as relevant, through the Offshore Chemical Regulations and the Oil Pollution Prevention and Control regulations. - Work will be undertaken within permit consent agreement limits. - Any chemical and solids would be collected, skipped and shipped to shore for treatment and disposal.	1	5	5	- Procedural cleaning and/or containment process. - Maintenance procedures. - Bulk handling procedures and personnel training. - Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution. - Preferred operational procedures to be in place onboard vessels including use of drip trays under valves, use of pumps to decant lubricating oils, use of lockable valves on storage tanks and drums. - Chemical storage areas contained to prevent accidental release of chemicals. - Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures - Arrangements in place to track spills. -Residuals at cut ends released into the marine environment (post-flushing - should be low). Flooding into the pipeline only up to a certain level (pressure dependent), so displacement is not complete pipeline.	1	4	4	-These are routine operations and will be conducted within the agreed permit conditions and using Chrysaor's procedural cleaning and containment processes. -Any residual remaining material will be in trace levels/volumes following the DFPV regime and will not pose any significant risk to water quality. -Well cleaning is outwith the scope of this EA and will be P&A, covered by their own permitting regime.	No
Power Generation	Project Emissions	**Gaseous emissions to atmosphere and energy use** Increased degradation of local/regional air quality (NOx and particulates). Transboundary air pollution. Contributing to global warming (CO2).	Emissions during decommissioning activities will occur in the context of the cessation of production. As such, almost all future emissions (from Project operations and vessels) will cease. - MARPOL compliance. - UKAPP compliance for vessels.	1	5	5	- Low sulphur diesel. '- Contractor selection - maintenance programmes and audits. '- Campaign, logistics, sharing vessels (across Chrysaor's Southern North Sea portfolio) optimising vessels to minimise use.	1	4	4	Emissions values will be included but will very likely represent a negligible proportion of all operational O&G UKCS emissions over the year.	No
	Project Energy Use	**Resource Use** Impact on climate change and reduction of resources of hydrocarbons. Some materials decommissioned in situ and some materials available for recycling.	-Energy use during decommissioning activities will occur in the context of the cessation of production. As such, almost all resource use (from Project operations, vessels and materials) will cease.	1	5	5	- Campaign, logistics, sharing vessels (across Chrysaor's Southern North Sea portfolio) optimising vessels to minimise use. -Observing the Waste Hierarchy	1	4	4	Energy value likely to be small. Replacement of materials decommissioned in situ is a theoretical value to replace the amount which would otherwise be recycled.	No
Vessel Use	Vessel Engine Noise	**Underwater Noise** Physiological harm, behavioural modifications to marine mammals, turtles and potentially fish. Population impacts due to cumulative impact or impacting a reproductively significant number of individuals or location. DP vessels may be used. Thruster noise when initially deploying anchors and if DP used.	-Comparable with operational background vessel noise.	3	5	15	- Campaign, logistics, sharing vessels (across Chrysaor's SNS decommissioning portfolio) optimising vessels to minimise use - Main potential impact likely to be from disturbance rather than injury - Contractor selection - Minimising the duration, disturbance and risk of requiring the activity to be repeated.	2	5	10	Not deemed to be significant in relation to current vessel activity already being moderate, activities are far from shore and not in the vicinity of key areas for receptors and that the planned activities will be short in duration. Deemed to be a minor risk and therefore insignificant. Potential Stakeholder concern due to proximity of Southern North Sea SAC which is designated for Harbour Porpoise therefore scoped in to further assessment.	Yes
	Vessel Discharges	**Discharges to Sea** (e.g. grey water, blackwater, ballast)	Routine discharges from vessels are typically well-controlled activities that are managed on an ongoing basis under MARPOL Annex IV.	1	5	5	'- Procedural cleaning and/or containment process. - Maintenance procedures - Bulk handling procedures and personnel training	1	4	4	These are routine operations and will be conducted within the agreed permit conditions and using the vessel procedural cleaning and containment processes.	No
	Vessel Physical Presence	**Other Users** e.g. Fisheries, Recreational users	- Limited duration. - Stakeholder engagement. - Existing controls through the Consent to Locate process. - UKHO standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings.	1	5	5	Campaign logistics and sharing vessels (across Chrysaor's SNS decommissioning portfolio) - Collision risk assessment. - Stakeholder consultation. - Logistics plan.	1	3	3	Not expected to be significant over normal vessel traffic and implementation of notifications etc.	No

Project Activity	Detailed Activity	Summary of Environmental Impact/ Location-Specific Sensitive Habitats and Species	Controls, Mitigations and Ranking								Actions	
			Existing controls - Industry Standard, Legislative or Prescriptive	Initial Ranking taking into account existing controls and mitigation			Project Specific and Chrysaor Best Practice	Final Ranking taking into account project-specific controls and mitigation			Comments	Taken Forward for Further Assessment?
				Consequence	Likelihood	Initial Risk / Impact Ranking		Consequence	Likelihood	Final Risk / Impact Ranking		
Topside, Jacket and Subsea Infrastructure Decommissioning	Cutting and Removal	**Underwater Noise** Physiological harm, behavioural modifications to marine mammals, turtles and potentially fish. Population impacts due to cumulative impact or impacting a reproductively significant number of individuals or location.	- Intermittent and single source noise that is limited in duration	3	5	15	- Main potential impact likely to be from disturbance rather than injury - Suitable technology for cutting will be selected to ensure the effectiveness of the cutting (likely to use diamond wire or similar mechanical form of cutting) - Minimising the duration, disturbance and risk of requiring the activity to be repeated. - Use of internal cutting where possible and external cutting methods as a contingency.	2	5	10	Planned activities will be short in duration and carried out in isolation. External cutting represents a worst-case scenario Deemed to be a minor risk and therefore insignificant. Potential Stakeholder concern due to proximity of Southern North Sea SAC which is designated for Harbour Porpoise therefore scoped in to further assessment.	Yes
		Seabed disturbance Disturbance to the seabed, including to features of conservation importance during removal Localised physical seabed disturbance resulting in community change. Recovery time and extent dependent on type of seabed and species present and location specific estimate within EA. Lethal/sub-lethal effects on benthic and epibenthic fauna from physical abrasion; Smothering of organisms following settlement of resuspended particles.	'- Pre-decommissioning seabed surveys '-Stakeholder consultation	2	5	10	'- Review of survey data for potential sensitive habitats of seabed. ' - Cutting and lifting operations controlled by ROV. ' - Internal cutting will be used preferentially where access is available. ' - Heavy lift vessels are likely to be equipped with dynamic positioning (DP) rather than relying on anchors to remain in position	2	3	6	No evidence of S. spinulosa or A. islandica aggregations within the CMS, nor confirmed widespread presence of 'seapens and burrowing megafauna communities' Deemed to be a minor risk and therefore insignificant. Potential stakeholder concern due to proximity to Dogger Bank SAC (protected for *'Sandbanks which are slightly covered by seawater all the time'*) and impact on features of conservation importance including sessile and mobile organisms, therefore scoped in to further assessment.	Yes
		Bird Disturbance All nesting birds and nesting activities are protected from damage by conservation legislation. Under the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2017 – (OMR 17), it is an offence to: 1. Take, damage or destroy the nest of any wild bird while that nest is in use or being built, or 2. Take or destroy an egg of any wild bird.	-Preferred approach is to avoid activity during breeding season which is not always practicable -Licensing requirements	3	2	6	-Chrysaor are committed to deterring birds from their installations out with the breeding season to mitigate against nesting birds on the platform. Chrysaor are in the process of surveying their installations to identify the presence of any wild birds and if discovered, may employ a range of non-invasive/ non-lethal deterrents to prevent birds nesting. These methods will continue throughout the duration of decommissioning. -Should these measures not prove successful, Chrysaor will engage with OPRED to agree any further licensing requirements, as appropriate.	2	2	4	Opportunistic species such as Kittiwake and Herring Gull are utilising artificial nest locations and successfully rearing chicks. In some instances, colonies of several hundred birds have established and return each year. Although for most offshore platforms, the number of breeding birds remains very low.	No
Pipeline Decommissioning	Cutting and lifting	**Underwater Noise** Physiological harm, behavioural modifications to marine mammals, turtles and potentially fish. Population impacts due to cumulative impact or impacting a reproductively significant number of individuals or location.	- Intermittent and single source noise that is limited in duration	3	5	15	- Main potential impact likely to be from disturbance rather than injury - Suitable technology for cutting will be selected to ensure the effectiveness of the cutting (likely to use diamond wire or similar mechanical form of cutting) - Minimising the duration, disturbance and risk of requiring the activity to be repeated. - Use of internal cutting where possible and external cutting methods as a contingency.	2	5	10	Planned activities will be short in duration and carried out in isolation. External cutting represents a worst-case scenario Deemed to be a minor risk and therefore insignificant. Potential Stakeholder concern due to proximity of Southern North Sea SAC which is designated for Harbour Porpoise therefore scoped in to further assessment.	Yes
		Seabed disturbance Disturbance to the seabed, including to features of conservation importance during removal	'- Pre-decommissioning seabed surveys '-Stakeholder consultation	3	5	15	'- Review of survey data for potential sensitive habitats of seabed. ' - Cutting and lifting operations controlled by ROV. ' - Internal cutting will be used preferentially where access is available. ' - Heavy lift vessels are likely to be equipped with dynamic positioning (DP) rather than relying on anchors to remain in position	2	5	10	No evidence of S. spinulosa or A. islandica aggregations within the CMS, nor confirmed widespread presence of 'seapens and burrowing megafauna communities' Deemed to be a minor isk and therefore insignificant. Potential stakeholder concern due to proximity to Dogger Bank SAC (protected for *'Sandbanks which are slightly covered by seawater all the time'*) and impact on features of conservation importance including sessile and mobile organisms, therefore scoped in to further assessment.	Yes
	Physical presence of free-spans/ exposures	**Other Users** Snagging risk to trawl and other demersal fisheries from pipelines and any sediment berms or depressions. Risk over time due to sediment movement and exposure.	- Seabed clearance certificate required before the 500 m safety zone is opened up for use. -Continued monitoring for an agreed period and remediation if required, accurate mapping of decommissioned in situ location and state -Following seabed clearance, the opening of the subsea 500m zones to other sea users will also have a positive impact.	5	2	10	'-Remediation on free spans and exposures -Remediation of berms or depressions if deemed appropriate. - The profile of the rock-placement allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear. '- Final visual and/ or overtrawl seabed survey will be undertaken of the 500 m safety zone to ensure that the seabed is cleared for use following decommissioning.	5	1	5	Deemed to be a minor risk and therefore insignificant. Potential Stakeholder concern due to demersal fishery snagging risk, therefore scoped in to further assessment.	Yes

Project Activity	Detailed Activity	Summary of Environmental Impact/ Location-Specific Sensitive Habitats and Species	Controls, Mitigations and Ranking								Actions	
			Existing controls - Industry Standard, Legislative or Prescriptive	Initial Ranking taking into account existing controls and mitigation			Project Specific and Chrysaor Best Practice	Final Ranking taking into account project-specific controls and mitigation			Comments	Taken Forward for Further Assessment?
				Consequence	Likelihood	Initial Risk / Impact Ranking		Consequence	Likelihood	Final Risk / Impact Ranking		
	Long term degradation of pipeline decommissioned *in-situ*	**Seabed disturbance** Gradual breakdown of pipeline and release of contaminants. Pollution of the marine ecosystem. Organic enrichment and chemical contaminant effects in water column and seabed sediments.	-Continued monitoring for an agreed period and remediation if required, accurate mapping of decommissioned in situ location and state	1	5	5	Same as existing controls	1	5	5	-Not an accute impact as breakdown of components will occur over decades, 100s of years '-Effects are usually minimised by rapid dilution in massive receiving body of water Deemed to be a minor risk and therefore insignificant. Potential stakeholder concern due to proximity to protected areas and impact on features of conservation importance including sessile and mobile organisms, therefore scoped in to further assessment.	Yes
Pipeline Remediation	**Remediation - Introduction of new substrate**	**Seabed Disturbance** -Introduction of new substrate which may alter habitat architecture, influencing water movement, sediment accumulation and light conditions. - Impact on Dogger Bank SAC	-Minimise introduction of material where possible	4	5	20	-A rock-placement vessel or ROV support vessel will be used. The rock mass will be carefully placed over the pipeline end by the use of an ROV-controlled fall pipe equipped with cameras, profilers, pipe tracker and other sensors as required. '-Implementation of Chrysaor's Environmental Management Strategy. '-Visual surveys of the seabed where possible to locate obstructions and to localise (and minimise) any post-decommissioning overtrawl surveys that may be required	3	5	15	No evidence of S. spinulosa or A. islandica aggregations within the CMS, nor confirmed widespread presence of 'seapens and burrowing megafauna communities' Deemed to be a medium risk and therefore potentially significant. Potential stakeholder concern due to proximity to Dogger Bank SAC (protected for '*Sandbanks which are slightly covered by seawater all the time*') and impact on features of conservation importance including sessile and mobile organisms, therefore scoped in to further assessment.	Yes
	Remediation - Reburial	**Seabed Disturbance** -Localised physical seabed disturbance resulting in community change. Recovery time and extent dependent on type of seabed and species present and location specific estimate within EA. Lethal/sub-lethal effects on benthic and epibenthic fauna from physical abrasion; Smothering of organisms following settlement of resuspended particles. -Impact on Dogger Bank SAC	-Minimise disturbancce to the seabed during decommissioning activities	3	5	15	-Volume of sediment mobilised proportional to area of sediment disturbed.	2	5	10	No evidence of S. spinulosa or A. islandica aggregations within the CMS, nor confirmed widespread presence of 'seapens and burrowing megafauna communities' Deemed to be a minor risk and therefore insignificant. Potential stakeholder concern due to proximity to Dogger Bank SAC (protected for '*Sandbanks which are slightly covered by seawater all the time*') and impact on features of conservation importance including sessile and mobile organisms, therefore scoped in to further assessment.	Yes
Drill Cuttings Decommissioning	**Drill cutting disturbance during cutting/ removal activities**	**Discharges to Sea** '-Planktonic organisms most vulnerable receptor.	-Minimise disturbancce to the seabed during decommissioning activities	2	4	8	Overall, environmental baseline surveys indicated that there was no evidence of drilling related hydrocarbon contamination within the CMS	1	4	4	-Effects are usually minimised by rapid dilution in massive receiving body of water No evidence of drilling related hydrocarbon contamination within the CMS due te dispersal over time in a highly dynamic seabed environment.	No
		Waste Resource use Energy consumption Use of landfill space	'-In accordance with the BEIS Guidance Notes under the Petroleum Act 1998, the disposal of such installations should be governed by the precautionary principle. '-Waste Heirarchy				-All waste will be handled and disposed of in line with the Chrysaor Waste Management Strategy as part of the project Active Waste Management Plan. '-Approximately 97% of material recovered will be recycled. A target of less than 3% to go to landfill. '-Potential positive impact from recycling of steel. '-Selected contractor will be assessed for competence.				Not scored as all will be managed through Chrysaor's waste management strategy and recorded through the project materials inventory. All waste will be managed in line with current legislation.	No
Waste Management		**Waste** Waste, including non-hazardous, hazardous, radioactive and marine growth.	'-In accordance with the BEIS Guidance Notes under the Petroleum Act 1998, the disposal of such installations should be governed by the precautionary principle. '-Waste Heirarchy '-As per the Landfill Directive, pre-treatment will be necessary for most hazardous wastes which are destined to be disposed of to landfill site.				'-All waste will be handled and disposed of in line with the Chrysaor Waste Management Strategy as part of the project Active Waste Management Plan. '-There will be an inventory of hazardous waste compiled (including asbestos) to aid the segregation and recycling of waste. '-NORM and any other hazardous waste will be dealt with by specialist contractors who will be selected for competence. Quantity of hazardous waste is not expected to be significant. '-Inventory of waste - tracking materials to final place					No

Project Activity	Detailed Activity	Summary of Environmental Impact/ Location-Specific Sensitive Habitats and Species	Controls, Mitigations and Ranking: Existing controls - Industry Standard, Legislative or Prescriptive	Initial Ranking taking into account existing controls and mitigation: Consequence	Initial Ranking: Likelihood	Initial Ranking: Initial Risk / Impact Ranking	Project Specific and Chrysaor Best Practice	Final Ranking taking into account project-specific controls and mitigation: Consequence	Final Ranking: Likelihood	Final Ranking: Final Risk / Impact Ranking	Actions: Comments	Actions: Taken Forward for Further Assessment?
		Waste Onshore dismantling yard activities including airborne noise, odour, light, dust and aesthetics	'-In accordance with the BEIS Guidance Notes under the Petroleum Act 1998, the disposal of such installations should be governed by the precautionary principle. '-Waste Heirarchy -Onshore yards already deal with potential environmental issues as part of their existing site management plans.				-Based on Chrysaor's contracting strategy, multiple disposal facilities are likely. Whilst the yards are yet to be selected, they will be in the UK or Europe. Chrysaor's procedures require suitably approved facilities, including site visits, review of permits and consideration of how new facility and construction and design has been developed to minimise impact.					No
Unplanned Events	Loss of containment	**Accidental Events** Pollution of the marine ecosystem with hydrocarbons Project will introduce new diesel inventory to the site with additional inherent spill / pollution risk e.g. from heavy lift vessel.	'- OPEP/SOPEP, including modelling and appropriate response planning - Collision risk assessment - Communication Interface Plan - Navaids used where appropriate	4	2	8	- Vessel diesel inventory expected to be within quantity modelled in OPEP - Maintenance procedures - Bulk handling procedures and personnel training - Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution - Maintenance procedures - Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures - Arrangements in place to track spills - Adverse weather working procedures - Use of existing 500 m safety exclusion zone at platforms during lifting operations. -Navigation aids, lighting in line with HSE and MCA requirements -500 m safety exclusion zone to remain in operation.	3	1	3	-Well P&A is outside of the scope of this specific impact assessment, since it not dependent on approval of the DP. The possibility of a well blowout therefore does not require consideration here. -Reduced to 'as low as reasonably practicable'	No
	Dropped objects	**Seabed Disturbance** Localised physical seabed disturbance resulting in community change. Recovery time and extent dependent on type of seabed and species present and location specific estimate within EA.	- Industry-standard procedures in place to make sure that the location of any lost material is recorded and that significant objects are recovered where practicable.	1	3	3	- Chrysaor's Environmental Management System. - Procedures will be in place to reduce the potential for dropped objects. - Training and awareness of contractors will be required. - Lift planning will be undertaken to manage risks during lifting activities, including the consideration of prevailing environmental conditions and the use of specialist equipment where appropriate. - All lifting equipment will be tested and certified. '- Dropped objects would be recovered where practicable.	1	3	3	Chrysaor procedures will reduce the potential for dropped objects.	No

Appendix 6 Energy and Emissions Summary

Appendix 6.1 Energy and emissions by project activity

Planned activity	Operations energy (GJ)	Operations CO_2 equivalent (Te)
Removal of surface installations	808,632.2	61,640.2
Removal of subsea infrastructure	141,986	10,823.2
Removal and remediation of pipeline sections/ends	285,669.4	21,775.9
Removal of stabilisation materials	34,174.3	2,605
Total	**1,270,461.9**	**96,844.3**

Appendix 6.2 Offshore transport energy and emissions

Vessel type	Total duration (days)	Operations energy (GJ)	Operational CO_2 equivalent (Te)
HLV	98	**1,270,461.9**	**96,844.3**
Tug	104		
Crew Transfer Vessel	26		
Supply Vessel	20		
Guard Vessel	44		
AHTSV	261		
DSV/CSV	238		
Survey Vessel	51		

Appendix 6.3 Material inventory emissions by DP

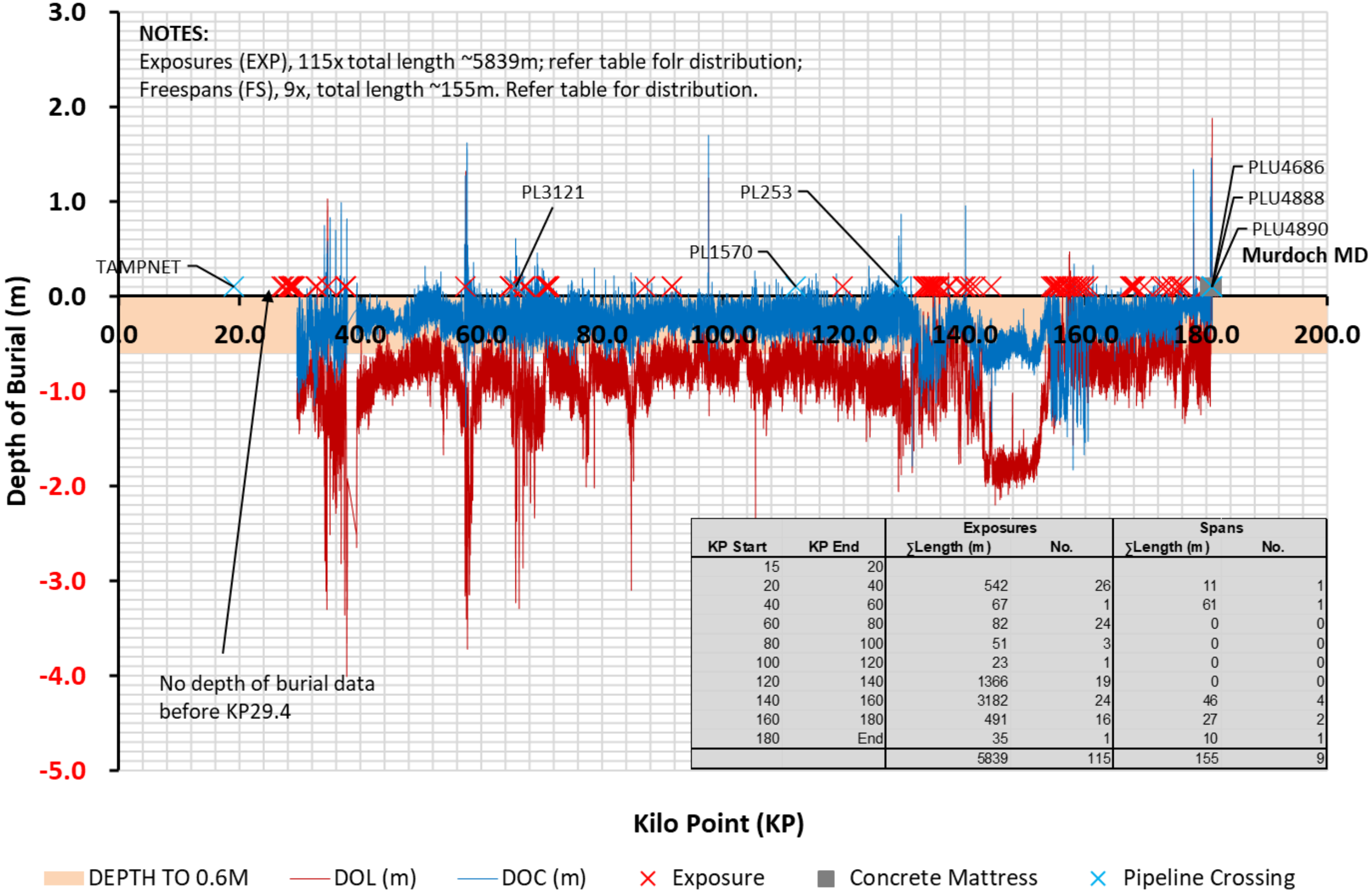
DP	Item	CO2 (Te)			Energy (GJ)		
		Recovered	Remaining	Total	Recovered	Remaining	Total
CDP1b	Pipelines	308.9	5,877.8	6,186.7	1,635	41,823.4	43,458.4
CDP2	Pipelines	293.2	7,458.2	7,751.4	2,452.1	83,819.1	86,271.2
	Structures	299.9	9,304.6	9,604.5	3,447.7	132,906.6	136,354.3

DP	Item	CO2 (Te)			Energy (GJ)		
		Recovered	Remaining	Total	Recovered	Remaining	Total
CDP3	Pipelines	308.3	6,442.2	6,750.5	1,877.7	5,5012.3	56,890
	Structures	298.1	9,296.4	9,594.5	3,441.3	137,035.8	140,477.1
Total		**1,508.4**	**38,379.2**	**39,887.6**	**12,853.8**	**450,597.2**	**463,451**

Appendix 7 Depth of Burial

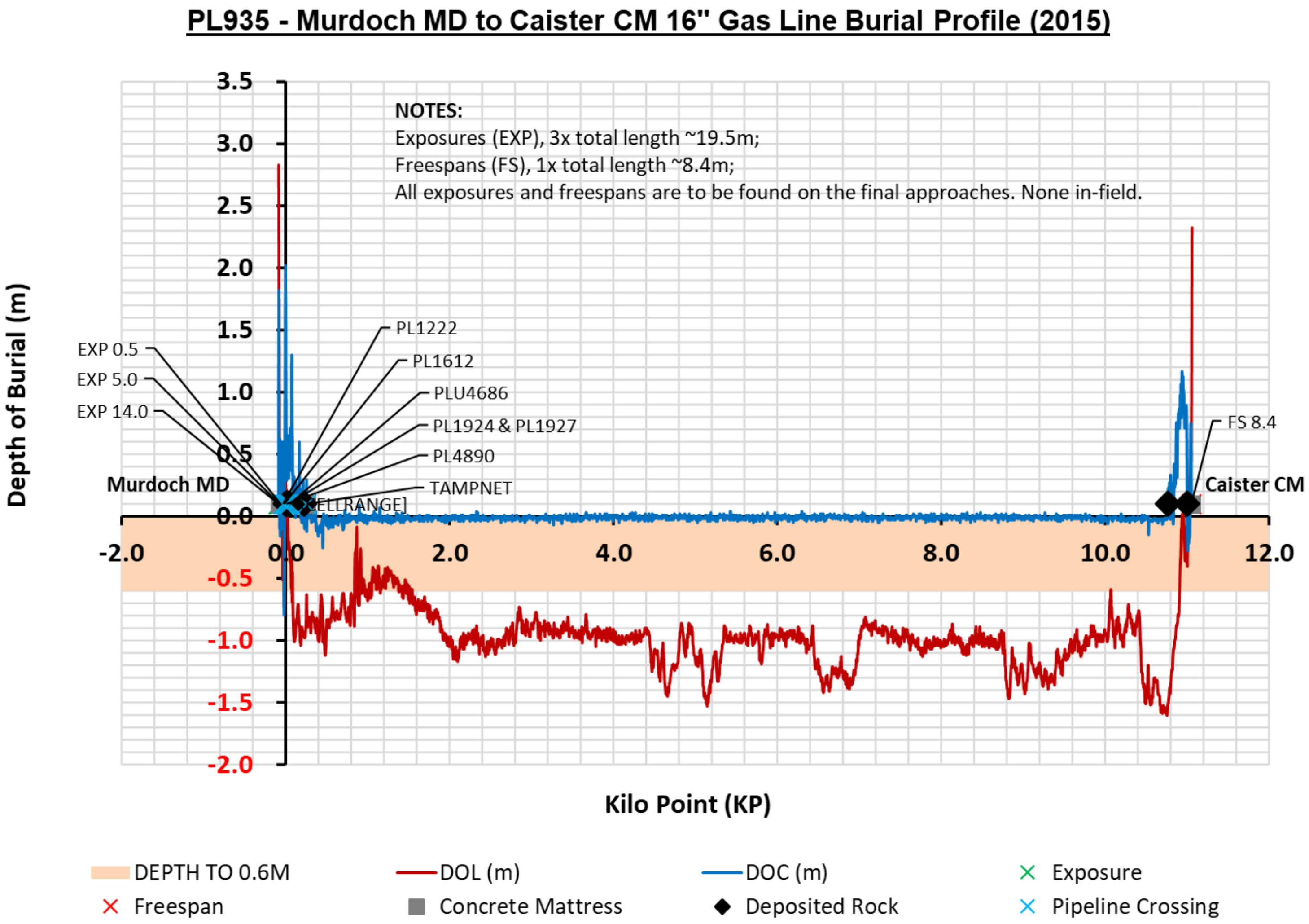
Appendix 7.1 PL929 DoB

PL929 - TGT to Murdoch MD 26" Gas Line Burial Profile (2006)

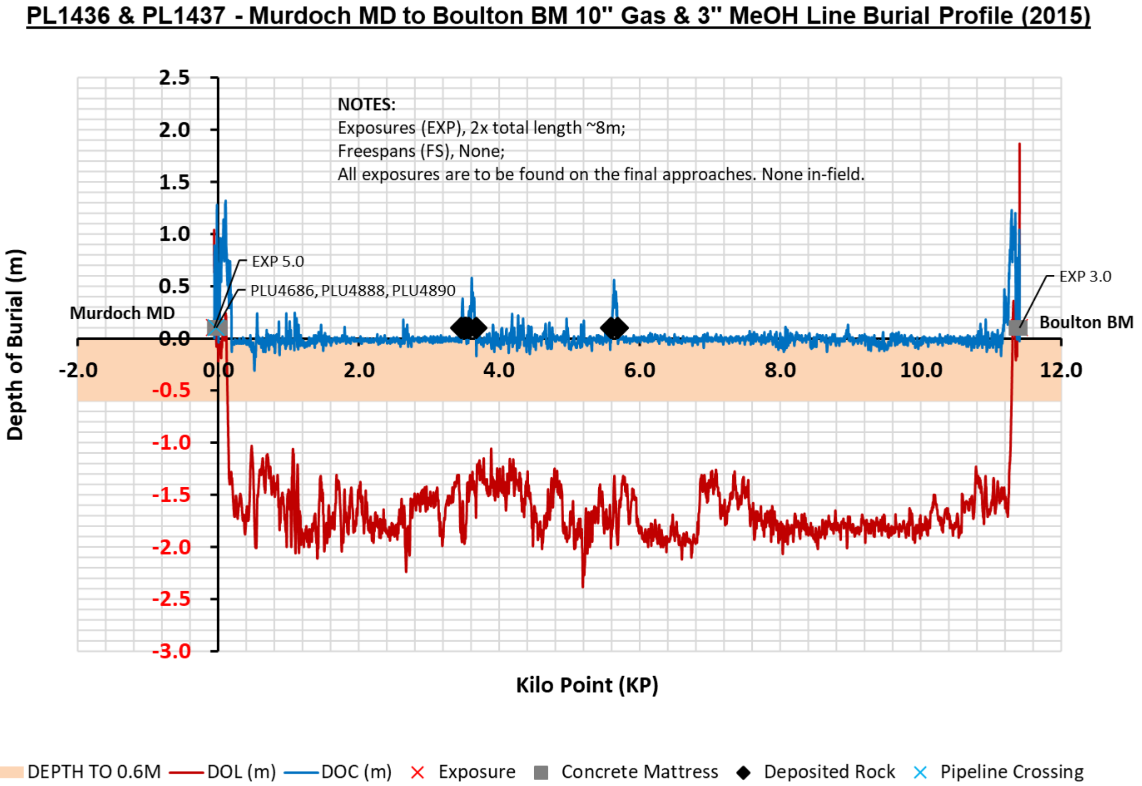


		Exposures		Spans	
KP Start	KP End	∑Length (m)	No.	∑Length (m)	No.
15	20				
20	40	542	26	11	1
40	60	67	1	61	1
60	80	82	24	0	0
80	100	51	3	0	0
100	120	23	1	0	0
120	140	1366	19	0	0
140	160	3182	24	46	4
160	180	491	16	27	2
180	End	35	1	10	1
		5839	115	155	9

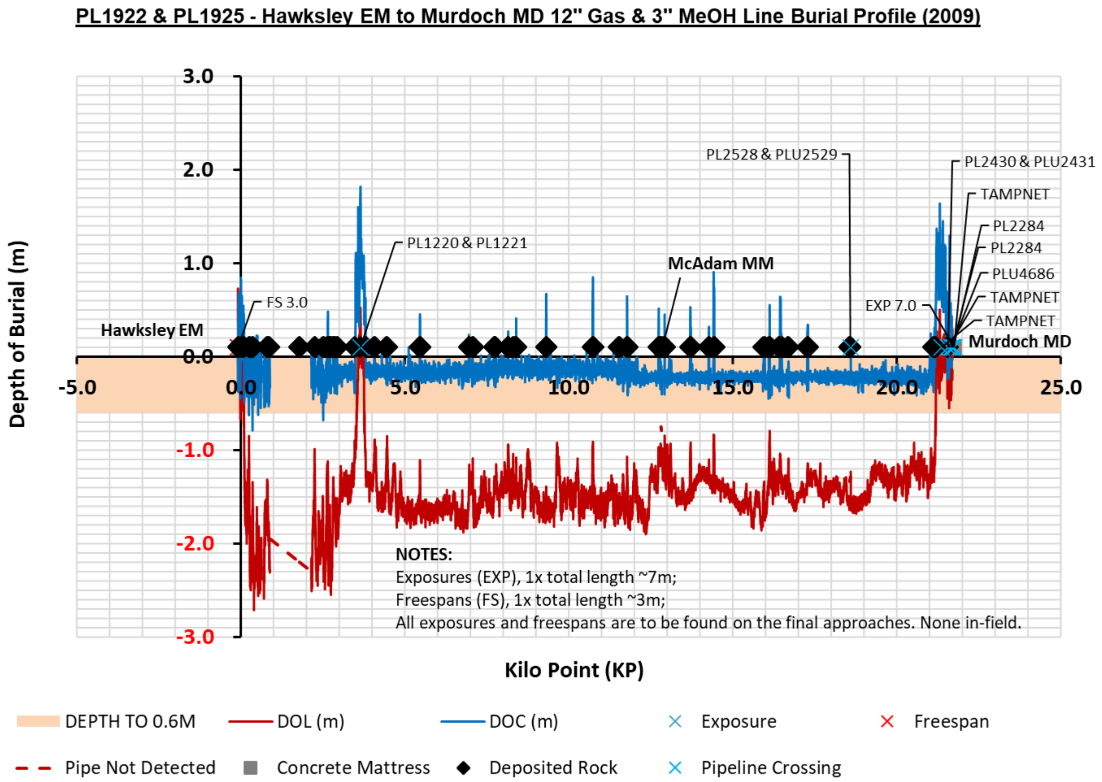
Appendix 7.2 PL935 DoB



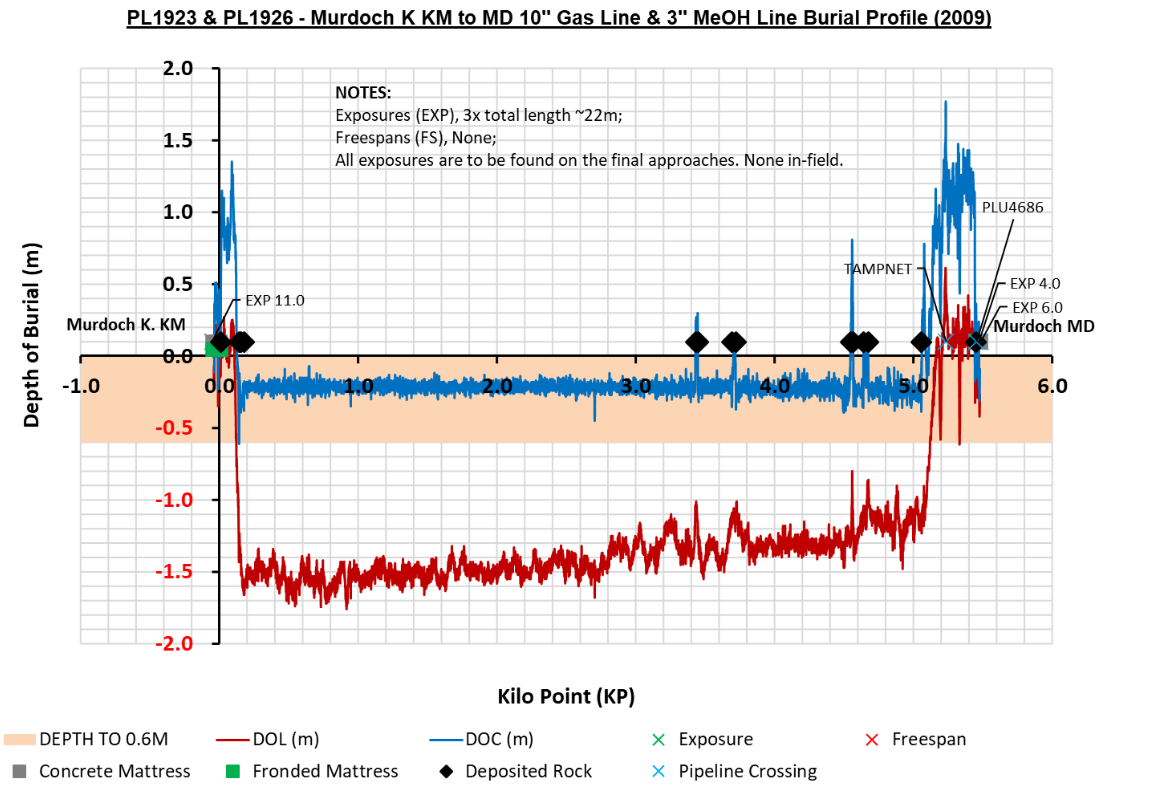
Appendix 7.3 PL1436 & PL1437 DoB



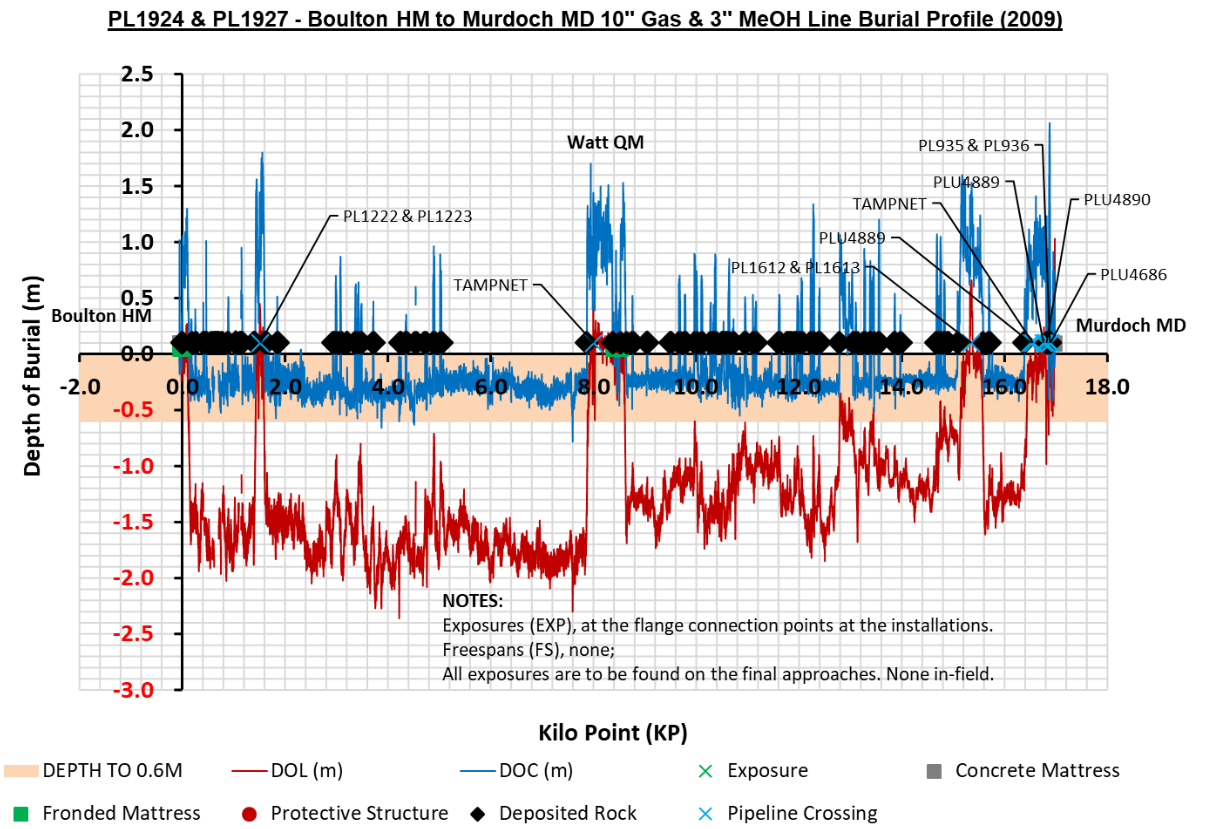
Appendix 7.4 PL1922 & PL1925 DoB



Appendix 7.5 PL1923 & PL1926 DoB

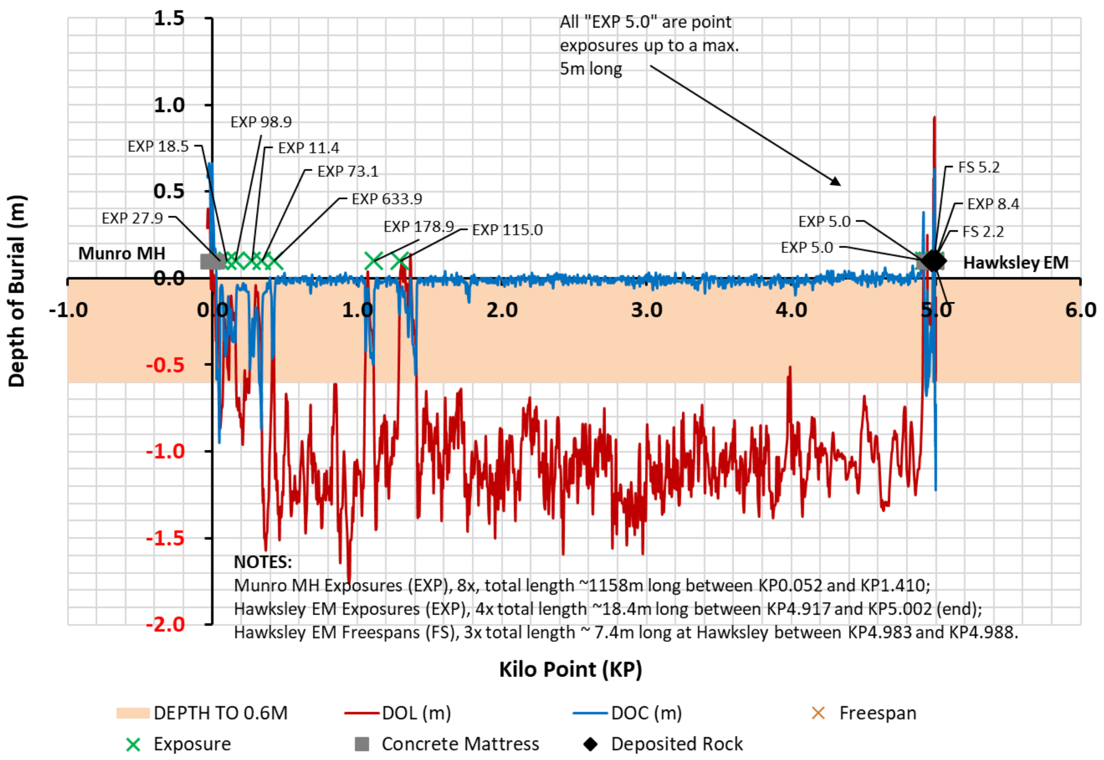


Appendix 7.6 PL1924 & PL1927 DoB



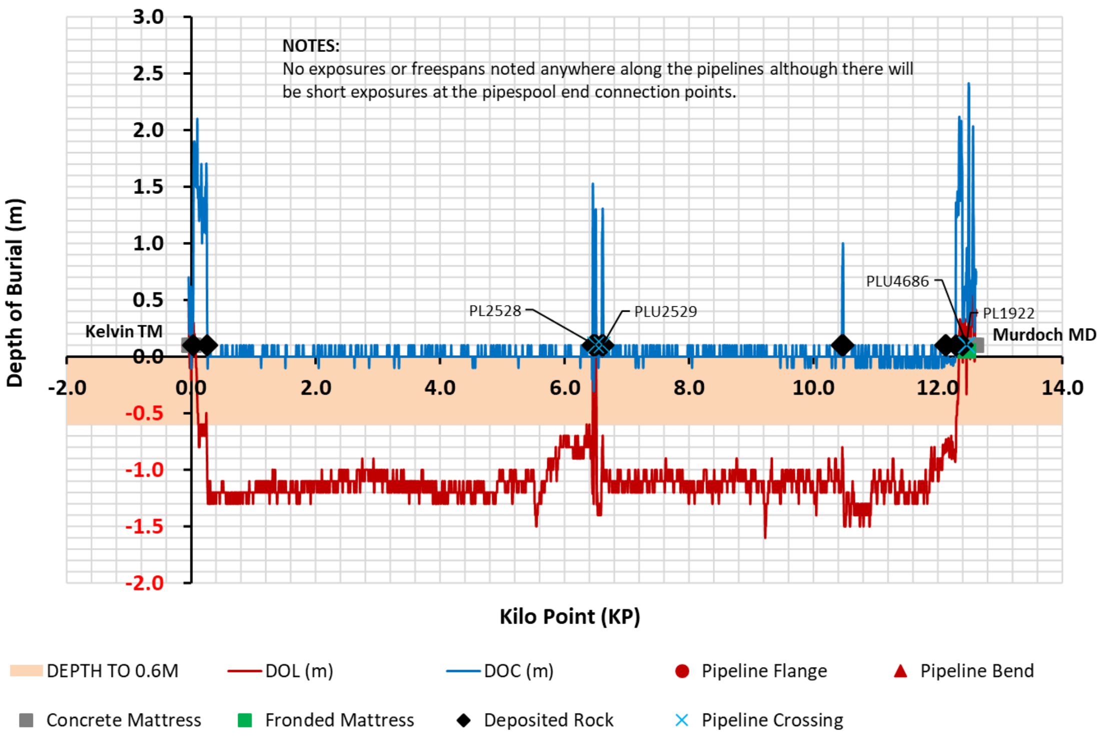
Appendix 7.7 PL2109 & PL2110 DoB

PL2109 & PL2110 - Munro MH to Hawksley EM 10" Gas & 3" MeOH Line Burial Profile

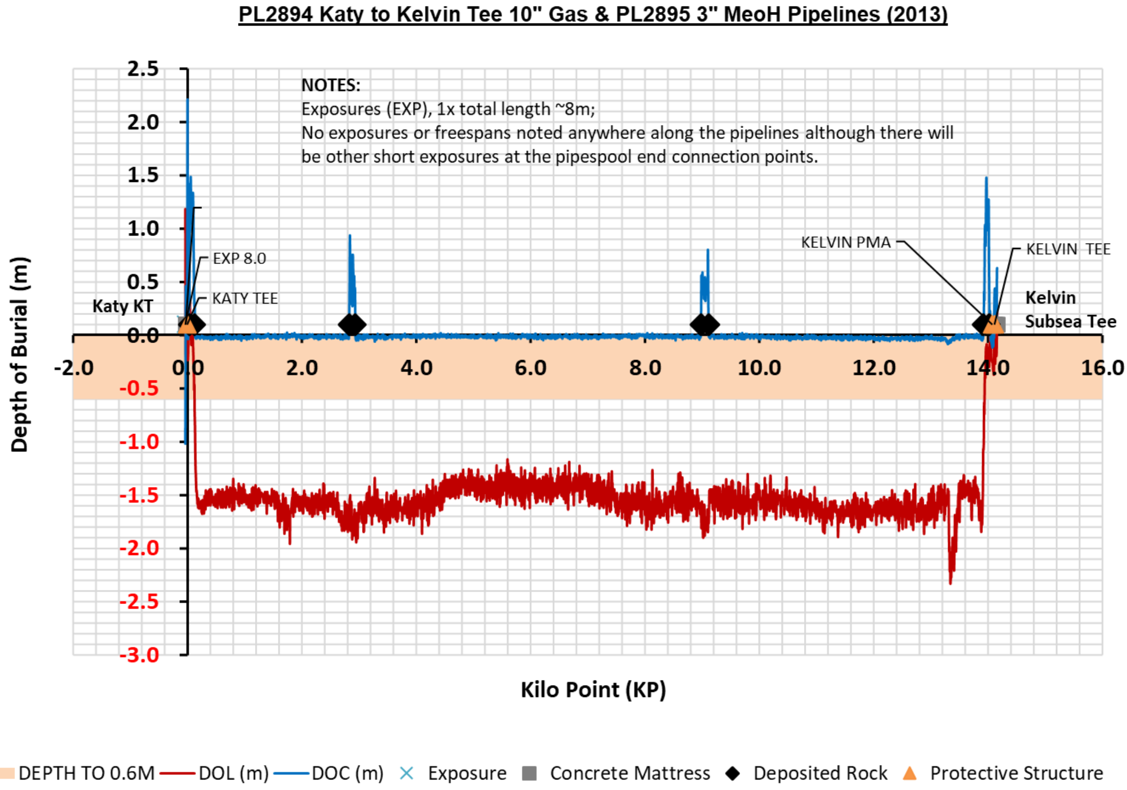


Appendix 7.8 PL2430 & PLU2431 DoB

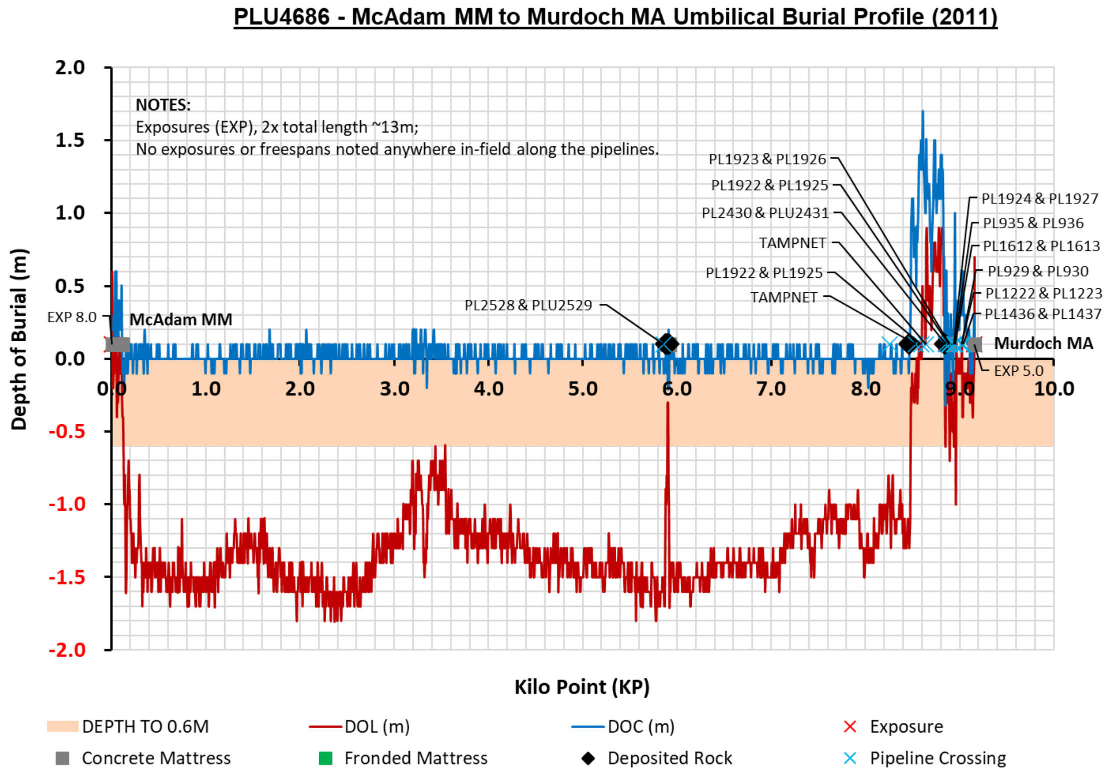
PL2430 & PL2431 - Kelvin TM to Murdoch MD 12" Gas & 3" MeOH Line (2011-12)



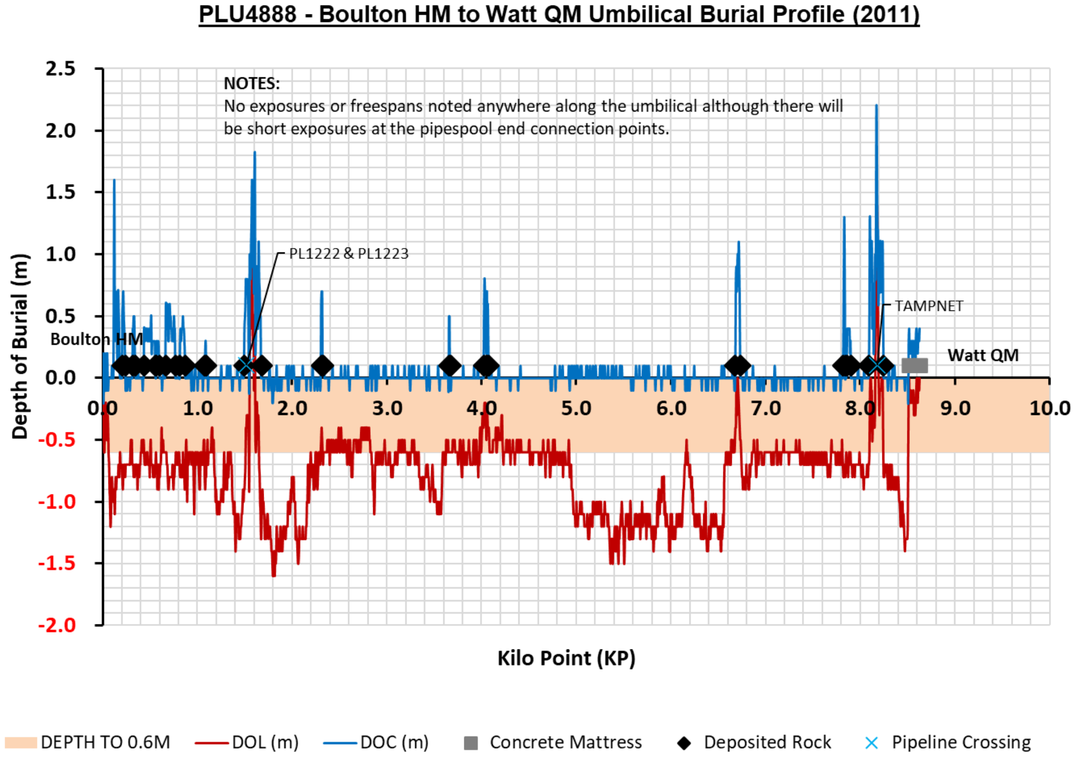
Appendix 7.9 PL2894 DoB



Appendix 7.10 PLU4686 DoB



Appendix 7.11 PLU4688 DoB



Appendix 7.12 PLU4890 DoB